An exploratory study of physical activity and lifestyle change associated with pregnancy and gestational diabetes mellitus and the implications for health promotion interventions

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An exploratory study of physical activity and lifestyle change associated with pregnancy and gestational diabetes mellitus and the implications for health promotion interventions

Frances Mary Doran


Thesis submitted to Southern Cross University in fulfillment of the requirements for the Degree of Doctor of Philosophy in Health and Human Sciences

May 2009
I certify that the work presented in this thesis is, to the best of my knowledge and belief, original, except as acknowledged in the text, and that the material has not been submitted, either in whole or in part, for a degree at this or any other university.

I acknowledge that I have read and understood the University’s rules, requirements, procedures and policy relating to my higher degree research award and to my thesis.

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Abstract

This research was an exploratory study of physical activity, pregnancy and Gestational Diabetes Mellitus (GDM) with implications for health promotion interventions. The study aimed to explore women’s physical activity levels before, during and after pregnancy including women who experienced GDM; factors that influenced levels of physical activity; women’s attitudes and information received in relation to physical activity; the influence of a diagnosis of GDM on a woman’s life; any subsequent lifestyle changes made to manage GDM during pregnancy and to prevent the progression to Type 2 diabetes postpartum. Interpretive constructivist gendered health promotion was the methodological framework of the research which utilised a mixed methods design.

The research was conducted in three main stages. Stage 1 was a qualitative exploration of physical activity in relation to pregnancy and GDM. Methods used were focus groups and individual interviews. Participants included Indigenous women, women from the Pacific Islands, women in Tonga who developed GDM, and health professionals in Tonga who worked in the GDM & diabetes area. Stage 2, the quantitative stage, included a survey on physical activity and pregnancy, a survey on GDM, and a seven-day physical activity diary. Stage 3 involved in-depth interviews with Australian women who developed GDM.

Results indicated that moderate-intensity physical activity was viewed as beneficial before, during and after pregnancy and for the management of GDM but, in general, women’s participation in moderate physical activity across all stages was low. Walking was the most common type of physical activity at all stages. Walking slowly was the only activity that increased during pregnancy compared to before pregnancy and this finding adds to the body of knowledge in this area. Factors that supported women to engage in physical activity during and after pregnancy related to perceived personal physical and psychological benefits and barriers were associated with external constraints such as lack of time and lack of childcare. In relation to GDM, lifestyle changes to diet and physical activity made during pregnancy as a result of a diagnosis of GDM were difficult to sustain after the baby was born, despite women’s awareness of their increased risk of developing future Type 2 diabetes.

Attention to physical activity as a component of antenatal care for women in this study was lacking. During pregnancy, minimal attention was given to physical activity by their health care providers, despite frequent interaction with the health care system. Few women reported being advised by their health providers to engage in regular or more physical activity during their antenatal visits. However, there was a significant statistical difference between women who developed GDM compared to those without GDM; the former were advised to engage in physical activity as part of the management of GDM. Postpartum follow-up screening was low. Postpartum screening and
ongoing lifestyle support in this group of women was virtually absent. Women who develop GDM are at a high risk of developing Type 2 diabetes and there is a gap in follow-up care and support for this group of women.

Women may be missing out on the benefits of physical activity during and after pregnancy, especially those women who develop GDM. There is an opportunity for health care providers to develop empowering partnerships with pregnant women and to develop strategies to enable women to participate in physical activity with a consideration of the factors that both support and hinder women’s participation in physical activity. Recommendations reflective of a gendered approach to health promotion which consider the social determinants of health are proposed.
List of publications


Dedication

To my Mum for having such faith in me.
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Abbreviations

GDM = Gestational Diabetes Mellitus
PA = Physical Activity
WHO = World Health Organization
BMI = Body Mass Index
T2D = Type 2 Diabetes
Chapter 1: Introduction
Introduction

This introductory chapter provides an outline of the study. The scope of the study is introduced and the researcher’s personal motivation for choosing the research topic is presented. The background, key issues and aims of the research are introduced followed by a brief overview of the chapters of this dissertation.

Scope of the study

This thesis explored physical activity, pregnancy and Gestational Diabetes Mellitus (GDM) from a health promotion perspective. A review of the literature revealed that minimal research focused on women’s experience of GDM and in what way a diagnosis of GDM leads to sustained lifestyle changes. In particular, reducing women’s increased risk of Type 2 diabetes has received little attention. Physical activity during pregnancy; attitudes towards, and levels of, physical activity; types of activity; changes in activity levels from pre-pregnancy to postpartum; and factors that influence women’s engagement in physical activity has also been explored. Some groups of women have a higher risk of developing GDM and an exploration of GDM from these high-risk groups was sought.

The researcher within the study – personal motivation for choosing this research topic

Guba and Lincoln (2005, p. 196) have suggested that authenticity is a feature of the “goodness … criteria” within an “interpretive framework” (p. 22) and that the researcher’s values and beliefs will influence the design and framing of the research. Therefore, in order to be consistent with this paradigmatic requirement, the following is offered as the personal motivations for this research project. On a personal level, I enjoy being physically active in a way that is integrated into my lifestyle. ‘Exercise’ has never been a chore and I enjoy being physically active for the benefits I gain both for my physical and emotional well-being. It helps me to maintain a healthy weight, lift my spirits and manage my stress. When my child was small, I cherished the times I could engage in physical activity but, as a new mother, it became more challenging to integrate physical activity into my lifestyle. Except for walking with my baby in the pram, I needed support to engage in all other activities. From my own experiences and those of friends and family, I am aware of how important this support is because it enables new mothers to engage in physical activity.

On a professional level, I have worked and studied in the area of women’s health and health promotion at community-based women’s health centres and within the University sector for over 20 years. I have lived and worked in the South Pacific and have seen first hand the devastating health effects of
diabetes, high levels of obesity and low levels of physical activity. Attention to lifestyle factors is crucial to curb the burden of illness associated with diabetes and other chronic illnesses and I believe that attention to the social determinants of health must underpin any health promotion activities. Lifestyle changes will only occur if people understand the benefits to be gained from making such changes and if the social and environmental conditions facilitate changes that can be integrated into their lifestyles in a positive way.

I have a commitment to the promotion of women’s health. I believe pregnancy is a very significant part of a woman’s life and a time when women may pay closer attention to their own health. After the baby is born, sometimes women’s own health priorities can be put on hold for a while. I am also aware that many factors influence health and lifestyle choices.

Health professionals are ideally placed to support women with their health, especially during pregnancy when women frequently access the health care system. I believe that, in general, pregnancy is best viewed not from an illness model of care, but from a focus on wellness and health promotion. A focus on physical activity as one aspect of lifestyle change has wide-ranging social, health, psychological, physical and economic benefits, especially for women who develop GDM and who therefore have an increased risk of developing Type 2 diabetes later in their lives. Pregnancy is a significant but small component of women’s lives. Health professionals have an opportunity to view pregnancy in the context of women’s overall lives and promote health within a primary health care (PHC) framework.

Key issues: Background to the study

The background and some of the key issues to this research are briefly introduced here. These are discussed in detail in the literature review in Chapter 2 but it is important to provide some context to the study. GDM is defined, the incidence described, and some of the problems associated with GDM, including women’s increased risk of developing Type 2 diabetes are introduced. Physical activity in relation to pregnancy generally, and specifically in relation to GDM management, prevention and as a modifiable risk factor for GDM and Type 2 diabetes is discussed. The global public health significance of GDM and Type 2 diabetes, especially in high-risk populations, is also established.

Incidence of GDM

GDM is the most common complication of pregnancy but the exact number of women who experience GDM is not known. Incidence varies between different populations and diagnosis depends on the criteria used (Hollander et al., 2007), age and ethnicity (Hoffman et al., 2003). GDM effects between 3-15% of pregnancies (Ben-Ziv & Hod, 2008) and up to 20% in high-risk groups such as women from the Pacific Islands (Australian Institute of Health and Welfare (AIHW), 2003; Yue et al., 1996). International figures estimate the
incidence of GDM to be between 4% (King, 1998) and 8% (AIHW, Templeton, & Pieris-Caldwell, 2008).

What is GDM?

GDM is a common but controversial disorder (Turok et al., 2003). It is defined as carbohydrate intolerance of variable severity (Colagiuri et al., 1998) or glucose intolerance that begins (Turok et al., 2003) or is first recognised during pregnancy (Kjos & Buchanan, 1999) and goes away after delivery.

The cause of GDM is not completely known. It is a form of hyperglycaemia (Buchanan & Xiang, 2005) which is characterised by insulin resistance and decreased insulin secretion. There is a similarity between the pathogenesis of Type 2 diabetes and GDM; Ben-Ziv & Hod (2008) suggest that they are probably the same disease but at different stages on the spectrum of glucose intolerance. As early as 1991, O’Sullivan noted that “GDM is in essence an early stage of NIDDM [now known as Type 2 diabetes] that would remain undetected had it not been for the ‘fortuitous’ event of pregnancy” (in Yue et al., 1996, p. 75).

GDM usually occurs midway through pregnancy (Scollan-Koliopoulos, Guadagno, & Walker, 2006), during the second trimester and usually goes away after pregnancy. Because of the effects of the pregnancy hormones, there is a decrease in the ability of cells to produce insulin; this is known as increased insulin resistance (AIHW et al., 2008). Women who have GDM are unable to produce extra insulin to overcome this resistance and, as a result, the level of glucose in the blood becomes higher than usual. These chronically high levels of blood glucose mean that women are unable to absorb the glucose into their cells and within a short time of eating are considered to be glucose intolerant (AIHW et al., 2008). It is a complex condition that spans a spectrum of glycaemia, pathophysiology and clinical effects and there is a wide diversity of opinion regarding detection and clinical management (Kjos & Buchanan, 1999, p. 1749). Whether insulin or only diet modification is used for treatment, the definition of any degree of glucose tolerance applies (Ben-Ziv & Hod, 2008).

Problems associated with GDM

A diagnosis of GDM heralds potential risks for the mother and the baby (Buchanan et al., 2007) and women who are diagnosed with GDM are at a high risk of developing GDM in subsequent pregnancies (Nohira et al., 2005; Saydah et al., 2005). Following a pregnancy complicated by GDM, women have a 30-70% higher risk for the development of subsequent Type 2 diabetes (Lauenborg et al., 2004). A diagnosis of GDM may be seen as a warning signal for the development of future Type 2 diabetes and is an “excellent marker” (McElduff, 2003, p. 3) for targeted preventive strategies, both during pregnancy and in the postpartum period.
GDM and Type 2 diabetes

GDM goes away after the baby is born but it may return in a subsequent pregnancy. It may take several weeks before the GDM goes away and women usually have a blood test one to two months after delivery to check that blood glucose levels have returned to normal (Hoffman et al., 2003). For most women with GDM, their blood glucose levels return to normal, but they are at an increased risk of Type 2 diabetes in the future (AIHW et al., 2008).

The fact that GDM disappears after pregnancy is important because previously undiagnosed diabetes mellitus Type 2 can be frequently mistaken for GDM. Type 2 diabetes does not disappear after pregnancy. GDM has been described by Buchanan et al. as a stage in the evolution of diabetes (Buchanan et al., 2007). Even though women who develop GDM are at an increased risk of developing Type 2 diabetes, there has been little research exploring the impact GDM has on a woman’s life, especially in relation to lifestyle changes to ameliorate her risk of future Type 2 diabetes. Furthermore, there are no formal follow-up programs for this high-risk group of women.

GDM is a non-modifiable risk factor for Type 2 diabetes. Modifiable risk factors for both GDM and Type 2 diabetes include lack of physical activity, obesity and poor diet. In both developed and developing countries, the global incidence of GDM, Type 2 diabetes and obesity in women is increasing (Catalano & Ehrenberg, 2006; World Health Organization (WHO), 2003; Zimmet et al., 1997). Diabetes, including GDM is a significant global public health issue in the Asia-Pacific region (Zimmet et al., 1997) which includes Australia and the Pacific Islands.

Lifestyle changes following a diagnosis of GDM

Often, intense antenatal education is given to women upon a diagnosis of GDM and throughout pregnancy (The Australasian Diabetes in Pregnancy Society (ADIPS), 2002). Attention to diet is the main therapeutic strategy for controlling blood glucose levels (ADIPS, 2002) and physical activity is encouraged if there are no underlying contra-indicated medical or obstetric conditions.

Following a diagnosis of GDM, women are advised to make lifestyle changes – mainly to diet. Changes to physical activity are also recommended but the ADIPS guidelines for GDM for physical activity are fairly general (Hoffman et al., 2003). Even though exercise has long been accepted as an adjunctive therapy in the management of diabetes in the non-pregnant population, exercise in the past has not been a serious part of the management of GDM (Dempsey et al., 2005) and arguably is not currently a serious component of general antenatal care for all women (Haertsch et al., 1999). One of the reasons for this is the dearth of research to clearly support recommendations for or against different types, duration and intensity of physical activity during pregnancy (Ceysons et al., 2006; Kramer & McDonald, 2006). However, in 2002, the American College of Obstetricians and Gynecologists (ACOG) published new guidelines and recommendations for physical activity during
pregnancy and the postpartum period (ACOG, 2001). Within these guidelines, pregnancy was recognised as a unique time for behaviour modification and no longer considered a condition for confinement. Habits adopted during pregnancy can affect a woman’s health for the rest of her life and, for the first time, the recommendations suggested a possible role for exercise in the management of gestational diabetes (cited in Artal et al., 2003).

Why a focus on physical activity?

Physical inactivity: Generally and during pregnancy

Physical inactivity is one of the modifiable risk factors for lowering the risk of GDM, and preventing the onset of diabetes in people at risk, yet less than half of all adult Australians are sufficiently active to a level that will produce a health benefit (Dunstan et al., 2003). Specific to pregnancy, the common pattern is that women do less exercise as their pregnancies progress (Bung et al., 1991; Clarke et al., 2004) and many women (irrespective of a diagnosis of GDM) stop exercising when they become pregnant (Clarke et al., 2004). Evidence is clear that the benefits of physical activity during pregnancy far outweigh the risks (Bauman, 2004; Brown, 2002; Dempsey et al., 2005; Oken et al., 2006). Consequently, women who do not engage in healthy levels of physical activity during pregnancy and postpartum may be missing out on the benefits conferred by moderate physical activity. As will be shown in the literature review, few studies have explored women’s views, beliefs and attitudes towards physical activity during pregnancy and the reasons for inactivity (Clarke et al., 2004; Symons Downs & Hausenblas, 2004; Thornton et al., 2006).

Physical activity and role in prevention and management of GDM

Evidence is emerging which suggests that physical activity both before (Zhang et al., 2006) and during pregnancy (Avery & Walker, 2001; Brankston et al., 2004; Clarke et al., 2004; Garcia-Patterson et al., 2001) has a positive effect on GDM. Some studies have reported that women who consistently engage in physical activity during pregnancy reduce their risk for GDM compared to inactive women (Dempsey et al., 2005). Obese and overweight women (Brankston et al., 2004; Dye et al., 1997) in particular experience benefit.

Postpartum attention to physical activity

In Australia, after a baby is born, there is no formal follow up of women who have had GDM (AIHW et al., 2008) although women are advised to have follow-up postpartum screening to check their diabetes status at six to eight weeks, and two to three years postpartum (Hoffman et al., 2003). Potentially, this follow-up screening could be an opportune time for health promotion and health education (to encourage physical activity) for women who have had GDM. Few studies have assessed changes women make postpartum GDM. One study found that even though women may have been worried about developing Type 2 diabetes, lifestyle changes were minimal, if made at
all (Stage et al., 2004). Serious attention to physical activity is a necessary preventative measure to stem the diabetes epidemic (Dutton et al., 2005; Evenson et al., 2009; Smith et al., 2005; Symons Downs & Ulbrecht, 2006).

**Factors that help and hinder women’s engagement in physical activity during pregnancy**

In order to encourage women to participate in physical activity both during pregnancy and during the postpartum period, especially those women who had GDM, it is necessary to identify and understand the factors that both hinder and support women to engage in physical activity, including the fear of developing diabetes. There has been little research undertaken into these areas. When the literature was initially reviewed in the beginning stages of this thesis, research into the factors that influence women’s participation in physical activity during pregnancy and in the postpartum period was noticeably absent. More recently, such research has emerged (Duncombe et al., 2007; Evenson et al., 2009; Koh et al., 2008; Smith et al., 2005). However, in relation to women who experience GDM and lifestyle changes made in the postpartum period as a result of concerns about developing Type 2 diabetes, only two related articles were identified in the literature review (Fehler et al., 2007; Stage et al., 2004).

**Gendered approach to health promotion**

This research is based on women’s health issues, pregnancy and gestational diabetes. It is informed by an understanding of the social determinants that influence these women’s health experiences. Gender is one factor that influences these experiences. Possible health promotion responses in relation to these issues are considered within a gendered approach to health promotion. There is scant attention to a gendered approach to health promotion in the broader literature. Only one article was found in the literature review that specifically discussed a gendered approach to health promotion (Keleher, 2004). Much more attention has been given to the social determinants that influence health (Baum, 2002a; Commonwealth Department of Community Services and Health, 1989; Doyal, 1995; Keleher, 2008; Keleher & MacDougall, 2009; McMurray, 2007; Talbot & Verrinder, 2005; WHO, 2008). The discussion of the results of this research considers gender as one health determinant and highlights the need to take a gendered approach to health promotion.

**This research**

Given a consideration of the above issues, which are discussed in detail in the next chapter, the literature review, this research sought to explore women’s experiences, views and behaviours in relation to physical activity, pregnancy and GDM.

Specifically the aims of the study were to:
1. Explore physical activity levels for pregnant women before, during and after pregnancy, especially for women at high risk of developing GDM;

2. Explore factors that influence levels of physical activity during pregnancy and postpartum; and

3. Explore the impact of GDM on a woman’s life in terms of lifestyle changes, especially physical activity during pregnancy, after a diagnosis of GDM, and postpartum.

**Outline of the thesis**

**Chapter 2: The literature Review**

As mentioned in the above introduction, key issues concerning pregnancy, physical activity and gestational diabetes are presented in the literature review. The literature review expands on issues already introduced and critically reviews the literature on GDM, pregnancy and physical activity.

**Chapter 3: The methodology**

The theoretical/conceptual perspective which formed the methodological framework of the study is presented in Chapter 3. The research was undertaken within a constructivist interpretive, methodological framework using a mixed methods approach. It was informed by a commitment to primary health care and health promotion and guided by feminist research principles. This chapter includes a discussion of the social determinants of health with a focus on gendered health promotion because these were key factors that influenced the theoretical framework of the research.

**Chapter 4: Research methods**

To meet the aims of the study and answer the research objectives, a mixture of quantitative and qualitative research methods were used. Qualitative methods enabled an exploration of some of these issues through focus groups and individual interviews. Quantitative data were collected though surveys and a physical activity diary and enabled the collection of objective data on attitudes towards physical activity and behavioural measures of physical activity before, during and after pregnancy. A description of the mixed methods approach used is presented in Chapter 4. Data collection, methods of qualitative and quantitative analyses, ethical considerations and methods to enhance the trustworthiness of the study are also described in this chapter.

There were three stages to the study, reflecting the different methods used. Stages 1 and 3 related to the qualitative research and Stage 2 related to the quantitative component of the research.

**Chapter 5: The qualitative research and brief overview of findings**

Chapter 5 outlines the qualitative phase of the research (stages 1 and 3). It was decided to discuss the qualitative stages of the research in one chapter in order to present the findings in a coherent manner.
In the beginning phase of the research, to explore the area of physical activity with all pregnant women as well as those who had a high risk of developing GDM, focus groups were conducted in Australia. From these focus groups, two women who were known to have GDM were referred to the researcher and were then individually interviewed. Data from the interviews and focus groups were used in the preliminary development of surveys on physical activity and GDM.

For a more in-depth exploration of GDM within high-risk groups of women, semi-structured individual interviews were conducted in the Pacific island of Tonga with women who had developed GDM. Health care providers were also interviewed to explore their views on risk factors, screening, management, follow up and lifestyle issues related to GDM.

In Stage 3 of the research, semi-structured, in-depth individual interviews were conducted with Australian women who had developed GDM to explore in more depth some of the results that emerged from the quantitative research and to further explore some of the factors associated with a diagnosis of GDM.

The results of the qualitative research are presented as themes. Similar themes emerged in all stages of the qualitative research. All women reported that, during pregnancy, minimal attention was given to physical activity by their health care providers, despite frequent interaction with the health care system. Women were aware of the benefits of physical activity but barriers to physical activity were reported. For pregnant women who experienced a diagnosis of GDM, the common theme reported for women interviewed in Tonga and Australia was that, even though they were advised to make lifestyle changes to manage GDM, most of the attention was directed towards dietary changes. Lifestyle changes were reported to be difficult both during pregnancy and in the postpartum period. Concerns with weight emerged as a common theme for women in all stages of the qualitative research. Obesity and lack of physical activity were issues highlighted in interviews with the Tongan health professionals. In Tonga, GDM was not seen to be a significant warning signal for the development of Type 2 diabetes. This was despite the high prevalence of diabetes in Tonga, which was considered to be the most significant health issue in Tonga as reported by the health professionals.

Chapter 6: Results of the quantitative research

Chapter 6 describes the results of the quantitative data collection methods used in the second stage of the research. The results of stage 1 of the qualitative research informed the development of the quantitative data collection methods: two surveys and a physical activity diary. One survey, the Pregnancy and Physical Activity Survey (PPAS) was completed by all women in the study. A survey specific to gestational diabetes, the GDM Survey, was also developed and was completed only by women who experienced GDM. The PPAS explored attitudes and behaviour related to physical activity undertaken by women before, during and after pregnancy with pregnant
women and women who had developed GDM. The GDM survey related to physical activity, lifestyle changes and factors that influenced whether behaviour altered or not following a diagnosis of GDM. The seven-day physical activity recall diary provided information on duration, type and intensity of physical activity during pregnancy. The diary was completed by some of the women; those with and without a diagnosis of GDM.

The survey data were analysed using the SPSS computer package. The quantitative data are presented as tables and figures.

Chapter 7: Discussion of the quantitative research and brief overview of findings

A discussion of the results of the quantitative research is presented in Chapter 7. The discussion is linked to themes in the broader literature and also to similar themes that emerged from analysis of the qualitative data.

The factors that supported women to engage in physical activity during and after pregnancy are discussed. As a result of factor analysis, ‘personal/family limitations’ and ‘physical limitations’ were categorised as the main barriers to physical activity; in the postpartum period, in addition to ‘personal/family limitations’, ‘personal/family responsibilities’ were identified. The factors that supported women’s participation in physical activity during and after pregnancy were similar and were categorised as ‘intrinsic factors’ which related to personal beliefs and ‘extrinsic factors’ which related to the social determinants of health. For women in the postpartum period who had experienced GDM, participation in physical activity was shown to be significantly associated with concerns about the fear of developing future Type 2 diabetes.

Generally, physical activity before and during pregnancy and in the postpartum period for all women in this study was low. A large proportion of women’s activity was taken up with child-caring and household responsibilities. Walking slowly was the only activity that increased during pregnancy compared to before pregnancy and this finding adds to the body of knowledge in this area. A search of the literature failed to identify any other study that reported walking slowly as an activity that increases across pregnancy. Attitudes towards moderate physical activity were generally positive but this was not reflected in reported levels of moderate physical activity undertaken by women in this study.

Few women reported being advised by their health providers to engage in regular or more physical activity during their antenatal visits. However, there was a significant statistical difference between women who developed GDM compared to those without GDM; the former were advised to engage in physical activity as part of the management of GDM. Postpartum follow-up screening was low.
Chapter 8: Conclusion, implications and recommendations

Chapter 8 ‘wraps up’ the key issues that were identified in the research. Implications for health promotion/health education interventions are discussed and recommendations are made.

In this study, the lack of attention given to physical activity by health professionals for pregnant women is apparent. Low levels of participation in physical activity during and after pregnancy were reported by women in this study. Factors that both helped and hindered women’s participation in physical activity both during and after pregnancy were identified and recommendations as to how an awareness of these key issues could inform health professionals practices are made.

Lifestyle changes were reported to be difficult to make although the diagnosis of GDM did have an impact on women’s lives in terms of their increased awareness of the need to engage in healthy levels of physical activity and the fear of developing Type 2 diabetes. Postpartum screening and ongoing lifestyle support in this group of women was virtually absent. Women who develop GDM are at a high risk of developing Type 2 diabetes and there is a gap in follow-up care and support for this group of women.

Pregnancy is a time when women may become more aware of their health and make positive lifestyle changes. During pregnancy, women frequently engage with the health care system, especially if they develop GDM. As such, pregnancy can be an excellent time for health promotion. Attention to physical activity during pregnancy needs to be a serious and routine component of antenatal care, especially for women who are diagnosed with GDM, for GDM management and Type 2 diabetes prevention. A diagnosis of GDM may serve as a warning signal to the woman and her health care providers that she is at risk of developing Type 2 diabetes. At present, there is a missed opportunity to direct resources and attention to this identified target group to develop, promote and support appropriate healthy lifestyle practices.

Empowerment and partnerships which enable women to develop personal skills to take greater control of their own health, a focus on wellness, and ‘education for health’ have been key issues within the PHC movement, with health promotion a key strategy. An understanding of the social determinants which influence health and lifestyle has underpinned the PHC and health promotion developments. This research has attempted to integrate these issues specifically in relation to pregnancy, GDM and levels of physical activity; the research is informed by an understanding of the factors which influence women’s participation in physical activity. Health professionals have a key role in this and recommendations are made for health promotion and health education interventions. Empowering partnerships between health professionals and women to develop strategies to support healthy levels of physical activity are suggested with a model of care proposed.
Having briefly overviewed the research project and the structure of the thesis in this first chapter, the following chapter critically reviews the literature on issues related to GDM, pregnancy and physical activity.
Chapter 2: Literature review
Introduction

This chapter reviews the literature on GDM (screening, associated problems, complications, incidence, and risk factors), pregnancy and physical activity. The rates of GDM are increasing and women who experience GDM have an increased risk of developing Type 2 diabetes. Literature on diabetes generally and GDM specifically is reviewed, with attention drawn to high-risk groups, particularly women from Pacific Island backgrounds. Physical activity is one of the modifiable risk factors for GDM and diabetes. It has a beneficial role in the prevention and management of GDM; lifestyle interventions have been shown to reduce the incidence of diabetes. There is clear evidence of the benefits of physical activity during pregnancy for women without a diagnosis of GDM, yet many women decrease their participation in physical activity during pregnancy. The prevalence of physical activity in the postpartum period is also low. These issues are synthesised and factors that both facilitate and hinder women’s participation in physical activity before, during and after pregnancy are reviewed. Key issues are highlighted which provide the foundation for the development of the subsequent research.

The literature was identified through database searches such as ProQuest 5000, CINAHL with full text, PubMed, Expanded Academic ASAP and Medline using key words such as pregnancy, physical activity, exercise, gestational diabetes, health promotion, women, diabetes and Type 2 diabetes. The review includes Australian and non-Australian research, policy documents, reports, guidelines and scholarship articles.

Estimates of GDM in Australia: GDM is increasing

ADIPS reports that GDM affects around 5% of pregnancies (Hoffman et al., 2003). In 2005-2006, Australian hospitalisation data showed that 4.6% of women giving birth in hospital were diagnosed with GDM (AIHW et al., 2008).

An earlier report of New South Wales (NSW) hospital birth data indicated that the rate of GDM had increased from 4.2% in 1998 to 5.1% in 2002 (Shand et al., 2008). Diabetes Australia estimates that the number of women who are diagnosed with GDM is expected to exceed 90,000 by 2012 if the increasing trend continues, which equates to a nine-fold expected increase in six years (Diabetes Australia New South Wales, 2007). National hospital data indicated that the age-standardised rate of GDM among women aged between 15 and 49 years increased by 22% over six years (from 2000-2006) (AIHW et al., 2008). Women from the Pacific Islands/Polynesian background and Indigenous Australians are high-risk groups for GDM, with reported incidence rates around 20% (AIHW et al., 2008; Hoffman et al., 1998; Simmons et al. on behalf of ADIPS, 2002; Yue et al., 1996).

GDM is increasing for all Australian women, but the trend is higher for Indigenous and Polynesian women (AIHW et al., 2008). Between 2000-2001
and 2005-2006, the rate of GDM for Polynesian women born overseas increased by 16% (AIHW et al., 2008). The age-standardised rate of GDM for Indigenous Australian women was 1.5 times higher than for non-Indigenous women (AIHW et al., 2008). Hollander et al. (2007) concluded from their literature review that, whilst percentages reported in the literature are variable, ethnic origin and age seem to be important factors.

**Global estimates of GDM: GDM is increasing**

Globally, GDM is also increasing. Beischer et al (1991) “have demonstrated over more than a quarter of a century of observation that the incidence of GDM has increased from around 1% to more than 8% globally” (in Colagiuri et al., 1998, p. 6). A review of the literature by Ferrara (2007) showed that the prevalence of GDM increased by approximately 16-127% in several race/ethnicity groups during the past 20 years. Differences in methodology and study (Ferrara, 2007), lower cut-off values for diagnostic screening tests (Saydah et al., 2005), the increase in screening (Hollander et al., 2007), increase in maternal age and in increase in the prevalence of overweight/obesity (Ferrara, 2007; Kim et al., 2002) may be contributing factors to the increased reported incidence of GDM.

Reports of incidence of GDM vary for different countries of birth (Beischer et al., 1991). The incidence rates of GDM range from 2-20%, depending on which population is studied. The incidence rates of GDM in the United States (US), United Kingdom (UK) and Australia are fairly comparable (2-9%) (Hoffman et al., 1998; Kim et al., 2007). In all countries, minority groups (mainly non-white women) experience higher rates of GDM (Dyck et al., 2002; Ferrara, 2007; Sermer, 2003; Solomon et al., 1997). In the US, Asians, Hispanics, African-American women and Native Americans are at higher risk of GDM than non-Hispanic white women (Ferrara, 2007).

**Problems associated with GDM**

As a result of glucose intolerance, GDM increases the risk of serious complications in both the mother and the child (AIHW et al., 2008). Although GDM is a temporary form of diabetes and usually disappears after the baby is born, it is a marker for a greater risk of developing Type 2 diabetes later in life (discussed in more detail further in this chapter).

**Risks for the baby**

For the foetus or neonate there is an increased risk of perinatal mortality (Shand et al., 2008) and morbidity (Watson et al., 2003), macrosomia (Kwik et al., 2007), and an increased likelihood of birth defects and congenital abnormalities, birth trauma, hyperbilirubinemia and neonatal hypoglycaemia (Turok et al., 2003). Offspring of mothers who had GDM are at increased risk of obesity, glucose intolerance and diabetes in late adolescence and adulthood (Australian Diabetes Society, 2003; Ben-Ziv & Hod, 2008).
Risks for the mother

For the mother, the risk of pre-eclampsia, caesarean delivery (Saydah et al., 2005) and future Type 2 diabetes increases with the onset of GDM (Feig et al., 2008). There is controversy related to the evidence for higher rates of caesarean delivery for women who experience GDM (Kjos et al., 1999; Hollander et al., 2007). Although caesarean delivery is more common in women who have GDM, it may be a result of macrosomia or alterations in GDM management because the woman has been diagnosed with GDM (Hoffman et al., 2003; Kjos & Buchanan, 1999; Theodoraki, 2008). Some researchers have suggested that there is a risk of “over-aggressive” management of GDM related to intense monitoring which may result in increased caesarean rates for women with GDM compared to women without GDM (Theodoraki, 2008). Nevertheless, there is a dilemma between failing to recognise and treat the condition as opposed to overly aggressive approaches to detection and treatment resulting in unnecessary interventions (Kjos & Buchanan, 1999). Treatment of GDM has been found to reduce negative pregnancy outcomes (Crowther et al., 2005).

Positive outcomes of treatment for GDM

In Australia a large randomised controlled trial was undertaken to investigate the management of GDM across 14 centres in Australia and four centres in the UK (Crowther et al., 2005). It was a milestone study which provided direction for the lowering of the diagnostic criteria for GDM. The study is known as the Australian Carbohydrate Intolerance in Pregnant Women Study (ACHOIS) and aimed to measure the effect of different treatments on prenatal outcomes. Women were randomly divided into two groups. One group (n=510) received routine antenatal care and the intervention group (n=490) received home glucose monitoring, review by a diabetes educator, dietician and physician and insulin therapy if glycaemic control was not achieved. Fewer babies were large for gestational age, there were less serious perinatal outcomes, and measures of maternal quality of life were better in the intervention group. Crowther et al. (2005) found that untreated glucose intolerance in pregnancy resulted in serious neonatal complications compared to women who were treated.

Similarly Kwik et al. (2007) compared pregnancy outcomes across three groups of women who had GDM and attended Royal North Shore Hospital, with the aim of establishing a threshold for diagnosis at the Royal North Shore hospital in Sydney, Australia. Women were divided into a treated group (n=275) if their oral glucose tolerance test (OGTT) met the American Diabetes Association (ADA) criteria for treatment. The treatment was diet modification and regular endocrinologist review. The untreated group (n=213) received standard antenatal care if the women did not fulfil the OGTT/ADA criteria. A comparison group (n=197) included women with normal OGTT who received the same intervention as the treated group. Women not treated for GDM had larger babies, more shoulder dystocia, more
pre-eclampsia and birth trauma (Kwik et al., 2007). Because untreated GDM was associated with larger babies and more birth trauma, the authors recommended that the current Australian diagnostic criteria for GDM be lowered in line with the American diagnostic criteria. As a result of the study, even though the threshold for diagnosis was lowered at the Royal North Shore hospital (Kwik et al., 2007), the ADIPS diagnostic guidelines were not changed as a result of these studies. Ross (2006) commented that the decision taken by ADIPS to adopt a more conservative approach to the diagnosis of GDM (and not to lower the diagnostic threshold) was made on the premise that interaction with the medical profession can have adverse affects. Once a disease in pregnancy is diagnosed, more intense monitoring and treatment can actually be harmful medically, socially and psychologically (Ross, 2006). (Issues surrounding screening and diagnosis for GDM are discussed in more detail further in the chapter.)

**Risk factors for GDM**

The degree of risk used to warrant screening and to determine a diagnosis of GDM varies. According to Dornhorst et al. (1998), the extent of this risk depends on the diagnostic criteria used to identify GDM and on maternal risk factors.

Risk factors for GDM include obesity, maternal age, ethnicity (especially Aboriginal or Torres Strait Islander (ATSI) or Pacific Islander background), a history of GDM in a previous pregnancy, poor pregnancy outcome in the past, glycosuria and a family history of diabetes (AIHW et al., 2008; Hoffman et al., 1998; Kim et al., 2007; Saydah et al., 2005; Solomon et al., 1997). Having previously had a large baby (>90th centile, >4000g at birth) (Ross, 2006) is also a risk factor, and lack of physical activity influences a woman’s risk of developing GDM (Dempsey et al., 2004; Zhang et al., 2006). (The role of physical activity in relation to reducing the risk of GDM, the management of GDM, and patterns of physical activity during pregnancy are discussed separately further in this chapter.)

**Age**

Age is a clear risk factor for the development of GDM (Saydah et al., 2005). The incidence rate of GDM varies according to age (Hollander et al., 2007) and between the ages of 25 and 45 years, the incidence increases 12-fold (Ross, 2006).

Most countries use ≥25 years as cut-off point for the risk threshold (Hollander et al., 2007) but the cut off point can be as high as >40 years of age (Ross, 2006). A cut-off point of ≥30 years in Australia is recognised as a risk factor for GDM (that would indicate the need for a screening test).

In Australia from 2000 to 2006, there was a 22% overall increase in GDM for women aged 15-29 years and the overall rate of GDM for all women increased by 30%. Women in Australia aged <25 years are not considered ‘at risk’(AIHW et al., 2008). Yet given the increase in GDM in this age group,
there may be implications in terms of possibly rethinking the age at which women are at risk of developing GDM.

Body Mass Index

Body Mass Index (BMI) is used as an indicator for the risk of developing GDM but the range to determine risk varies. Overweight/obesity in Australia is defined as BMI>25 kg/m$^2$ (Cameron et al., 2003). ‘Persistent obesity’ is also identified as a risk factor for GDM (Dornhorst & Rossi, 1998). Overweight is a concerning risk factor, given that the prevalence of obesity in Australia has almost doubled in the last 20 years (1980-2000) (Cameron et al., 2003). Results from the 1999–2000 Australian Diabetes, Obesity and Lifestyle Study revealed that over 60% of men and women in Australia were overweight. Obesity was strongly associated with lack of physical activity (Cameron et al., 2003).

Several researchers have suggested that obesity is the most significant modifiable risk factor for GDM (Hu et al., 2001; Yun et al., 2007) and is the most common risk factor for the development of GDM. Obesity parallels the epidemic of diabetes (Ferrara, 2007; Scollan-Koliopoulos et al., 2006) and in some cases, GDM may indicate undiagnosed Type 2 diabetes (Scollan-Koliopoulos et al., 2006).

A combination of risk factors increases the risk of GDM

The risk of GDM increases when risk factors such as overweight/obesity, poor diet and lack of exercise are combined (Dornhorst & Rossi, 1998; Hu et al., 2001; Yun et al., 2007; Zhang et al., 2006).

Solomon et al. (1997) reported on the findings of the Nurses Health Study 11, which involved 14,163 female nurses aged 22 to 42 years in America without previous GDM or other diabetes, who reported a singleton pregnancy between 1990 and 1994. The risk for GDM increased with advancing maternal age, a history of Type 2 diabetes in a first degree relative, non-white ethnicity, pre-gravid BMI, weight gain in early adulthood and pre-gravid cigarette smoking. Of this cohort, 722 (~5%) reported a new diagnosis of GDM. Slight associations between higher levels of pre-gravid physical activity and reduced risks for GDM were found among these women (Solomon et al., 1997). As noted by the authors, the self-report nature of this study may actually underestimate the incidence of risk factors.

The risk factors for GDM are similar to the risk factors for diabetes. Hu et al. (2001) found a combination of risk factors such as lack of exercise, a poor diet and current smoking even after the adjustment to BMI increased the risk of diabetes. However, the single most important predictor of diabetes was overweight or obesity. The relative risk for women with a BMI of ≥35 kg/m$^2$ was 38.8, compared to 20.1 for women with a BMI of 30-34.9 kg/m$^2$. These results were from a Nurses’ longitudinal study whereby 84,941 female nurses were followed from 1989-1996 and 3,300 new cases of diabetes were documented during the 16 years of follow up. (See Table 2.1)
The combined modifiable risk factors, that is being overweight and low physical inactivity, for developing diabetes among women with previous GDM were similarly reported by Yun et al. (2007). Using the data from the 2003 Behavioural Risk Factor Surveillance System, cross-sectional data for non-pregnant women were used to estimate and compare the prevalence of modifiable risk factors across three groups. These groups were women with previous GDM, women with current diabetes, and women without current diabetes. Compared to women without diabetes, women with previous GDM were more likely to be overweight (62% vs. 49%) or obese (29.4% vs. 20%) and to have a higher prevalence of no leisure time activity (32% vs 25.7%) (Yun et al., 2007).

Risk of developing GDM in subsequent pregnancies

A previous pregnancy with GDM is a risk factor for future GDM (Ferrara, 2007; Nohira et al., 2005; Yogev & Langer, 2004). Yogev and Langer (2004) conducted a retrospective longitudinal study with 389 women who developed GDM in 2 consecutive pregnancies. The goal was to evaluate pregnancy outcome and birth weight diversity in these women. Their goal was not to report on women’s risk of developing GDM but determine the risk to the baby in terms of birth weight. Comparable pregnancy outcome was found between the two groups. The authors did not state how many were in the study population; only that 389 women met their inclusion criteria. The risk of developing GDM in this population was not reported. (Yogev & Langer, 2004) (See Table 2.1)

A review of research by Kim et al. (2007) to determine the recurrence of GDM found that the rates varied from 30-84%. Lower rates were found in non-Hispanic, white women (30-37%) whereas higher rates were found in minority populations (52-69%). No other risk factors (such as maternal age, parity, BMI, OGTT levels or insulin use) were associated with recurrence of GDM across the studies reviewed.

The rate of recurrence of GDM in subsequent pregnancies among women who had already had a pregnancy complicated by GDM was similarly explored by MacNeill et al. (2001). A retrospective longitudinal study was undertaken in Nova Scotia, Canada with 651 women diagnosed with GDM between 1980 and 1996. (MacNeill et al., 2001). (See Table 2.1) A 35.6% recurrence rate of GDM in the subsequent pregnancy was reported. Infant birth weight in the index pregnancy and maternal pre-pregnancy weight before the subsequent pregnancy were the main predictors of recurring GDM. The study did not examine lifestyle factors such as physical activity. Weight gain, loss, and change were the main factors explored. The authors suggested that strategies to reduce maternal pre-pregnancy obesity and neonatal macrosomia may help lower the recurrence rate (which was just over one-third in this largely white population) of GDM (MacNeill et al., 2001). Longitudinal studies related to GDM and diabetes are outlined in Table 2.1.
The Australian Longitudinal Study on Women’s Health (ALSWH) is a population-based study and involves three large, nationally representative, cohorts of Australian women representing three generations (Australian Government Department of Health and Ageing, 2006). It began in 1996 and is funded by the Australian Government Department of Health and Ageing. Younger women, were aged 18 to 23 years when recruited in 1996 (n=14247). Mid-aged women, were aged 45 to 50 years in 1996 (n=13716) and older women, were aged 70 to 75 years in 1996 (n=12432) (Lee et al. 2005 in Australian Government Department of Health and Ageing, 2006). The women have been surveyed about the prevalence of diabetes three times from 1996 to 2004. The data on GDM is not clear yet as GDM was excluded from the question on diabetes after the first survey. In the first survey data on diabetes was general and GDM was not separated out from the diabetes per se. The fifth survey administered in 2009 includes a specific question asking a woman if she has been diagnosed with GDM in the past three years but results are not yet available. (Australian Government Department of Health and Ageing, 2009). Results from the first three surveys of the different age cohorts indicated that diabetes increases with age. The prevalence of diabetes in the youngest age groups ranged from 1% to 5% from survey 1 to survey 3; for women in the middle age cohort diabetes increased from 3% to 8% respectively and at the start of the study, when women in the older age group were aged 70-75 years, the prevalence of diabetes was 9% which increased to 12% at the time of the third survey. (Australian Government Department of Health and Ageing, 2006) (See Table 2.1)
Table 2.1 Longitudinal studies related to GDM and diabetes

<table>
<thead>
<tr>
<th>Author/place</th>
<th>Type of study</th>
<th>Years</th>
<th>Sample size and description</th>
<th>Main findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>MacNeill et al, 2001</td>
<td>Retrospective longitudinal</td>
<td>1980 - 1986</td>
<td>651 diagnosed with GDM</td>
<td>35.6% recurrence rate of GDM</td>
</tr>
<tr>
<td>Hu et al. 2001</td>
<td>Prospective longitudinal</td>
<td>1980 - 1996</td>
<td>84,891 female nurses</td>
<td>3.8% developed diabetes 61% of these cases attributed to overweight (defined as body-mass-index of 25 or higher)</td>
</tr>
<tr>
<td>Yogev &amp; Langer, 2004</td>
<td>Retrospective longitudinal</td>
<td>Mean interval was 3 years between pregnancies</td>
<td>389 women with two consecutive pregnancies</td>
<td>Could not predict an expected increase in birth weight between pregnancies</td>
</tr>
<tr>
<td>Australian Longitudinal Study on Women’s Health</td>
<td>Prospective population based longitudinal</td>
<td>1996 – ongoing (as of 2009)</td>
<td>40595 – 3 different age cohorts</td>
<td>Diabetes increases with age: nil data on GDM</td>
</tr>
</tbody>
</table>

Risk of developing Type 2 diabetes

Women who develop GDM are at risk of developing future Type 2 diabetes (Lee et al., 2007). Estimates of the conversion rates vary. There is evidence that the conversion rate is most rapid in the first five years postpartum (Kim et al., 2002). Some have suggested that the most rapid conversion rate is in the first nine months, which then remains fairly constant (Feig et al., 2008). The reported rates of conversion to Type 2 diabetes postpartum GDM similarly vary from 1.7% at one year (Lee et al., 2007); to 52.7% at 11 years (Löbner et al., 2006) to 25.8% at 15 years (Lee et al., 2007) to 70% at 20 years postpartum GDM (Kim et al., 2002).

The conversion rate from GDM to Type 2 diabetes is influenced by being overweight/obese (Lauenberg et al., 2004; Löbner et al., 2006), insulin use/hyperglycaemic during pregnancy (Kjos et al., 1999; Löbner et al., 2006; Kim et al., 2002), having a first degree relative with Type 2 diabetes (Löbner et al., 2006), and ethnicity (Ross, 2006; Simmons et al., 1995; Yue et al., 1996).

Table 2.2 highlights studies that have explored the conversion rates from GDM to Type 2 diabetes and some of the factors that place women at a higher risk.
### Table 2.2: Conversion rates from GDM to Type 2 diabetes (T2D) and risk factors reported as cumulative index (CI) unless specifically indicated as Odds Ratio (OR)

<table>
<thead>
<tr>
<th>Author/place</th>
<th>Type of study</th>
<th>Conversion rate</th>
<th>Length of time from GDM to T2D</th>
<th>Risk factors (↑=increase)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feig et al. (2008) Canada</td>
<td>Population-based database n=21,823 GDM women</td>
<td>3.7% 18.9%</td>
<td>9 months 9 years</td>
<td>Unable to assess risk factors of ethnicity, obesity. ↑Visits to primary care providers. → ↑diagnosis of GDM. More urban than rural women had GDM.</td>
</tr>
<tr>
<td>Lee et al. (2007) Sydney</td>
<td>Survival analysis retrospective cohort study n=5,470 GDM n=783 non-GDM</td>
<td>1.7% 17% 25.8%</td>
<td>1 year 10 years 15 years</td>
<td>Risk increased if women needed insulin for GDM and/ or were from Asia.</td>
</tr>
<tr>
<td>Löbner et al. (2006) Germany</td>
<td>Prospective study 1989-1999 n=302</td>
<td>52.7% 14%</td>
<td>11 years* 8 years**</td>
<td>*Significant risk increased with &gt;2 prior pregnancies; BMI &gt; 30 kg/m² if insulin was required. Autoantibody positive to GDM. **Women without above risk factors ⅓ all women had first degree relative with diabetes (non-significant finding).</td>
</tr>
<tr>
<td>Ross (2006) Australia</td>
<td>Meta-analysis</td>
<td>3-10% 10-20% 50% GDM have 6 x higher rate of T2D than non-GDM</td>
<td>1 year 1 year 10 years</td>
<td>Impaired glucose tolerance.</td>
</tr>
<tr>
<td>Kim et al. (2002)</td>
<td>Systematic literature review</td>
<td>CI Ranged from 2.6-70%</td>
<td>6 weeks 20 years</td>
<td>Main risk factor elevated fasting glucose level during pregnancy. CI increased in the first 5 years and then levelled after 10 years.</td>
</tr>
<tr>
<td>Kjos et al. (1999)</td>
<td>Literature review</td>
<td>17-63%</td>
<td>5-16 years</td>
<td>Hyperglycaemia during pregnancy, or soon after; diagnosis of GDM before 24 weeks of gestation. Obesity.</td>
</tr>
</tbody>
</table>
The most recent study to explore the risk of development of diabetes after a diagnosis of GDM was a large Canadian population-based study of over 21,000 women who had a pregnancy complicated by GDM (Feig et al., 2008). The records of deliveries between 1995 and 2002 were identified from a database. Records of women with GDM were then linked to another database that recorded Type 2 diabetes. The rate of conversion from GDM to Type 2 diabetes increased over time to almost 20% in 9 years. The large sample size allowed a strong assessment of the conversion rate of GDM to Type 2 diabetes. Even though the authors note they were not able to link conversion rates to risk factors such as obesity and ethnicity, they noted that less than 10 visits to a primary care provider two years before the index pregnancy and women without a usual care provider were less likely to receive a diagnosis of GDM (Feig et al., 2008).

Lee et al. (2007) undertook a large prospective study in Sydney comparing the cumulative risk for developing Type 2 diabetes in pregnant women with and without GDM who attended postnatal follow up at the Mercy Hospital between 1971 and 2003 and found that, although the risk increased in time for both groups, it was 9.6 times higher in the GDM group. It was estimated that within 15 years, 26% of women postpartum GDM pregnancy will develop Type 2 diabetes (Lee et al., 2007). This is not as high as reported by Ross (2006) who determined from a meta-analysis that within 10 years about 50% of women postpartum of a GDM pregnancy will develop diabetes, but higher than that reported by Feig et al (2008). Löbner et al. (2006) reported a conversion rate to Type 2 diabetes of almost 53% at 11 years postpartum GDM pregnancy for women with multiple risk factors. This conversion rate is similar to that estimated by Ross (2006) but risk factors are more clearly identified by Löbner et al. (2006), who identified obesity as a significant risk factor. Lauenborg et al. (2004) also found that obesity was the main factor that contributed to diabetes post GDM, where, in Denmark, the incidence of Type 2 diabetes doubled in 10 years (1987-1996) which was linked to an increase in BMI (>25 kg/m²) during this period.

Kim et al. (2002) examined 28 studies that were published between 1965 and 2001 where women underwent testing for GDM and then were tested for Type 2 diabetes after delivery. They reported a conversion rate to Type 2 diabetes as high as 70% for women 28 years postpartum GDM (Kim et al., 2002). The conversion rate increased markedly in the first five years. The main risk factor most commonly associated with development of Type 2 diabetes was an elevated fasting glucose level during pregnancy.

Ethnicity influences conversion from GDM to Type 2 diabetes. An Australian study found that following GDM, Aboriginal women were likely to present 12 years later with diabetes compared to 23 years for Anglo-Celtic women (Yue et al., 1996). Specific to Polynesian women, a New Zealand study reported that the prevalence of Type 2 diabetes postpartum GDM was found to be as high as 30% (Simmons et al., 1995).
Summary of risk of developing Type 2 diabetes

It is clear that GDM is a risk factor for the future development of Type 2 diabetes and that being overweight and ethnicity contribute to earlier conversion rates. Women who experience a pregnancy complicated by GDM are clearly a high-risk group for the development of Type 2 diabetes and would benefit from targeted postpartum monitoring (Löbner et al., 2006), preventive interventions and regular screening (Feig et al., 2008).

Screening

Screening during pregnancy – controversy over universal or selective screening

Screening procedures identify pregnant women who have a sufficient risk to warrant a diagnostic test; the OGTT (Kjos & Buchanan, 1999). Similar to other areas of GDM study and treatment, there has been controversy and debate surrounding screening guidelines (Crowther et al., 2005; Oats, 1998; Sermer, 2003; Wilson, 2001). The controversy is around the most accurate screening test and whom to screen. With universal screening, all pregnant women are screened which includes many no-risk pregnancies, whereas selective screening targets only those at high risk and therefore misses some low-risk pregnancies (Oats, 1998; Wilson, 2001). Advocates of universal screening argue that it picks up more cases, facilitates an earlier diagnosis and is associated with improved pregnancy outcomes (Coffey, 2006).

Across the globe, several different screening tests are in use and, according to Hollander et al. (2007, p. 129), “predisposing factors for developing GDM are not helpful in developing a screening policy.” It is still unclear as to what degree of hyperglycaemia revealed in a screening test is considered abnormal. According to Ross (2006, p. 393), “available data do not demonstrate a clear cut off of glycaemic above which there is increased perinatal morbidity.”

In a systemic review of the GDM literature, Hollander et al. (2007) concluded that there is no gold standard screening test, nor any clear threshold value above which complications are markedly increased. Hollander et al. (2007) report on the unclear benefits of treatment and the disadvantages to diagnosing and treating women without a clearly proven benefit for GDM. They defended the position that all screening and treatment of GDM is suspended until further research has proven a clear benefit that the threshold for making a positive diagnosis and initiating treatment should be raised significantly (Hollander et al., 2007).

Screening recommendations in Australia: from ‘universal/selective’ to ‘universal’

Since 1998, the ADIPS recommendations had been to test every woman for GDM. (Hoffman et al., 1998) However, selective screening was advocated if resources were limited or if women had a high risk of GDM. As such,
universal screening was not an unequivocal recommendation (Martin, 1991) and many women were not screened for GDM.

A study undertaken in NSW, Australia into the extent of undiagnosed GDM found that, during a four-year period (1991-1994), approximately 50% of women were probably not tested for GDM (Moses & Colagiuri, 1997). The data were gathered from the NSW Midwives Data Collection annual reports and compared with three GDM incidence surveys. Although the screening rate had increased following the 1991 ADIPS recommendations, not all women in NSW were actually tested during this time (Moses & Colagiuri, 1997).

New evidence and unequivocal recommendations for universal screening by ADIPS

In 2005, in light of positive results from the ACHOIS (Crowther et al., 2005), an unequivocal recommendation was made by ADIPS. It was suggested that screening should be offered to all pregnant women and that “universal screening should now be accepted and implemented” (McIntyre et al., 2005, p. 288).

In reference to the result of Crowther et al’s study (2005) in relation to the benefits of treatment of GDM, McIntyre et al. (2005) noted that even though most of the women in the study were relatively ‘low risk’ (~30 years; BMI~26 kg/m²; mainly from European background) and therefore would not have been tested based on these risk factors, the benefits of treatment were evident. Given that most women with GDM have no symptoms and many have none of the classic risk factors for GDM, screening based on risk factors adds extra complexity to busy medical practices (McIntyre et al., 2005). However, even though “universal screening for GDM is recommended in Australia, there are currently no national data sources for assessing the proportion of pregnant women who are being screened” (AIHW et al., 2008, p. 4).

Screening and diagnosis in Australia

The ADIPS procedures for screening and diagnosis of GDM are reported in Table 2.3. Universal screening is recommended at 26-28 weeks gestation. Any woman considered to have a high risk of GDM is advised to have a screening test (an OGTT) any time, but usually early in her pregnancy (Hoffman et al., 1998). After a positive screening test, the optimum time for a diagnostic test is 28-30 weeks gestation.
Table 2.3: Procedures for screening and diagnosis of GDM in Australia
(adapted from Hoffman et al., 1998, p. 93)

<table>
<thead>
<tr>
<th>Indication</th>
<th>Optimal time for testing</th>
<th>Test</th>
<th>Diagnostic Criteria – venous plasma glucose level (mmol/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clinical suspicion of GDM</td>
<td>Any time during gestation</td>
<td>75 OGTT (fasting)</td>
<td>0 hours &gt; 5.5 2 hours &gt; 8.0</td>
</tr>
<tr>
<td>Screening</td>
<td>26-28 weeks gestation</td>
<td>50 g glucose load (morning/non-fasting)</td>
<td>1 hour &gt; 7.8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>75 g glucose load (morning/non-fasting)</td>
<td>1 hour &gt; 8.0</td>
</tr>
<tr>
<td>Confirmation of diagnosis after a positive screening test</td>
<td>26-30 weeks gestation</td>
<td>75g OGTT (fasting)</td>
<td>0 hours &gt; 5.5 2 hours &gt; 8.0</td>
</tr>
</tbody>
</table>

Diagnosis
The criteria for diagnosis of GDM also vary across the globe (Kwik et al., 2007). Table 2.4 summaries the diagnostic criteria for a diagnosis of GDM according to American, Australasian and WHO recommendations (adapted from Kwik et al., 2007). WHO has the lowest diagnostic cut-off values for a two-hour plasma glucose level. Despite recommendations as a result of two Australian studies (Crowther et al., 2005; Kwik et al., 2007) to lower the ADIPS two-hour cut off value to WHO levels, the Australian guidelines have not been altered by ADIPS.

Table 2.4: Diagnostic criteria for GDM based on 75 g glucose tolerance test
(Kwik et al., 2007)

Figure removed due to copyright restrictions

The ADIPS decided not to lower the thresholds to diagnose GDM (McIntyre et al., 2005).

Standard management of GDM: Diet and insulin
Dietary therapy is the primary management tool for GDM with particular attention to carbohydrate intake. Women need to monitor their blood glucose levels (BGLs). When diet alone is insufficient to manage the BGLs, insulin
then becomes part of the management. From 2005 to 2006, analysis of the records of women who delivered in Australian hospitals in 2005-2006, indicated approximately $\frac{2}{3}$ of women required insulin to manage their GDM (AIHW et al., 2008). The use of oral hypoglycaemics is not standard management because the efficacy and safety of their use is not yet clear (Hoffman et al., 2003; Ross, 2006). Currently a trial is underway to compare treatment with Metformin (an oral hypoglycaemic agent) with insulin (the Metformin in Gestational Diabetes (MiG) trial) to better understand the benefits and risks of oral hypoglycaemic use for GDM (Rowan, 2007).

According to the ADIPS, GDM management guidelines (which were revised in 2002) patient education is very important and a team approach is advocated (Hoffman et al., 2003). Compliance with treatment depends on a woman’s understanding of the implications of GDM for her baby and herself, the dietary and exercise recommendations, and the process and goals of self monitoring. Within the ADIPS guidelines, specific attention is given to glycaemic control via dietary therapy and monitoring of blood glucose levels. Insulin therapy is also discussed in detail in the guidelines (Hoffman et al., 2003), yet little attention is given to physical activity.

### Physical activity within the ADIPS GDM Management Guidelines

Scant mention is made of physical activity within the revised ADIPS GDM management guidelines. These guidelines are a guide to GDM management and the results of future good quality randomly controlled research are needed to support evidence-based practice. The guidelines are informed by “reasonable consensus of informed opinion in Australasia” (Hoffman et al., 2003, p. 7). Yet, given the evidence on the positive role of physical activity in general and especially for women with GDM with uncomplicated pregnancies (discussed in detail further in the chapter), it seems that physical activity is still not a serious part of the management of the GDM (Bung & Artal, 1996). In 2002, ACOG published for the first time new specific guidelines and recommendations for physical activity during pregnancy and the postpartum period (ACOG, 2003). In the ACOG guidelines, the recommendation for all pregnant women is 30 minutes of physical activity on most, if not all, days of the week (ACOG, 2003). Perhaps when the ADIPS guidelines are revised, similar specific guidelines will be recommended.

### Follow-up screening

**Why follow up is important**

For women with GDM who have an increased risk of postpartum glucose intolerance (Retnakaran et al., 2008) and a high risk of developing Type 2 diabetes (Feig et al., 2008), postpartum follow up and monitoring is essential (McElduff, 2003).
ADIPS recommends that all women with previous GDM be offered testing for diabetes with a 75 g OGTT, six to eight weeks after delivery. Repeat testing for women with normal glucose tolerance and those who have the potential for further pregnancies should be tested every one to two years. If pregnancy does not occur, follow-up testing should be performed every three years (Hoffman et al., 2003).

Follow-up screening enhances earlier detection of Type 2 diabetes through blood glucose level testing and monitoring. If diabetes is detected earlier, intervention can begin earlier and perhaps prevent or reduce serious long-term complications (Chittleborough et al., 2005). If women access the health care system again for screening, it also provides an opportunity to raise awareness of the risk of developing diabetes in the future and support women to adopt or maintain healthy lifestyle behaviours with attention to weight, diet and physical activity (Coffey, 2006).

The revised 2002 ADIPS GDM management guidelines stress the importance of counselling in relation to women’s increased risk of developing permanent diabetes (Hoffman et al., 2003) and that women are made aware of the symptoms of hyperglycaemia. Advice about the importance of healthy eating and exercise patterns postpartum is recommended within the guidelines (Hoffman et al., 2003); however, given the problems with follow-up care and screening, women may not be receiving the benefit of this support.

Do women follow up for postpartum screening?

Follow-up screening rates are low (England et al., 2009) and postpartum monitoring of this target group is difficult (Hunt & Conway, 2008; McElduff, 2003). Testing and preventive intervention in women with GDM are complicated by issues of discontinuity in young women, partially due to the loss of follow up after delivery, mothers’ underestimation of their risk of Type 2 diabetes, and difficulties of implementation of exercise and diet in women with small babies (Kim et al., 2002). Some researchers advocate a shared-care approach between health care providers as a valid option that needs consideration (McElduff, 2003) to enhance access to this target group.

A 2003 survey of ACOG Fellows (conducted by Gabbe et al. 2004 and cited by Kim et al., 2007) revealed that approximately 75% reported performing postpartum screening for diabetes in their patients with a history of GDM. However, it is interesting to compare this screening figure with the reported experience, albeit not from obstetricians or gynaecologists, of Australian women. As was reported in an Australian study of 1,300 women who had GDM, less than 40% returned for screening at the recommended six to eight weeks postpartum (Diabetes Australia New South Wales, 2007).

Similar to the lack of information for screening during pregnancy, information about follow-up screening at one, two or three years is basically non-existent in Australia because there are no national data sources for assessing the proportion of pregnant women who are being screened (AIHW et al., 2008). Neither of the two main national diabetes organisations in
Australia monitor follow-up screening of GDM: Diabetes Australia or the National Diabetes Register (which is administered by the AIHW) (AIHW et al., 2008). There is no national recall system in Australia despite the evidence of the effectiveness of such a strategy that is described below.

A GDM Recall Register Pilot Project

A GDM Recall Register Pilot Project was undertaken in Adelaide in 2005 to determine the effectiveness of establishing a centralised register and long-term recall system of women who developed GDM (Chittleborough et al., 2005). Women were recruited to the Register through the hospital diabetes centres, where women diagnosed with GDM were invited to enrol at the time of their first appointment with the Diabetes Educator. At the end of the pilot stage, 107 women were on the register, 53 had been sent a reminder letter, and 47 women participated in a phone survey (with a response rate of 89%).

Evaluation of the project indicated that the pilot recruitment project was an effective systematic method for long-term follow up of women who had GDM, and an effective way to remind women to have a blood glucose test. The majority of women reported having a follow-up test in response to receiving a reminder letter. At this test, support for lifestyle changes towards reducing women’s modifiable risk factors to prevent future Type 2 diabetes was provided. Women on the register reported very positive feedback about the value of the register to them (Chittleborough et al., 2005). Cost-benefit analysis may yet indicate the role of such a diabetes recall register to follow up with women who need screening (similar to the Pap Smear Reminder service) in reducing the burden of illness associated with the development of Type 2 diabetes.

Type 2 diabetes

A public health concern

Diabetes is a major cause of disability and premature death. The estimated direct annual health care costs of diabetes in Australia was around $1.4 billion in 1995 and by 2010 this is expected to reach $2.3 billion (Australian Diabetes Society, 2003). The 1999-2000 Australian Diabetes, Obesity and Lifestyle Study (known as the AusDiab Study) estimated that nearly 840,000 Australians aged 25 years or over had Type 2 diabetes (96% of all diabetes cases) that accounted for 7.1% of the population (AIHW, 2008). By 2010, the number of Australians with diabetes is predicted to be 1.2 million (Australian Diabetes Society, 2003).

Even though men experience about a 1% higher age-standardised prevalence rate for Type 2 diabetes (7.6%) compared to women (6.5%) (AIHW, 2004), when the prevalence rate of GDM (6-9%) is included in the estimates of those who experience diabetes overall, women experience higher rates of diabetes. It is more common in people over 40 years, but the rates are increasing in all age groups (AIHW, 2004). The prevalence of diabetes is expected to increase by 33% as the levels of obesity in the Australian community continue to rise (AIHW, 2003). The incidence of GDM usually parallels the incidence of Type 2
diabetes in the underlying population (Ferrara, 2007; Ben-Haroush et al., 2003) and GDM is a risk factor for the development of Type 2 diabetes. Countries with a high incidence of GDM also experience high rates of diabetes (Ferrara, 2007). Pregnancies associated with diabetes are saturating high-risk obstetric clinics and neonatal intensive units, already becoming a heavy burden to the health care systems around the world (Forsbach-Sa'nchez et al., 2005). In some populations, women who have had GDM comprise a substantial number of women (about one-third) who ultimately develop diabetes (Cheung & Byth, 2003).

**Global epidemic of diabetes**

Diabetes affects 6% of the world’s population and the prevalence is increasing (Adeghate, 2006). Diabetes is a major global public health concern (Australian Diabetes Society, 2003; Bassett, 2005; Cockram, 2000; Ferrara, 2007; Zimmet et al., 1997) that is predicted to place a huge burden on the health care systems throughout the world (Adeghate, 2006).

WHO predicts that global diabetes prevalence will continue increasing and that the current estimate of 150 million diabetes cases will double by 2025 (WHO, 2002 in AIHW, 2003). Bassett (2005) argues that diabetes needs to be seen as an epidemic because of its rapidly increasing prevalence and a public health response is needed to curb the problem.

**The Asia-Pacific region**

The increase in diabetes (primarily Type 2 diabetes) is occurring in both developed and developing countries, and especially in Asia and the Pacific (AIHW, 2003). Cockram (2000) suggested that the Asia-Pacific region is at the forefront of the current epidemic of diabetes of which both Tonga and Australia are a part. WHO estimates are that 150 million people are affected by diabetes in the Asia-Pacific region (Cockram, 2000).

The Asian Pacific Cohort Studies Collaboration (2007) undertook a study to obtain the most representative data of the prevalence of Type 2 diabetes in the adult population in countries of the WHO Asia-Pacific region. The prevalence of diabetes ranged from 2.6% in China (the lowest of these countries) to 15.1% in Tonga, which was the highest (in this study); Australia was 7.4%.

In Tonga, approximately 15% of the adult population have Type 2 diabetes (Colagiuri et al., 2002) which has doubled in the last 25 years and in the study by Colagiuri et al. (2002), 80% of the diabetes reported was previously undiagnosed. The current prevalence in Tonga is higher than WHO estimates for the projected prevalence of diabetes for 2030 (Asian Pacific Cohort Studies Collaboration, 2007).

**Risk factors for diabetes: Similar to those for GDM**

The behavioural and modifiable risk factors for Type 2 diabetes are the same as the risk factors for GDM: obesity, lack of physical activity and an unhealthy
diet. Age, urbanisation, family history, ethnicity, previous GDM, and impaired glucose tolerance are other risk factors for diabetes (AIHW, 2008).

Risk factors in Asia and the Pacific

Obesity is a major problem in the South Pacific. A Workshop on Obesity Prevention and Control Strategies in the Pacific was held in Samoa in September 2000 which reported that high rates of obesity parallel a high prevalence of diabetes (Secretariat of the Pacific Community, 2000). In most of the South Pacific, the obesity rate is well over 20%; almost 30% for women (Secretariat of the Pacific Community, 2000).

The reasons for increases in obesity are the result of complex social and economic change (Secretariat of the Pacific Community, 2000). Most of the pacific Island countries have undergone dramatic demographic and epidemiological changes in recent decades (McCarty & Zimmet, 2001). These include reduced physical activity; increased availability of high-fat, energy foods; changes in manual employment; changes towards westernised diets; and an increase in imported foods since the mid-90s (Secretariat of the Pacific Community, 2000).

Reduced physical activity

Lifestyle changes from rural to urban in the Pacific region has led to a reduction in physical exercise (Dowse et al., 1996 in McCarty & Zimmet, 2001). As early as 1994, the WHO Study Group (1994) suggested that “increasing physical activity should be an important component of strategies aimed at the prevention of diabetes and improvement of insulin sensitivity in affected individuals” (in McCarty & Zimmet, 2001, p. 242). This is supported by Cockram (2000) who suggested that there is an urgent need for governments to prioritise diabetes as a key issue throughout the Asia-Pacific region (to which Australia belongs) and that diabetes prevention programs can be justified “on economic, as well as humanitarian grounds” (p. 43).

McCarty & Zimmet (2001, p. 243) refer to the depth of the problem:

The magnitude of the diabetes epidemic in the Pacific region coupled with the significant morbidity and mortality associated with diabetic complications heralds the need for increased attention and resources to primary prevention of diabetes. The fact that the strongest environmental risk factors are potentially modifiable, points to lifestyle intervention, with the incorporation of a healthy diet and increased physical activity, as a means of curbing the impact of this epidemic in the Pacific region. Promotion of healthy lifestyles, while respecting local culture, poses an enormous challenge but it essential to optimize health for all Pacific Islanders.

Physical activity and lifestyle interventions to prevent Type 2 diabetes

Lifestyle interventions have been shown to be effective in reducing the incidence of Type 2 diabetes.
The first randomised trial to clearly demonstrate the positive outcomes of lifestyle interventions in reducing the incidence of Type 2 diabetes (Pan et al., 1997) was the Da Quing study in China, a random control trial of 577 people with impaired glucose tolerance. Patients from outpatient clinics were randomly allocated into a control group or one of three active treatment groups: diet only, exercise only, or diet and exercise. Although the cumulative incidence for each intervention group was comparable, the exercise-only group achieved the best result. At six years, the cumulative incidence was 67.7% in the control group compared with 43.8% in the diet group, 46% in the exercise group, and 41% in the diet and exercise group.

The Diabetes Prevention Programme (DPP) in the US similarly demonstrated the effectiveness of intensive lifestyle modification (including diet and weight control) in reducing the incidence of Type 2 diabetes in adults with impaired glucose tolerance. The DPP involved randomised clinical trials in 27 centres with 3,234 adults (DPP Research Group, 2002b). There were three arms to the study: an intensive 16-session lifestyle intervention, a usual care arm, and the distribution of Metformin to one group. The lifestyle intervention achieved a 58% reduction in the incidence rate of Type 2 diabetes compared to a 31% reduction in the Metformin-treated group, compared with the controls. Because the results of the behavioural intervention were so convincing, the trial was stopped early (DPP Research Group, 2002b).

A Finnish diabetes prevention project also demonstrated the effectiveness of lifestyle intervention in reducing the incidence of Type 2 diabetes. A random control trial was undertaken with 522 people with impaired glucose. The intervention included individualised counselling aimed at reducing weight, dietary changes and increasing physical activity. The mean duration of follow up was 3.2 years and each year an OGTT was performed and diabetes was confirmed by a second test. During the trial, the risk of diabetes was reduced by 58% in the intervention group and was directly related to the amount of lifestyle change (Tuomilehto et al., 2001).

Despite the intense interventions associated with these projects, it is clear that lifestyle modification towards increasing physical activity is associated with a lower risk of Type 2 diabetes. The benefits of physical activity are also associated with lowering the risk of GDM, and in normalising glucose control in women who have GDM and linked to reduced maternal outcomes. These are discussed in the next section.

**Physical activity and GDM**

Over the last 10 years, there has been an increase in the number of studies examining patterns of physical activity in relation to GDM management, prevention, and pregnancy outcome. A synopsis of these studies is presented in Table 2.4. Abbreviations used in Table 2.4 are indicated in the key below.
Table 2.4: Studies examining PA and GDM: Management, prevention; pregnancy outcome; patterns of physical activity
(adapted from Gavard & Artal, 2008)

<table>
<thead>
<tr>
<th>Author/year</th>
<th>Study type</th>
<th>PA period</th>
<th>Sample size</th>
<th>Aim</th>
<th>Type of activity</th>
<th>Main findings</th>
<th>Critique</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liu et al.</td>
<td>Analysis of data from 1988 Survey</td>
<td>Before and during preg.</td>
<td>4,813</td>
<td>Assess if PA during preg. reduces the risk of GDM among previously inactive women</td>
<td>Recreational</td>
<td>~12% previously inactive became active. Women who became active had 57% lower adjusted OR of GDM. Brisk walking and PA during preg→↓ GDM. PA during preg associated with ↓ risk of GDM among previously inactive women</td>
<td>Data could be 20 years old. Small subsample within a large probability study</td>
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<td>(2008)</td>
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<tr>
<td>Snapp et al.</td>
<td>Retrospective secondary analysis of 1988 database</td>
<td>Current preg.</td>
<td>Subset of 75,160 GDM women. 27% ex. group</td>
<td>Assess the association of maternal ex. during GDM preg. and selected maternal outcomes</td>
<td>Recreational walking most common activity (80%)</td>
<td>Women in the non-ex. group had a RR 12.9 times higher for delivering a LGA baby</td>
<td>Data could be 20 years old</td>
</tr>
<tr>
<td>(2008)</td>
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<tr>
<td>Artal et al.</td>
<td>Lifestyle intervention</td>
<td>During preg.</td>
<td>96 n=39 in ex. + diet group n=57 in diet group</td>
<td>Assess wt gain restriction regimen, with or without ex. on glycaemic control, preg. outcome</td>
<td>Recreational</td>
<td>Wt gain/wk significantly lower in diet and ex. Group. Caloric restriction + ex. → limited wt gain in obese women with GDM, ↓ macrosomia</td>
<td>Lack of randomisation Self-selection bias (but 2 groups were not significantly different) Small sample size</td>
</tr>
<tr>
<td>Author/year</td>
<td>Study type</td>
<td>PA period</td>
<td>Sample size</td>
<td>Aim</td>
<td>Type of activity</td>
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<tr>
<td>Oken et al. (2006)</td>
<td>Prosp cohort study</td>
<td>1 yr pre-preg. 3/12 pre-26-28 wks gestation</td>
<td>1805</td>
<td>Explored the rel'p between PA and television viewing before and during preg. with risk of GDM and abnormal glucose tolerance</td>
<td>Recreational</td>
<td>PA reduces the risk for developing both GDM and abnormal glucose tolerance, especially vigorous PA pre-preg. &amp; at least light – mod. activity during preg.</td>
<td>Overwt and sedentary women may have inaccurately reported their PA and TV viewing behaviours. Participants mainly white and well-educated</td>
</tr>
<tr>
<td>Avery &amp; Walker (2001)</td>
<td>One-group repeated measure design</td>
<td>One session 14 women with GDM</td>
<td>14</td>
<td>Evaluate the effect of a single session of ex. at rest and 2 low &amp; mod. intensity on blood glucose &amp; insulin</td>
<td>Cycling</td>
<td>Acute decline in blood glucose levels during low-moderate intensity ex. Mod. had more decline. Declines disappeared after 45 minutes</td>
<td>Small sample size</td>
</tr>
<tr>
<td>Garcia-Patterson et al. (2001)</td>
<td>Controlled cross over</td>
<td>2 days after GDM diagnosis 3-7 days apart</td>
<td>20</td>
<td>Evaluate light ex. program for treatment of GDM</td>
<td>Light post-prandial walking</td>
<td>Very light ex. ↓ post-prandial BGLs</td>
<td>Very small numbers. One day intervention</td>
</tr>
<tr>
<td>Author/year</td>
<td>Study type</td>
<td>PA period</td>
<td>Sample size</td>
<td>Aim</td>
<td>Type of activity</td>
<td>Main findings</td>
<td>Critique</td>
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<tr>
<td>Dempsey et al. (2004)</td>
<td>Cross-sectional case control study</td>
<td>1 yr pre-preg. 1st 20 weeks preg.</td>
<td>155 GDM cases 386 normotensive, non-diabetic controls</td>
<td>Explored risk of GDM PA undertaken year before preg and in the first 20 weeks of preg.</td>
<td>Recreational</td>
<td>PA 20 wks preg. 48% reduction in risk of developing GDM Greatest reduction in risk when women engaged in PA both before and during preg.</td>
<td>Possible recall error. Self-report but to minimise systematic reporting errors trained interviewers</td>
</tr>
<tr>
<td>Dempsey (2004)</td>
<td>Prosp study normotensive, nondiabetic, pregnant</td>
<td>1 yr pre-preg. + 7 days pre-interview during preg. mean gestational age 12.7 wks.</td>
<td>909</td>
<td>Explore the rel’p between exercise before, during and after preg. and the link between a reduction in GDM</td>
<td>Recreational</td>
<td>Women who exercised before and during their preg. experienced a 69% reduced risk</td>
<td>Selection bias related to 1 yr Strength – 2 time periods used; large cohort</td>
</tr>
<tr>
<td>Brankston et al. (2004)</td>
<td>Random control Diet alone Diet+ex.</td>
<td>From 26 wks preg.</td>
<td>35</td>
<td>Investigate if resistance exercises ↓ need for insulin in overwt women with GDM 20-40 yrs; 26-32 wks gestation</td>
<td>Circuit type resistance</td>
<td>Ex. ↓ need for insulin in overwt women (BMI &gt; 25 kg/m² pre-preg. Women in diet + ex. group prescribed less insulin and longer delay from diagnosis to insulin</td>
<td>Overwt. Diet regime not adequately checked. Ex. to start earlier as benefits not seen until 4th wk of training. Small numbers</td>
</tr>
<tr>
<td>Dye et al. (1997)</td>
<td>Case control retrospective study</td>
<td>Entire preg.</td>
<td>12799 372 GDM 12404 controls</td>
<td>Explore links between obesity, PA and GDM</td>
<td>Any exercise</td>
<td>Women with BMI ≤ 30 who did or did not ex. during preg. risk was similar. Risk lower morbidly obese women</td>
<td>Self-report. PA assessed after delivery</td>
</tr>
<tr>
<td>Author/year</td>
<td>Study type</td>
<td>PA period</td>
<td>Sample size</td>
<td>Aim</td>
<td>Type of activity</td>
<td>Main findings</td>
<td>Critique</td>
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<td>---------------------</td>
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<td>--------------------------------------------------</td>
</tr>
<tr>
<td>Jovanovic-Peterson et al. (1989)</td>
<td>Randomised trial of diet V’s diet plus CV conditioning</td>
<td>6-week program</td>
<td>15</td>
<td>Assess the impact of a training program on glucose tolerance in GDM</td>
<td>20 minutes 3 x wk for 6/52 arm ergometer used to maintain heart rate in the training range</td>
<td>Ergometer training is feasible in women in GDM → ↓ glucose blood levels. Ex + diet better than diet alone</td>
<td>Small sample. Short ex. time of 6/52</td>
</tr>
</tbody>
</table>

**Key**
- preg. pregnancy
- lit literature
- PA Physical activity
- GDM GDM
- Ex. exercise
- ↓ decrease
- ↑ increase
- → leads to
- ~ approximately
- BMI Body Mass Index
- OR odds ratio
- vig. Vigorous
- mod. moderate
- wt. weight
- LA leisure activity
- LGA low for gestation age infant
- RR Relative risk
- q’aire questionnaire
- prosp Prospective
- rel’p Relationship
- amt amount
Randomised trials, although with very small numbers, have demonstrated that physical activity reduces glucose levels in women who have GDM (Garcia-Patterson et al., 2001; Jovanovic-Peterson et al., 1989). Other observational studies have also shown that physical activity before pregnancy reduces the risk of GDM (Dempsey et al., 2004; Rudra et al., 2006; Zhang et al., 2006).

Liu et al. (2008) assessed 4,813 women’s risk of developing GDM. Women who were previously inactive before pregnancy were compared to those who became active during pregnancy and physical activity during the entire pregnancy was assessed (Liu et al., 2008). Those who became active during pregnancy had a 57% reduction lower adjusted odds of developing GDM (OR=0.43, 95% CI=0.20-0.93). Other studies have explored physical activity in relation to risk reduction for GDM and assessed physical activity in the first 20 weeks of pregnancy (Dempsey et al., 2004; Oken et al., 2006) and seven days prior to interview (Dempsey et al., 2004); however, the study by Liu et al. (2008) adds to the body of knowledge in the area specifically in relation to physical activity across the entire pregnancy.

In a case control study with 155 GDM cases and 386 normotensive non-diabetic controls (Dempsey et al., 2004), participation in any recreational activity during the first 20 weeks of pregnancy was assessed. Compared to inactive women, those who were active during the first 20 weeks of pregnancy experienced a 48% reduction in GDM (OR=0.52, 95% CI=0.33-0.80) and any type of activity was significantly associated with a lowered risk of GDM. Activity undertaken the year before pregnancy was also associated with a significant risk reduction and women who were active both before and during pregnancy experienced the greatest reduction in risk (OR=0.40, 95% CI=0.23-0.68).

The same authors sought to corroborate the findings that maternal recreational physical activity reduces GDM risk in a prospective study of 909 normotensive non-diabetic women (Dempsey et al., 2004). Pregnant women were questioned during early gestation about their levels of physical activity, one year before their pregnancy and seven days before the interview. The results showed that women who exercised before becoming pregnant (active women) compared with inactive women experienced a 56% reduction in gestational diabetes risk (RR=.44, 95% CI=0.21-0.91) (Dempsey et al., 2004). Women who exercised before and during their pregnancy experienced a 69% reduced risk (RR=0.31, 95% CI=0.12-0.79). The results supported the findings of their first study: physical activity undertaken both before and during pregnancy reduces women’s risk of GDM.

Similar to the above study where women who had GDM were categorised into ‘active’ and ‘inactive’ groups, Snapp et al. (2008) also examined ‘exercisers’ and ‘non-exercisers’ to explore maternal outcomes for women who had GDM. As part of a larger retrospective study using secondary analysis of the 1988 National American Maternal Infant Health Survey, women completed a questionnaire at the end of their pregnancies about
physical activity undertaken during pregnancy. Women were placed into the ‘exercise’ group if they engaged in physical exercise for at least 30 minutes, three times a week, for ≥ six months of pregnancy. They were placed into the ‘non-exercise’ group if they reported lower frequency duration. The main finding was that the women in the exercise group were less likely to deliver a low for gestational age (LGA) infant (0.73% CI=0.10-5.18) than women in the nonexercise group (9.46% CI=4.41-19.12). The authors concluded that moderate physical activity, such as brisk walking for 30 minutes three times a week, may reduce the delivery of a LGA (Snapp & Donaldson, 2008).

Dye et al. (1997) also examined physical activity during pregnancy using data from a population based birth registry and women were categorised as ‘exercisers’ or ‘non-exercisers’. After delivery, 12,796 women were interviewed about physical activity during their pregnancies and were then grouped according to exercise status; those who exercised one to two times per week versus no exercise. Although evidence was found that women who exercised for at least 30 minutes a week at some time during their pregnancy had a lower risk of GDM, this result was only indicated for morbidly obese women (when the sample was stratified by pre-pregnancy BMI). Women who did not exercise who had a BMI > 33 kg/m² were at greater risk than exercisers of developing GDM (OR=1.9, 95% CI=1.2-3.1). As pointed out by Dye et al. (1997), obesity is an increasing, not a decreasing health problem and if exercise does indeed play a role in reducing the risk that obese women who become pregnant will develop GDM, it is critical that this relationship and its correlates be explored further.

Oken et al. (2006) explored recreational physical activity before and during pregnancy and its relationship to GDM in a prospective study of 1,805 women who received prenatal care. Although most of the findings for light–to–moderate activity showed lowered risk for GDM, unlike the results of studies reported so far, the only significant finding was that women who engaged in vigorous physical activity in the year before pregnancy experienced a reduced risk of GDM (OR=0.56, 95% CI=0.33-0.95) compared with women who did not report vigorous activity before pregnancy. Women who were active before and during pregnancy benefited the most, similarly reported by others (Liu et al., 2008; Pan et al., 1997). Walking was protective, and a sedentary lifestyle was harmful.

Zhang et al. (2006) similarly concluded that physical activity undertaken before pregnancy contributes to a lower risk of developing GDM. They reported on the data analysis of 21,765 women (1,428 women with GDM) who participated in a prospective cohort study among women in the Nurses’ Health Study II to assess whether the amount, type, and intensity of pregravid physical activity and sedentary behaviours were associated with GDM risk. Women who participated in the highest quintile of physical activity had approximately a 20% risk reduction for developing GDM (relative risk (RR)=0.81, 95% CI=0.68-1.01 for total activity, and RR=0.77, 95% CI=0.69-0.94 for vigorous activity). This study followed on from an earlier study, which
also used data from the Nurses Health Study where women who reported higher physical activity levels prior to pregnancy were found to be less likely to develop GDM but the associations were not significant (Solomon et al., 1997).

Although not related to a lowered risk for GDM, Brankston et al. (2004) reported that physical activity for overweight women with GDM decreased their need for insulin. Women were randomly assigned to a group that received diet plus circuit-type resistance training or diet only. Although the number of women who required insulin was the same, a subgroup analysis of overweight women (who had a pre-pregnancy BMI of >25 kg/m$^2$) showed a significantly ($p<.05$) lower insulin use in the diet plus exercise group (Brankston et al., 2004). The benefits of physical activity for managing women’s blood sugar levels (BSL) are also reported by Garcia-Patterson et al. (2001) who evaluated a light exercise program for the treatment of GDM with 20 non-exercise trained women with GDM (Garcia-Patterson et al., 2001). Women’s BSL were measured on two different days. On the control day, women had breakfast and then remained seated. On the study day, after breakfast the women walked on a self-paced flat surface. Even though the numbers in the study were small, they found that very light exercise decreased postprandial blood glucose levels in women and suggested that women with GDM could benefit from postprandial exercise and actually delay or prevent insulin therapy.

There is evidence of types and level of intensity of physical activity most beneficial in lowering the risk of GDM. Liu et al. (2008) reported that brisk walking contributed to a lower adjusted odds ratio (OR=0.44, 95% CI=0.19-1.02) (Liu et al., 2008). Similarly Zhang et al. (2006) reported that brisk walking or very brisk walking was associated with a significantly reduced risk of GDM compared to women whose walking pace was casual (RR=0.75, 95% CI=0.64-0.87, and RR=0.77, 95% CI=0.69-0.94, respectively) (Zhang et al., 2006). It was also found that women who climbed ≥ 15 flights of stairs a day also had a significantly lower risk of GDM than women who climbed ≤ two flights of stairs a day (RR=0.50, 95% CI=0.27-0.90)( Zhang et al., 2006). Dempsey et al. (2004) also report particular benefits of vigorous activity before pregnancy and stair climbing during pregnancy but no benefit of walking or brisk walking was apparent in this case-control study. The benefits of vigorous activity before pregnancy and at least light to moderate or vigorous activity during pregnancy in lowering the risk of GDM were similarly reported by Oken et al. (2006). Snapp and Donaldson (2008) identified the benefits of moderate-intensity walking to reduce maternal outcomes for women who experience GDM.

On the other hand, a sedentary lifestyle before and during pregnancy has been reported to be inversely related to the risk of developing GDM (Oken et al., 2006; Zhang et al., 2006). One study did not observe any overall benefit of exercise during pregnancy. In this study, however, physical activity was assessed after delivery and women with GDM may have started exercising
after a diagnosis of GDM which may have led to some misclassification (Dye et al., 1997).

The beneficial role of physical activity in lowering the risk of GDM is evident from the above studies despite their limitations. Some of the limitations of these studies include: data collected may be up to 20 years old (Liu et al., 2008; Snapp & Donaldson, 2008); recall bias may have influenced some of the self-report data on physical activity (Dempsey et al., 2004; Dye et al., 1997; Oken et al., 2006; Solomon et al., 1997; Zhang et al., 2006); a long recall of physical activity (one year) (Dempsey et al., 2004); small numbers (Artal et al., 2007; Avery & Walker, 2001; Brankston et al., 2004); the use of a smaller subsample within a large weighted probability sample (Snapp & Donaldson, 2008); lack of randomisation (Artal et al., 2007; Brankston et al., 2004; Garcia-Patterson et al., 2001) and selection bias (Artal et al., 2007; Dempsey et al., 2004).

Nevertheless, over the last few years there has been an increase in evidence on the beneficial role of physical activity undertaken both before and during pregnancy in lowering the risk of GDM. Benefits relate to activity undertaken at moderate and vigorous levels of intensity (Liu et al., 2008), positive maternal outcomes (Hegaard et al., 2007), management of blood glucose levels (Damm et al., 2007), and particular benefits of physical activity for obese women (Brankston et al., 2004; Dye et al., 1997).

Bung and Artal suggested in 1996 that exercise had only recently been offered as an adjunctive therapy to prevent GDM (Bung & Artal, 1996). Six years later in 2002, the ACOG recommendations acknowledge for the first time the positive role of physical activity for the prevention and management of gestational diabetes (Artal et al., 2003). However, there remains a gap in empirical evidence that would enable specific guidelines for frequency, intensity, time (duration) and type of activity for optimal pregnancy outcomes (Liu et al., 2008). Mottola (2007, p. 385) stated that “[a]lthough exercise is still considered a valuable adjunctive therapy and preliminary results are encouraging … [R]esearchers have not been able to suggest a cost-effective, easily accessible, evidence-based program with guidelines for frequency, intensity, time (duration) and type of activity.”

Similarly, the low prevalence and declining patterns of physical activity during pregnancy, compared to before pregnancy, for women with GDM (Owe et al., 2007) are similar to patterns for women without a pregnancy complicated by GDM (Albright et al., 2005; Evenson et al., 2009; Ning et al., 2003; Zhang & Savitz, 1996) and further highlight the need for clear guidelines on the type, duration and intensity of physical activity during pregnancy for all women (Dempsey et al., 2005). Patterns of physical activity before, during and after pregnancy are discussed in the next section with a focus on women who do not experience GDM.

**Physical activity and pregnancy**

As early as 1992, from a review of the published literature on physical activity and pregnancy, the main findings reported were that all women do less
exercise as their pregnancy progresses but there were clear benefits of continuing exercise during pregnancy (Artal, 1992). Artal (1992, p. 363) concluded that pregnancy should not be seen as a state of confinement, that cardiovascular and muscular fitness can be reasonably maintained, and that exercise can be used as an alternate and safe therapeutic approach to GDM. Ten years later, Dempsey et al. (2005) again pointed out that there is ‘no need for a pregnant pause’ during pregnancy, despite traditional views of pregnancy as a time of confinement.

There is now considerable evidence that the benefits of physical activity during pregnancy far outweigh the risks (Brown, 2002; Dempsey et al., 2004; Gavard & Artal, 2008; Hammer et al., 2000; Leiferman & Evenson, 2003; Mottola, 2007). For the general adult population moderate levels of physical activity is clearly beneficial (Bauman, 2004) and recommended (National Public Health Partnership, 2005).

Despite these benefits, evidence has indicated that physical activity levels decrease during pregnancy compared to before pregnancy (Borodulin et al., 2008; Da Costa et al., 2003; Ning et al., 2003; Snapp & Donaldson, 2008; Zhang & Savitz, 1996), the prevalence of physical activity in the postpartum period is low (Gennero & Feher, 2000; Stage et al., 2004) and physical activity during pregnancy and in the postpartum period is influenced by a variety of factors (Duncombe et al., 2007).

**Physical activity decreases during pregnancy**

Owe et al. (2007) explored the level of exercise during pregnancy (weeks 17 and 30) and before pregnancy (data were collected retrospectively at week 17), and assessed the factors that were associated with regular exercise with 34,508 pregnant Norwegian women who completed self-reported questionnaires. Participation in all exercise decreased during pregnancy, except for swimming. Exercising pre-pregnancy was strongly correlated to exercise during pregnancy. Those defined as regular exercisers (exercised at a moderate level ≥ three times a week) were older and had a higher education level (Owe et al., 2007).

A lower prevalence rate of recommended activity for pregnant women (15.8%) compared to non-pregnant women (26.1%) was also reported by (Evenson et al., 2004) as a result of a study into leisure time physical activity (LTPA) in the US with 44,657 non-pregnant and 1,979 pregnant women. Results of phone interviews with pregnant women indicated that two-thirds of pregnant women reported participating in some LTPA, but < one-sixth met recommended levels of activity. The study did not focus on any particular stage during pregnancy and data on gestational age was not collected, so it was not possible to determine if LTPA decreased as the pregnancy progressed. The most common LTPA during pregnancy was walking, followed by swimming laps, weight lifting, gardening and aerobics. Data on occupational, child-care and household activities was not collected and, as the authors suggested, further research needs to incorporate all domains of
women’s physical activity as well as the enablers and barriers to participating in LTPA during pregnancy (Evenson et al., 2004).

A study by Da Costa et al (2003) which explored LTPA during pregnancy and the relationship to psychological wellbeing with 180 women using self-report and semi-structured interviews also found that exercise decreased during pregnancy. Pre-pregnancy, the rate of LTPA was 40% compared to 29% during the first and second trimesters and 21% in the third trimester. Regular exercise (defined as three or more sessions/per week for at least 30 minutes) also decreased from 59% in trimester 1 to 41.5% in trimester 2, and 39.5% in the third trimester. The preferred LTPA was low impact aerobics, followed by walking and swimming (most common in third trimester). Exercise was positively associated with psychological wellbeing. The authors suggested that even low intensity regular exercise may be a cost-effective method of enhancing psychological wellbeing although less than ⅓ of pregnant women engaged in any exercise during pregnancy (Da Costa et al., 2003). The survey was self-reported and excluded work-related activities but also revealed different patterns of exercise during each trimester.

Another study of 386 women by Ning et al. (2003) explored correlates of recreational physical activity in early pregnancy and found that the average intensity and duration of activity during pregnancy decreased compared to the year before the study. Women were interviewed during their hospital stay and were asked to describe their physical activity patterns during their teenage years, and whether they had engaged in recreational physical activity during the first 20 weeks of their pregnancy and in the year before their pregnancy. Sixty-one percent of women reported they did engage in physical activity during pregnancy which was positively related to activity in the year prior to pregnancy (OR=48.9) and their reported activity as teenagers (OR=4.0) (Ning et al., 2003). Approximately 22% of women reported being inactive the year before pregnancy and 40% of women reported that they did not engage in regular recreational physical activity during pregnancy. For women who were active before pregnancy, those that did continue to exercise during pregnancy decreased the average intensity and weekly duration of their exercise compared to the year before their pregnancy. The self-reported nature of the study, the length of recall of physical activity and the focus on recreational activity were limitations noted by the authors (Ning et al., 2003). Similar to the findings reported in other studies, walking was the most common activity (Da Costa et al., 2003; Evenson et al., 2004) followed by swimming, gardening and jogging. As reported in other studies (Evenson et al., 2004), education was found to be positively correlated with participation in physical activity (Ning et al., 2003).

In terms of recommended or regular activity, Evenson et al. (2004) found that approximately one in six women engaged in recommended LTPA during pregnancy. This was lower than reported in Da Costa et al’s (2003) study where approximately one in three women reported engaging in regular exercise. In the study by Ning et al (2003), 60% of women reported engaging
in regular recreational activity during pregnancy and Zhang et al. (1996) found that less than 50% of women exercised during pregnancy.

Low levels of physical activity during the postpartum period

An earlier study by Zhang and Savitz. (1996) explored the patterns and prevalence of physical activity during and after pregnancy via a self-report survey, during the postpartum period with 9,953 randomly selected women. Overall, 35% of women exercised both before and after pregnancy and 42% reported exercising during pregnancy. Thirteen percent of women did exercise before pregnancy but then stopped when they found out they were pregnant and 7% who did not exercise before pregnancy started to exercise during pregnancy. The most common activity was walking (42%) followed by swimming and aerobics (~12% each). Unlike other studies, women were asked to report the length of time they continued to exercise in the postpartum period. Approximately 50% (of those who exercised during pregnancy) continued to exercise for six months; 34% for four to six months and 16% for one to two months. The problems related to validating the accuracy of the data collected retrospectively via self-report are noted as limitations to the study (Zhang & Savitz, 1996) as are recommendations to the future collection of energy-expenditure categories for activity. However, few studies have explored the length of time it takes women to resume exercising after the birth of their babies; lifestyle changes and reasons for any changes (including fear of developing Type 2 diabetes) women make in the postpartum period.

A study was undertaken by Stage and colleagues (2004), which specifically explored lifestyle changes after GDM. A mailed survey was completed by 121 women 11-42 months after the pregnancy. More than 1/3 of women did not do any exercise in their leisure time either during or after their pregnancies. Exercise levels did not change after pregnancy even though 86 women were to some extent worried about developing Type 2 diabetes. Of these, 19 women (16%) had actually developed Type 2 diabetes and 22 women (18%) had impaired glucose tolerance. More women postpartum had gained weight rather than lost weight. Positive changes in diet were made. The authors suggested that even though many of the women were worried about developing overt diabetes, few had changed their lifestyle or lost weight postpartum. They recommend more frequent and intensive lifestyle instruction in the period after pregnancy. Research into this area is scant, particularly in relation to exploring whether the fear or awareness of the increased risk of Type 2 diabetes motivates postpartum lifestyle change for women who experienced GDM.

Factors that influence participation in physical activity: GDM and non-GDM

As indicated in the above studies, pregnancy is a time that may result in decreased levels of physical activity. Women may reduce their participation in physical activity for a number of reasons, even if they wish to be active.
Several studies have explored the factors that influence women’s participation in physical activity during pregnancy and in the postpartum period.

**Barriers during pregnancy**

Women’s perceived barriers to physical activity was explored with 1,535 pregnant women during the third trimester who answered an open-ended question about their primary barrier to physical activity during pregnancy. As part of a larger pregnancy, infection and nutrition study fifty-eight pregnant women were then interviewed in focus groups (Evenson et al., 2009). Evenson et al. identified intrapersonal barriers to physical activity, including low motivation, not enough time, lack of enjoyment of physical activity, lack of alternative childcare arrangements during pregnancy and lack of social support (Evenson et al., 2009).

**Barriers and facilitators – during and after pregnancy**

Albright (2005) explored barriers and facilitators to physical activity before pregnancy and following childbirth with 79 new Hawaiian mothers of infants between two and 18 months. Women completed surveys and participated in discussions. The most frequently mentioned barriers were personal and family/parenting duties (Albright et al., 2005). Compared to pre-pregnancy, Albright (2005) found that new mothers are a high-risk group for inactivity compared to pre-pregnancy. Women’s reported PA combined pre- and post-pregnancy resulted in four significantly different groups: those inactive before childbirth, 21.5%; those active before and after childbirth, 22.7%; women inactive before but active after childbirth, 12.6%; and women who were active before childbirth but inactive (or irregularly active) after childbirth, 43% (Albright et al., 2005). Walking, running and swimming were the most commonly performed activities pre-pregnancy; walking was most preferred after childbirth.

**Beliefs, barriers and behaviours – before, during and after pregnancy**

Whereas Albright (2005) focused on exercise before and after pregnancy, Symons Downs and Hausenblas (2004) explored exercise beliefs and behaviours with women during pregnancy and after pregnancy. Seventy-four women (one to six months postpartum) completed a questionnaire. The most common belief was that exercise improves mood and physical limitations during pregnancy, and in the postpartum period exercise controls weight gain. Overall, lack of time was the main barrier and the strongest influence was the woman’s husband or partner. These authors also found that participation in exercise was lower during and after pregnancy than before pregnancy (Symons Downs & Ulbrecht, 2006). Retrospective estimates of activity were used and the women who participated were mainly middle to upper class white women, limiting the generalisability of the results. The authors were originally interested in exploring beliefs and behaviours in women up to 12 months postpartum; however, the mean time postpartum was 3.52 months (Symons Downs & Ulbrecht, 2006). There is little research
which explores the length of time it takes for women’s activity levels postpartum to resume to pre-pregnancy levels, or if they even do.

**Beliefs, barriers and behaviours – during and after pregnancy for women who experience GDM**

Smith et al. (2005) identified barriers that hinder participation in physical activity levels during and after pregnancy for women with GDM. Two hundred and twenty-six women who had given birth in the previous six to 24 months and who could speak English participated in a telephone survey. The women were randomly selected from those who had attended a diabetes pregnancy clinic from four public hospitals in Western Sydney, NSW, Australia. Approximately one-third of participants reported engaging in physical activity that met current Australian recommendations and ~26% were classified as sedentary. Walking was the most common type of physical activity reported. The most common barriers to physical activity mentioned by the women were lack of childcare and lack of time. The type of social support most helpful was verbal encouragement, followed by assistance with childcare, help with household chores, and being accompanied during physical activity. Just under half of the women reported not knowing which exercises would help to prevent Type 2 diabetes. Women (only those who could peak English) were asked to self-report on their physical activity levels. As the authors noted, the actual participation levels in physical activity for women postpartum GDM may be lower than reported because there is a tendency to over-estimate physical activity.

Similarly, Symons Downs and Ulbrecht (2006) explored exercise beliefs and behaviours of postpartum women with a recent GDM history and found that social influences, support, and beliefs about the benefits of exercise were closely related to women’s levels of physical activity postpartum. Twenty-eight women completed a mailed questionnaire. The strongest perceived advantage of exercise in a pregnancy complicated by GDM was management of BSL; during the postpartum period, the strongest perceived advantage was for controlling weight. Fatigue was the most common barrier to exercising during pregnancy; postpartum, the main barrier was lack of time. A woman’s husband/partner was the strongest influence on exercise levels both during pregnancy and postpartum. Women who perceived advantages to exercise in pregnancy were more likely to exercise during pregnancy and postpartum (Symons Downs & Ulbrecht, 2006). The authors’ suggested that longitudinal studies are needed to explore whether beliefs change postpartum and how these beliefs are related to the possible future onset Type 2 diabetes in this population.

**Beliefs, behaviour and information sources**

Clarke et al. (2004) explored pregnant women’s beliefs, behaviours and information sources regarding physical exercise participation with 57 nulliparous pregnant women interviewed in a preliminary, prospective study. Levels of maternal physical activity were assessed through semi-structured
interviews at 16, 25, 34 and 38 weeks (Clarke et al., 2004). Pregnant women stopped or reduced exercise for two main reasons: because of physical changes, and for a combination of social and psychological factors (worried about risks to themselves or their baby which seems to be fuelled by inaccurate advice) (Clarke et al., 2004).

In the same study, almost half the women reported participating in some form of weekly exercise before they were pregnant but then did not pursue weekly exercise during pregnancy. Between 16 and 38 weeks gestation, women reported they had stopped or reduced exercising for a number of reasons: physical limitations (63%), responding to advice (52%), risks or dangers associated with that activity (32%), reduced motivation for exercise (13%) and 5% of women reported difficulty in finding an appropriate facility/area to exercise (Clarke et al., 2004).

Most of the information women reported receiving about pregnancy and exercise came from their family and friends, especially between 25 and 38 weeks gestation and the overriding lay advice was that physical activity should be limited (Clarke et al., 2004).

Unlike the unhelpful advice women reported in the above study by Clarke et al. (2004) that cautioned against physical activity during pregnancy, a study among pregnant and postpartum Latino women in the US reported favourably on advice received from family members. Thornton et al. (2006) investigated the influence of social support on weight, diet and physical activity and beliefs and behaviours in a small study with volunteer Latino participants who were almost exclusively Mexicans on a low income. In a community-based participatory project, women were interviewed in dyads with 10 pregnant and postpartum women and 10 people who influenced them. The main sources of emotional, instrumental and informational support in all areas were husbands and some female relatives. Barriers included absence of mothers, other female relatives or friends to provide childcare and companionship for exercise. Physical activity levels were not ascertained. Even though the results cannot be generalised to the broader population, the study highlights the cultural context of perceived facilitators to participation in physical activity. However, barriers reported by Latino women (lack of childcare and companionship) are similarly identified in other studies (Albright et al., 2005; Evenson et al., 2009), possibly reflecting common experiences of women across various cultures and the gendered nature of the social determinants of health.

Environmental as well as cultural determinants influence participation in physical activity (Giles-Corti & King, 2009; Lapierriere, 2008; French et al., 2001; Duncan & Mummery, 2005). Although not specifically related to pregnancy, factors such as good street lighting, parks, recreational playgrounds, sports fields, having access to sidewalks (Addy et al. 2008), enjoyable scenery, hills (Brownson et al., 2001), lighter traffic as well as seeing
people exercise in the neighbourhood have been found to be positively associated with physical activity. Physical activity is influenced by a multitude of social, personal and environmental factors including safety.

Concerns about the safety of physical activity during pregnancy reported by Clarke et al. (2004) are also reported by Duncombe et al. (2007) who explored women’s beliefs about the safety of exercise during pregnancy and factors related to exercise over the course of pregnancy. One hundred and fifty women completed a mailed questionnaire during each trimester of their pregnancy. Activity levels pre-pregnancy were retrospectively explored at the first point (Duncombe et al., 2007). Over the course of pregnancy, the amount and intensity of exercise decreased. The main reasons reported for not exercising during pregnancy related to feeling tired or unwell and being too busy. During late pregnancy, feeling uncomfortable and concerns for safety were the main barriers. Women who rated gentle and low to medium exercise as unsafe engaged in less intense and fewer minutes of exercise (Duncombe et al., 2007).

In summary, the evidence has suggested that women do less physical activity as their pregnancy progresses (Artal, 1992) and the prevalence of physical activity in the postpartum period is generally low. There are many factors that influence participation in physical activity during pregnancy and after the baby has been born (Smith et al., 2005) including lack of time, lack of childcare, lack of support, social and physiological influences. Women may be missing out on the benefits of moderate physical activity, partly because of receiving inaccurate information (Clarke et al., 2004; Duncombe et al., 2007; Symons Downs & Ulbrecht, 2006), partly due to the barriers women experience to participation in physical activity during and after pregnancy (Da Costa et al., 2003; Evenson et al., 2009), as well as unclear guidelines about staying active whilst pregnant (Mottola, 2007). The identification of determinants of physical activity during pregnancy and in the postpartum period has important implications for developing strategies to promote physical activity for women, particularly those who experience a pregnancy complicated by GDM who are at a high risk of developing future Type 2 diabetes (Ning et al., 2003). A consideration of these determinants has implications for health promotion, particularly a gendered approach to health promotion.

There is scant attention in the broader literature paid to a gendered approach to health promotion. These issues have not been addressed within this literature review chapter. Instead, a discussion of gender as one of the determinants of health and the implications this has for a gendered approach to health promotion is covered in the methodology chapter (Chapter 3), the discussion of the results of the research (Chapters 5 and 7) and in the final chapter (Chapter 8).
Conclusion

The results of this literature review highlight the increasing incidence of GDM and Type 2 diabetes and the beneficial role of physical activity in relation to reducing the risk of GDM and in the management of GDM. Lack of physical activity and obesity are risk factors for both GDM and Type 2 diabetes; prevalence rates for both these risk factors are increasing in Australia and in other high-risk populations, including women from the Pacific islands. Women who experience GDM are a clear target group for lifestyle interventions that would reduce their high risk of developing future Type 2 diabetes. Physical activity is one of the modifiable risk factors for GDM and Type 2 diabetes and lifestyle interventions have demonstrated the effectiveness of reducing the incidence of both GDM and Type 2 diabetes.

Women are advised to make lifestyle changes during pregnancy and recommendations call for follow-up screening to monitor women’s blood glucose levels. However, irrespective of a heightened awareness of their increased risk of developing diabetes, lifestyle change is difficult to achieve and maintain, especially for busy new mothers. Within the ADIPS GDM management guidelines, physical activity receives scant attention in relation to the management of GDM and further research will inform clear recommendations for types and duration of specific physical activity. Arguably, attention to physical activity is not a serious component of antenatal care of all pregnant women, irrespective of a diagnosis of GDM, although the benefits of physical activity during pregnancy are clear. It is not clear from this review how much attention is actually given to physical activity during pregnancy by health care providers.

There are few studies that explore the impact that GDM has on a woman’s life in terms of lifestyle changes women are encouraged to make (especially to physical activity) during pregnancy to manage GDM and then in the postpartum period to manage their increased risk of developing Type 2 diabetes. The area of follow-up screening and lifestyle support for this high-risk group of women is problematic. In Australia, although universal screening during pregnancy and follow-up postpartum screening is unequivocally recommended, the actual follow-up screening rates are not monitored. As such, the chance to monitor lifestyle support and education for women in the postpartum period, for those who have had GDM, has not been possible. It is clear that follow up is problematic. Overall, there seems to be a gap in care for these women postpartum, which is of concern, given their intense monitoring during pregnancy and the evidence that these women experience a 20-50% chance of developing Type 2 diabetes within 10 years postpartum (Feig et al., 2008; Ross, 2006).

There is a paucity of research which has explored the factors that would support lifestyle change both during pregnancy and in the postpartum period. Little research has been undertaken to explore whether the fear of developing Type 2 diabetes for women who develop GDM is a motivating
factor that would positively influence lifestyle changes to ameliorate their increased risk. This information could supplement information on factors that facilitate and hinder participation in physical activity during and after pregnancy.

Moderate-intensity physical activity levels for 30 minutes on most if not every day of the week is recommended for all women in the general population (Department of Health and Ageing, 2005). From the literature reviewed, it is clear that few pregnant women reach this recommended level of physical activity. It is also clear that less than 50% of non-pregnant women achieve recommended levels of physical activity (AIHW, 2008). The Australian guidelines for physical activity during pregnancy (particularly in relation to GDM) are very general and, overall, little attention is given to physical activity within these guidelines.

Physical activity is clearly beneficial during pregnancy, yet the prevalence of physical activity during pregnancy is generally low. Women reduce or stop exercising during pregnancy. In the postpartum period, it is not clear how long it takes for women to resume their pre-pregnancy levels of physical activity or if they ever do. However, women’s participation in physical activity during pregnancy and in the postpartum period is influenced positively and negatively for a variety of reasons. For women who develop GDM, their concerns about developing future diabetes has not been adequately researched in terms of a motivating factor for lifestyle changes to prevent Type 2 diabetes.

The present research - an exploration of physical activity, pregnancy and gestational diabetes

This study sought to explore physical activity, pregnancy and gestational diabetes; in particular, the way in which a diagnosis of GDM influences a woman’s life, particularly in relation to lifestyle change, and whether sustained lifestyle change in the postpartum period is influenced by an awareness of a woman’s increased risk of developing Type 2 diabetes. Patterns of physical activity before, during and after pregnancy; attitudes and beliefs towards physical activity during pregnancy; and factors that influence women’s engagement in physical activity were explored. Some of these issues were explored in detail with high-risk groups of women, in particular, Pacific Islander women.

The following chapter explores the multiple theoretical perspectives that informed the research and drove the mixed methods approach.
Chapter 3: Methodology
Introduction

The following is an exploration of the conceptual framing of this research project. The research was undertaken within a constructivist interpretive, methodological framework using a mixed methods approach. It was informed by a commitment to primary health care and health promotion and guided by feminist research principles. This chapter includes a discussion of the social determinants of health with a focus on gendered health promotion because these were key factors that influenced the theoretical framework of the research.

Interpretive constructivist was the methodological framework of this research that used mixed methods to enable a richer and deeper understanding of the behavioural patterns of physical activity and to explore women’s views on physical activity during and after pregnancy. Further, the factors that influenced participation in physical activity were explored, especially for women who experienced a pregnancy with GDM. The discussion begins with notions concerning world views, research focus and methodology. Various philosophical commitments that framed the research are discussed, including PHC principles and concepts of empowerment, partnership, health promotion and ‘education for health’. The decision to use mixed methods is also justified.

Developing research knowledge

Reflecting on questions about the nature of the investigation, the researcher’s position, and the topic to be explored, all assist the researcher to refine the conceptual underpinnings of the study and to formulate sensible and coherent research questions (Mason, 2002). Mason suggests the researcher needs to think about the essence of the research inquiry and consider their ontological perspective; how they see the very nature of the social world. Questions about epistemology help clarify the researcher’s stance and direct philosophical reflection on what is considered as evidence of the social reality to be explored. The epistemology helps to generate knowledge and explanations about the ontological components of the social world (Mason, 2002). Concepts that relate to ontology, epistemology and methodology are presented in Table 3.1.

Table 3.1 Reflections on ontology, epistemology and methodology

(developed from Guba, 1990; Jackson et al., 2003; Mason, 2002; Polit & Hungler, 1997).

<table>
<thead>
<tr>
<th>Perspective</th>
<th>Focus of each perspective</th>
<th>Questions linked to the perspective</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ontology</td>
<td>Provides the world view which guides the study (Jackson et al., 2003)</td>
<td>What is the nature of reality or the knowable? (Guba, 1990)</td>
</tr>
<tr>
<td>Epistemology</td>
<td>Provides a focus for the study (Jackson et al., 2003)</td>
<td>What is the relationship between the knower and the known? (Guba, 1990)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>How is the inquirer related to those being</td>
</tr>
</tbody>
</table>
Various terms are used to describe a conceptual framework. The net that contains the researcher’s epistemological, ontological, and methodological premises may be termed a *paradigm*, an interpretive framework, a basic set of beliefs that guides action (Guba, 1990, p. 17 in Denzin & Lincoln, 2000). Taylor (2006a) refers to methodology to describe the theoretical assumptions underlying the choice of methods in generating a particular form of knowledge and suggests that ‘epistemology’ and ontology are ‘inescapable’ (Taylor, 2006b, p. 320) terms for understanding how knowledge is developed.

Philosophy influences research and ideas about the creation of knowledge (Taylor, 2006b). For example, a qualitative approach values subjectivity in the creation of knowledge; a quantitative inquiry values objectivity (Taylor, 2006b). Theoretical assumptions are influenced by philosophical traditions, not only in the qualitative/quantitative debates but also within qualitative research itself (Grbich, 1999).

The key issue is that the researcher chooses the most appropriate method (Schneider et al., 2007) that is in line with the ontological and epistemological perspective of the researcher. The actual methods chosen to answer the research questions (which some refer to as methodology) are discussed in the next chapter. However, the conceptual framework (or ontological world view which guided this study) was informed by a philosophical commitment to the principles of PHC including notions of empowerment, partnership and health promotion. The epistemology (or what might represent knowledge) was a subjective exploration of a gendered social world where evidence was sought from participants, in this case women, about their social reality.

**Quantitative and qualitative approaches to research**

In a very simplistic categorisation, the search for exploring and explaining human knowledge has been classified as two main inquiries/paradigms; qualitative and quantitative (see Table 3.2).
Table 3.2 A comparison of qualitative and quantitative approaches
(adapted from Schneider et al., 2007; Taylor, 2006b)

<table>
<thead>
<tr>
<th>Concept</th>
<th>Qualitative</th>
<th>Quantitative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Origins</td>
<td>Search for meaning; interactive</td>
<td>Search for truth; objective, controlled</td>
</tr>
<tr>
<td>Problem areas for research</td>
<td>Are part of the whole context</td>
<td>Are reduced to smaller parts</td>
</tr>
<tr>
<td>Beliefs</td>
<td>Humans are complex: meaning attributed to experiences</td>
<td>Humans are biopsychosocial beings with measurable components</td>
</tr>
<tr>
<td>Truth</td>
<td>Multiple subjective realities</td>
<td>Objective reality</td>
</tr>
<tr>
<td>Basis of knowing</td>
<td>Meaning</td>
<td>Cause and effect</td>
</tr>
<tr>
<td>Reasoning/knowledge</td>
<td>Dialectic, inductive</td>
<td>Logistic, deductive Absolute – about finding cause and effect</td>
</tr>
<tr>
<td>Research questions</td>
<td>Left open as tentative ideas</td>
<td>Hypothesised</td>
</tr>
<tr>
<td></td>
<td>Explored by a variety of means</td>
<td>Tested empirico-analytically</td>
</tr>
<tr>
<td>Setting</td>
<td>Uncontrolled, naturalistic</td>
<td>Experimental control</td>
</tr>
<tr>
<td>Researcher position</td>
<td>Active and interactive with participants</td>
<td>Uses measuring instruments (questionnaires)</td>
</tr>
<tr>
<td>Data elements</td>
<td>Words / language</td>
<td>Numbers</td>
</tr>
<tr>
<td>Validity/research conditions</td>
<td>Participants’ validation</td>
<td>Validity through control of variables</td>
</tr>
<tr>
<td></td>
<td>Attention to context</td>
<td>Reliability through test and retest</td>
</tr>
<tr>
<td></td>
<td>Values subjectivity</td>
<td>Objectivity without human distortion</td>
</tr>
<tr>
<td>Analyses</td>
<td>Interpretive – manually or use software</td>
<td>Statistical - use software</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Interpreted as mathematical relations</td>
</tr>
<tr>
<td>Outcomes</td>
<td>Often thematic, conceptual; not quantifiable</td>
<td>Measurable – reported in numerical terms</td>
</tr>
<tr>
<td></td>
<td>Description, meaning, change</td>
<td>Description, prediction, change</td>
</tr>
<tr>
<td>Findings</td>
<td>Are qualified in words</td>
<td>Are quantified in numbers</td>
</tr>
<tr>
<td></td>
<td>Absolute claims not made</td>
<td>Generalisable claims</td>
</tr>
<tr>
<td></td>
<td>Provide insights to possibilities</td>
<td>Need to be statistically significant</td>
</tr>
<tr>
<td></td>
<td>Are specific to local phenomena</td>
<td>Can be predictive</td>
</tr>
<tr>
<td>Clinical application</td>
<td>Exploration of experiences of individuals</td>
<td>Generalise findings to similar groups</td>
</tr>
<tr>
<td></td>
<td>Translation of findings to similar context</td>
<td></td>
</tr>
</tbody>
</table>

According to Schneider et al., (2007) the debates as to the superiority of either approach have reflected narrow and inflexible world views yet there is now a more “reasoned and enlightened approach that includes research collaborations between disciplines, an acknowledgement of the equal and important place of qualitative research, and the advent of ‘mixed methods’ research” (Schneider et al., 2007, p. 26).
Qualitative research is interested in questions that involve subjectivity and values humans in the research process (Roberts, 2002) (see Table 3.2). Qualitative researchers are interested in finding out information that is contextual (Roberts, 2002) and recognise that meaning is socially constructed by individuals within the context of their worlds (Merriam, 2002, p. 3). Reality is viewed as a “multi-faceted experience rather than as a single, fixed objective actuality” (Jackson & Borbasi, 2008, p. 155). Qualitative research is focused on exploring a range of human experiences but does not seek to establish cause and effect relationships. It represents a different philosophical view towards reality from the positivist or scientific approach (Jackson & Borbasi, 2008). It can add meaning to data collected on specific variables (such as levels of physical activity, the number of women who reported something). It can also add more than statistical significance.

Within a qualitative framework there is no single, objective truth (see Table 3.2). People have different experiences and there are different perspectives on phenomena. In terms of objectivity, qualitative researchers do not present themselves as neutral to the research project but recognise the influence of their own ideas, values and beliefs (Jackson et al., 2003).

The relationship between the researcher and the participant differs between the two approaches. Often a quantitative researcher may have no direct contact with the participant and objectivity and impartiality are fundamental concepts. Yet within qualitative research “participants are viewed as ‘knowers’; that is, they are viewed as having the knowledge that the researcher seeks to gain. This is because they have lived through the experience” (Jackson et al., 2003, p. 142).

Whilst there are differences between qualitative and quantitative approaches, both approaches must be systematic and rigorous in their designs and both approaches can use deductive and inductive thinking (Taylor, 2006b). If a researcher wants to do research where the rules of scientific research can be applied (see Table 3.2) then a quantitative approach is obvious. But if a researcher wants to ask questions about human knowledge; if they value people’s subjective experiences and if they want to do more than ‘observe and analyse’, then a qualitative approach is more applicable.

**A convergence of the two approaches**

Whilst there are obvious differences between qualitative and quantitative approaches to research, the approaches can also complement each other and some researchers have combined quantitative and qualitative data to come up with rich data and rich research outcomes (Taylor, 2006a, referring to Cox et al., 2003; Fitzgerald & Teale, 2003-2004; Gibson & Heartfield, 2003; Wit et al., 2004). Even though qualitative and quantitative methods are often presented as two different paradigms (as seen in Table 3.2), there is a move away from separate paradigm models to more of a “convergence” (Teddlie & Tashakkori, 2009) of the two approaches. Mixed methods research has emerged as an
alternative to the dichotomy of qualitative and quantitative traditions (Baum, 2002b).

Denzin & Lincoln (2005) remain critical of mixed methods design. They argue that this ‘movement’ removes qualitative methods from an interpretative framework and creates an inquiry characterised by dualistic categories of exploration and confirmation (Denzin & Lincoln, 2005, p. 9). Critics of mixed methods research have raised questions about what is being mixed, and how it is mixed – concluding that it is not possible to mix paradigms because they are incompatible with each other (Brannen, 2005; Sale et al., 2002 in Creswell, 2007, p. 305).

**Health promotion research and the suitability of a mixed methods approach**

Historically there has been a paradigm tension (Schneider et al., 2007) particularly in health research. Quantitative approaches have primarily been adopted within the fields of medicine, public health (and, to a lesser extent, health promotion) and qualitative approaches have been more evident within nursing, midwifery and the social sciences (including social work).

Even though health promotion research has developed over the past few decades, it is still at an early stage in terms of theoretical perspectives (Baum, 2002c). It encompasses a variety of disciplines and perspectives and is an “evolving and dynamic process” (Gillis & Jackson, 2002, p. 275). There is a broad range of questions in health promotion research and a “rich repertoire of approaches is required” (Gillis & Jackson, 2002, p. 280). Debates about methods for health promotion research have focused on traditional public health measures versus non-traditional measures (Gillis & Jackson, 2002), reflective of issues within the qualitative/quantitative debate (Creswell, 2009). The research design is guided by the research questions and objectives (Creswell, 2009). Surveys, focus groups and interviews can all contribute to health promotion research and, depending on the type of study, either qualitative and quantitative methodologies may be appropriate (Gillis & Jackson, 2002). Qualitative research is often used to explore the experiences of people and quantitative data allows generalisable conclusions to be formed about a population (Andrew & Halcomb, 2008). The statistical assumptions underpinned by randomisation and significance may be in conflict with the way health promotion research is actually undertaken (Gillis & Jackson, 2002).

Often mixed methods are very appropriate for health and health care research for the depth of insight that can be obtained (Mertens, 2005 cited in Andrew & Halcomb, 2008). The advantage of using a mixed-method approach is that the researcher does not have to be “constrained by pre-determined designs, but can creatively develop a research plan that will most effectively answer the specific research question that the study seeks to answer” (Andrew & Halcomb, 2008, p. 179).
This research

This research aimed to explore women’s experience of pregnancy and physical activity; how a diagnosis of GDM influenced a women’s life and some of the factors that influenced participation in physical activity during and after pregnancy. These factors were explored using a combination of methods. A qualitative subjective exploration of women’s experiences of GDM, pregnancy and physical activity and factors that influenced women’s participation in physical activity added insight to the collection of specific behavioural data (type, level and duration) on physical activity and attitudes towards physical activity.

Research method rationale: The contributions of quantitative and qualitative methods in a mixed methods approach

Mixed method research aims to build on the strengths and reduce the weaknesses of both qualitative and quantitative approaches (Andrew & Halcomb, 2008). Whilst a mixed methods approach is not suitable to answer every research question, no single theoretical perspective or method used in isolation is able to provide a complete understanding of a subject (Andrew & Halcomb, 2008, referring to Denzin, 2005). Thus, combined methods can allow a broad and flexible approach to address research questions. Mixed methods research is not necessarily better research but a particular approach to address the questions of the study (Brannen, 2004). Brannen (2004, p. 324) has suggested that if:

... the generation of knowledge is understood with reference to the procedures and processes involved in doing research as well as to the ideas that underpin the framing of the research questions, then the issues of two competing paradigms of qualitative and quantitative research recedes into the background. Rather, what is foregrounded is the purposes of social inquiry.

Guba & Lincoln (2005) support this point when discussing issues pertinent to various research paradigms and include both qualitative and quantitative approaches within constructivism and critical theory (Guba & Lincoln, 2005).

Defining mixed methods

Although debate in the literature remains, mixed methods has emerged as a separate orientation in the past 20 years (Teddlie & Tashakkori, 2009) and has been referred to as the third methodological paradigm, alongside quantitative and qualitative paradigms (Johnson & Onweugbuzie, 2004; Tashakkori & Teddlie, 2003 in Andrew & Halcomb, 2007; Teddlie & Tashakkori, 2009). It is based on a pragmatic world view leaving the researcher to make inferences across the qualitative and quantitative data (Creswell, 2009). Mixed methodologists are interested in both narrative and numeric data in their analyses (Teddlie & Tashakkori, 2009) (see Table 3.3).
A definition of mixed methods research that appeared in the first issue of the *Journal of Mixed Methods Research* defined mixed methods research as research used when an “investigator collects and analyzes data, integrates the findings, and draws inferences using both qualitative and quantitative approaches or methods in a single study” (Tashakkori & Creswell, 2007, p. 4).

Mixed methodologists advocate the use of whatever methodological tools are required to answer the research questions (Teddlie & Tashakkori, 2009). According to Creswell & Plano Clark (2007, in Creswell, 2009, p. 4):

Mixed methods research is an approach to inquiry that combines or associates both qualitative and quantitative forms. It involves philosophical assumptions, the use of qualitative and quantitative approaches, and the mixing of both approaches in a study. Thus, it is more than simply collecting an analyzing both kinds of data; it also involves the use of both approaches in tandem so that the overall strength of a study is greater that either qualitative or quantitative research.

Table 3.3 summarises the contrasting dimensions of the three methodological paradigms: qualitative, mixed methods, and quantitative.

**Table 3.3. Dimensions of the three research paradigms**
(adapted from Teddlie & Tashakkori, 2009, p. 22)

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Qualitative research</th>
<th>Mixed methods research</th>
<th>Quantitative research</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paradigms</td>
<td>Constructivism</td>
<td>Pragmatism</td>
<td>Postpositivism</td>
</tr>
<tr>
<td>Form of data</td>
<td>Typically narrative</td>
<td>Narrative plus numeric</td>
<td>Typically numeric</td>
</tr>
<tr>
<td>Purpose of research</td>
<td>Typically exploratory</td>
<td>Confirmatory plus exploratory</td>
<td>Often confirmatory plus exploratory</td>
</tr>
<tr>
<td>Sampling</td>
<td>Mostly purposive</td>
<td>Probability, purposive &amp; mixed</td>
<td>Mostly probability</td>
</tr>
<tr>
<td>Data analysis</td>
<td>Trustworthiness (dependability), credibility (confirmability), Transferability</td>
<td>Inference quality, Transferability</td>
<td>Internal validity, External validity</td>
</tr>
</tbody>
</table>

As briefly outlined above, the methodological approach to this research was informed by quantitative and qualitative considerations which led to a mixed methods research design. The next section discusses some of the major assumptions and key concepts that distinguish quantitative from qualitative theoretical frameworks which can also be categorised into positivist and non-positivist (naturalist) paradigms.

**Positivist and non-positivist (naturalist) paradigms**

Approaches (theoretical frameworks, conceptual framework) to research can be separated into quantitative and qualitative approaches and then further categorised as positivist (or quantitative) or naturalist (qualitative) paradigms. The advantages in dividing the approaches is that knowledge can be
systematically differentiated (Grbich, 1999). The disadvantage lies in the oversimplification of the approaches where the approaches tend be polarised (similar to the quantitative/qualitative divide). Differences tend to be simplistically emphasised rather than shared concerns and the complexity of each process can be overlooked. In actuality, both paradigms are often included in the same study (Grbich, 1999). Major assumptions within these paradigms are outlined in Table 3.4.

Table 3.4: Major assumptions within positivist and post-positivist paradigms
(adapted from Polit & Hungler, 1997, Table 1-1, p. 13)

<table>
<thead>
<tr>
<th></th>
<th>Post-positivist naturalist assumptions</th>
<th>Positivist paradigm assumptions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ontology</td>
<td>Reality is multiple and subjective, constructed by individuals.</td>
<td>Reality exists; there is a real world driven by real natural causes.</td>
</tr>
<tr>
<td>Epistemology</td>
<td>The inquirer interacts with those being researched and findings are the creation of the interactive process.</td>
<td>Inquirer is independent from those being researched; the findings are not influenced by the researcher.</td>
</tr>
<tr>
<td>Values</td>
<td>Subjectivity and values are inevitable and desired.</td>
<td>Values and biases are to be held in check; objectivity is sought.</td>
</tr>
<tr>
<td>Methodology</td>
<td>Inductive processes. Emerging interpretations grounded in participant’s experiences; flexible design; context-bound; emphasis on narrative information; qualitative analysis which seeks patterns.</td>
<td>Deductive processes; fixed design; tight controls over context; emphasis on measured, quantitative information; statistical analysis which seeks generalisations.</td>
</tr>
</tbody>
</table>

The positivist paradigm

The basic belief of positivism is that reality is driven by immutable natural laws (Guba, 1990). The positivist approach reflects a traditional scientific objective approach and is more representative of quantitative research approaches that seek to observe, test and predict causal relationships (Schneider et al., 2007). Deductive reasoning underpins this approach (Schneider et al., 2007) where reality is viewed as being external to the researcher (Grbich, 1999).

The principles of scientific inquiry in health research are rooted in positivism. The biomedical model has been often used as the method of inquiry in health research (Polit & Hungler, 1997) where objective systems of observations and measurement are used (Bowling, 1997). However, positivists are not concerned with measuring the meaning of situations to people because they cannot be measured in a scientific and objective manner (Bowling, 1997).
The scientific approach typically focuses on a relatively small portion of the human experience (such as weight gain or measures of obesity). In order to study phenomena within the biomedical model, the approach is to measure it, control or eliminate complexities (Polit & Hungler, 1997). Yet “the study of human beings is more complex than the study of physical or natural phenomena” (Bowling, 1997, p. 108). Qualitative methods within a naturalistic paradigm can potentially complement the collection of such specific behavioural data and provide rich insights into human behaviour and social processes (Bowling, 1997).

The post-positivist paradigm

Within post-positivism, the ontological assumption moves to a more critical view of realism (Grbich, 1999). Within this approach, knowledge about ‘reality’ is approximated, and is sought through rigorous approaches such as ‘grounded theory’ (Grbich, 1999). The researcher owns his or her predispositions so that adjustments to the findings can be made. Critical multiplisms are recognised within a methodological framework that is experimental or manipulative (Grbich, 1999). A post-positivist paradigm includes critical and interpretive approaches (Grbich, 1999).

Interpretive research

According to Denzin & Lincoln (2003), all research is interpretive; it is guided by a set of beliefs and feelings about the world and how it should be understood and studied. Each interpretive paradigm makes particular demands on the researcher, including the questions he or she asks and the interpretations the researcher brings to them. Interpretive research paradigms differ according to criteria, theory and type of narration.

Denzin & Lincoln (2000, p. 6) propose that qualitative research:

- as a set of interpretive activities, privileges no single methodological practice over one another. As a site of discussion, or discourse, qualitative research is difficult to define clearly. It has no theory or paradigm that is distinctly its own.

However, at a very general level there are four qualitative interpretive paradigms: positivist/post-positivist, constructivist-interpretative, critical (Marxist, emancipatory), and feminist-post structural (Denzin & Lincoln, 2000). In later work, Guba & Lincoln (2005) revised this interpretive paradigm drawing on the work of Heron & Reason (1997) and added the “participatory/cooperative paradigm” (Guba & Lincoln, 2005, p. 192).

Interpretive

The interpretive approach is the foundation of social research techniques (Neuman, 1991). Interpretive researchers seek to learn how individuals interact with their social world and attempt to make sense of things of interest (Roberts & Taylor, 2002). Interpretive research aims to explore, describe and generate meaning within a social or practice context (Elliott, 2003).
Unlike a positivist approach, the interpretive approach is sensitive to context, uses a variety of methods to understand social life and is more concerned with achieving an empathic understanding of feelings and world views than with testing laws of human behaviour (Schneider et al., 2007). Interpretive approaches occur within a naturalistic or constructivist paradigm where reality is not fixed but is constructed according to naturally occurring events and situations (Schneider et al., 2007). Neuman (1991, pp. 51-52) elaborates on the importance of context, stating:

For interpretive researchers, social reality is based on people’s definitions of it … Positivists assume that everyone shares the same meaning system; they take it as a given that we all experience the world in the same way. The interpretive approach says that people may or not experience social or physical reality in the same way. Key questions for an interpretive researcher are: How do people experience their world?

**Constructivists**

Constructivists are interpretive researchers and individual constructions of ‘social reality’ are their focus (Grbich, 1999). Constructivists see reality as relative; “realities exist in the form of multiple mental constructions, socially and experientially based, local and specific, dependent for their form and content on the persons who hold them” (Lincoln, 1990, p. 25). Subjectivity allows an exploration of constructions held by individuals. While this is so, Guba & Lincoln (2005, p. 196) have argued that “individual and collective reconstructions” can, at times, be grouped into commonly accepted realities. Creswell (2007) uses the term ‘social constructivism’ and suggests that, as a world view, this approach is often ‘combined’ with interpretivism where researchers seek understandings of the world (Creswell, 2007). The goal of this research is to rely as much as possible on the participants’ views of the situation and in terms of practice the questions are fairly broad so that participants can construct meaning of the situation (Creswell, 2007). The researchers’ intent is to make sense of what they find and the interpretation is shaped by their own experiences and background which is why all qualitative research is often called interpretive research (Creswell, 2007).

**Critical theorists**

A critical theorist sees an individual’s reality as “shaped by social, political, cultural, economic, ethnic and gender values” (Denzin & Lincoln, 1994, p. 109 in Speziale & Carpenter, 2003, p. 2). The aim of the critical approach is to “enable empowerment, emancipation and equality for research participants and to challenge and change social structures” (Schneider, 2007, p. 23). Feminist critical theorist researchers further believe that knowledge is “co-created by researcher and researched” (Speziale & Carpenter, 2003, p. 3).

The critical theorists, or as Lincoln suggests those who support an “ideologically oriented inquiry” (Lincoln, 1990, p. 23) reject the claim of value freedom of the positivists. The task of their inquiry is to raise people to a level
of “true consciousness” (Lincoln, 1990, p. 23) so that once their oppression is realised, transformation can occur.

A critical approach includes a critique of either (or all of) gender, class, race and economic structures and emphasises emancipatory outcomes (Grbich, 1999). Critical theorists are more interested in the social construction of people’s experiences which include material resources and power. Their research has transformative or emancipatory potential to be a catalyst for positive and empowering change (Jackson & Borbasi, 2008).

Post structural/postmodern theorists

Poststructural/postmodern theorists are also concerned with power, gender, oppression (as with critical theorists), and how these transpire through language, large institutions and other governing agents (Jackson & Borbasi, 2008). A researcher adhering to a postmodern or post-structural philosophy would question all aspects of the construction of reality including how it is organised and what it is (Merriam, 2002). A postmodern/post-structural researcher may critically examine context, power and language differentials in historical and current discourses (Grbich, 1999).

Main differences between interpretive and critical qualitative methodologies

Guba & Lincoln (2005) link knowing to emancipation arguing that what critical theorists and constructivists have in common is that knowledge of the social forms the basis of social change. They suggest that for both critical and constructivist approaches “transactional knowing is instrumentally valuable as a means to social emancipation, which [as] an end in itself, is intrinsically valuable” (Guba & Lincoln, 2005, p. 198).

The main difference between interpretive and critical qualitative methodologies relates to the researcher’s intentions and what he or she hopes to achieve through the research (Taylor, 2006b). Constructivist researchers aim to generate meaning and understanding whereas critical researchers aim to bring about a change in the status quo. Even though they can both generate meaning, they differ in the intensity of their intentions (Taylor, 2006a). This research was very much in line with an interpretive constructivist framework as it attempted to make sense of a myriad of factors that influence physical activity during pregnancy and women’s experience of GDM. As Neuman (1991, p. 51) has suggested, “for interpretive researchers, social reality is based on people’s definitions of it.” This research was interested in questions that involve subjectivity where information was contextual to a particular social reality. Subjectivity allowed for an exploration of the constructions held by individuals.

Surveys were used to collect objective data (on knowledge, behaviour and attitudes towards physical activity) which was measured objectively and presented statistically. These data enriched the qualitative data where women’s subjective experiences were valued and considered as knowledge of
a specific construct. Jackson & Borbasi (2008) have suggested that researchers aligned within the interpretive constructivist tradition seek an understanding of people’s experiences by asking people who have lived with that experience. This research asked women about their experiences of GDM, their views on physical activity in relation to pregnancy, lifestyle changes, and their perceived risk of developing Type 2 diabetes.

However, the theoretical perspective that framed the conceptual framework for this research was fused with concepts from other disciplines. Whilst an interpretive constructivist paradigm was the overarching paradigm, principles within health promotion, PHC and feminist principles underpinned this research. (Feminist principles underpinned the research process and are discussed separately in Chapter 4). The research was informed by concepts of empowerment, partnerships and a social view of health. These concepts reflect elements of critical social science and liberal humanism that is inherent in the philosophy of comprehensive PHC (Davis, 1998).

Key principles which underpinned the conceptual framework of this research are illustrated below in Figure 3.1.
These concepts complemented the basic ontology, epistemology and approach of a constructivist researcher who used mixed methods to answer the research questions. (The research methods are discussed in detail in the next chapter). The results, in the form of qualitative and quantitative data, were framed by these concepts but did not have a primary aim to bring about individual or group emancipatory change. Rather, the implications for health promotion interventions were framed by these concepts. The research was also framed by a strong commitment to PHC principles and health promotion, both of which incorporate a social model of health (see Figure 3.1). The women’s health movement also links to the PHC movement. A discussion of some of these concepts follows.
The social view of health and the women’s health movement

The primary care, biomedical model is still a dominant framework within the current health care system (Germov, 2002) despite recent PHC reforms within the medical system which aimed to incorporate PHC principles based on a social view of health into current medical practice (Australian Division of General Practice, 2005; Keleher, 2007c). This research informs a consideration of health promotion programs that are responsive to women’s needs.

Historically, there has been debate about the social construction of women’s health and how women’s health and health care needs have not been met within a dominant biomedical framework (Broom, 1991; Doyal, 1995; Martin, 1989). Women’s dissatisfaction with the medical care system led to the creation of separate women’s health centres, spurred on by a feminist women’s health movement (Baum, 2002b; Broom, 1991; Weeks, 1994). In 1989, the first National Women’s Health Policy (NWHP) was developed. A social view of health which recognised that one’s health is influenced by social, environmental, political, psychological and economic factors underpinned the philosophy of the women’s health movement and the first NWHP (Commonwealth Department of Community Services and Health, 1989). This social model of health incorporated the social and economic as well as the biophysical contexts of health status. Health was recognised to be more than the ‘absence of disease’ and influenced by factors outside of the health care system. The NWHP adopted a social view of health and called for action in several key areas including reproductive health and sexuality. This social view of health is in line with principles within feminism, PHC, and health promotion practice which have influenced the development of the conceptual framework and approach taken within this research (see Figure 3.1).

The social determinants of health

The term ‘social determinants’ of health became popular in the 1990s and replaced other terms (such as social view of health, social model) although the recognition of the social determinants in shaping people’s experience of health was not new (Keleher, 2007a). Social determinants have informed public health for several decades. The social determinants or factors influence individual, family and community health include political, economic, environmental factors, housing, socio-economic status, culture, education and employment (Keleher, 2007c), and the social construction of gender (Keleher, 2004). These factors can create pathways to health or illness and in order to create better health the factors can potentially be altered or influenced (WHO, 2005, p. 4 in Keleher & MacDougall, 2009).

Gendered health promotion

Keleher (2004) has argued for the consideration of gender both in terms of the social determinants of health and the consequent development of health
promotion programs. She has argued for a comprehensive approach that views gender and inequalities as a social experience and asserts much needs to be done in the area of health promotion in relation to gender (Keleher, 2004). Keleher (2004) asserts that social experiences primarily create gender differences and that gender distinctions go beyond biological or psychological differences between men and women. A comprehensive understanding of gender recognises that societal expectations, women’s reduced income, discrimination, power relations and social norms “shape so much of women’s experience, and the social, cultural and economic environment that shapes women’s opportunities” (Keleher, 2004, p. 278). These factors are frequently associated with disempowering experiences (Keleher, 2007a). Within a social determinants framework, gender is one determinant of health and a gendered perspective clearly recognises that women are not a homogenous group (Keleher, 2004). Women’s differentials in health vary according to their experience of violence, disability, ethnicity, culture, race, work and socioeconomic situation (Doyal, 1995). However, an examination of economic, social and cultural influences on women’s wellbeing can identify the major obstacles that prevent women from optimising their health (Doyal, 1995).

Whilst there has been research reporting the different patterns of physical activity between men and women (Ainsworth et al., 1993), the results of different health outcomes between men and women might be noted without an explicit examination of gender as a determinant of health (Kohl et al., 1998; Merom et al., 2006).

A gendered consideration of walking – one example of physical activity

As discussed previously very little research has been undertaken which explores gender as a determinant of health.

Kavanagh & Bentley (2008) explored the determinants of walking, an example of one type of physical activity and highlight many factors that influence a gendered consideration of this activity. They noted that these determinants (influences/factors) have been perceived at many levels: the individual level (e.g. socioeconomic circumstances); the interpersonal (e.g. social support, number of people in house); and perceived environment (e.g. perceived safety and spaces to walk) (Sallis et al., 2006 in Kavanagh & Bentley, 2008). Kavanagh & Bentley (2008) suggested that, like most public health research, studies on walking ignore gender. However, there are clear gender differences in the determinants of walking (as outlined above). The impact of motherhood; the gendered nature of domestic and household work; social support; women’s experiences of violence and concerns about safety may influence the type, location and duration of physical activity (Sallis et al., 2006 in Kavanagh & Bentley, 2008). Understanding gender as a social determinant of health offers the potential to design, plan and deliver appropriate health promotion programs and reduce inequity. “Health promotion’s agenda is so
much more than the ‘absence of disease’, because it is about opportunities and capacities” (Keleher, 2004, p. 278).

Whilst there is a substantial body of evidence about health, including global social perspectives and social determinants of health (Germov, 2002; Keleher & MacDougall, 2009; Sen et al., 2007) and health inequities (Blas et al., 2008), these understandings have not substantially translated into a gendered approach to health promotion. Health promotion planning and practice informed by an understanding of social determinants of health is an emerging knowledge base (Keleher, 2007a). At this stage, it is an area that is significantly absent from the literature.

Health promotion approaches that are directed at social changes and policy “are needed to ensure gender is not rendered an invisible determinant” (Keleher, 2004, p. 278) and need to reflect models that are empowering and encourage participation. Keleher (2007a) argues that “understanding the drivers for health and the unequal social conditions in which they are situated, is critical for the creation of health promotion road maps” (p. 48). Consideration of the social perspectives of health were also key drivers for the emergence of PHC as a social movement (Keleher, 2007c).

Primary health care

PHC is a philosophy, a set of activities, a level of care and a strategy (Nesbitt & Hanna, 2008; Talbot & Verrinder, 2005). The philosophy of PHC includes the overlapping principles of equity, empowerment, community self-determination, intersectoral collaboration (PHC Research and Information Service, 2008, referring to Keleher, 2001), health promotion, community participation and maximum self-reliance (Nesbitt & Hanna, 2008). An understanding of the social, economic, cultural and political determinants of health is fundamental to the PHC philosophy. Over the past two decades, there has been an increasing recognition by world leaders of the social determinants of health and given the widening gap globally between the rich and the poor, there has been a stronger emphasis on equity (McMurray, 2007).

Primary care is drawn from a biomedical framework and is usually provided by doctors and nurses within an institutional setting. It is sometimes referred to as primary medical care (Macdonald, 2004). It is primary care in that it is aimed at helping people with the problem requiring care (McMurray, 2007).

PHC is drawn from a social model of health and is based on a very different set of principles of care from a primary care biomedical model. PHC is based on social justice principles. Within a PHC systems approach, the practitioner is committed to building the skills of the individual so that their capacity for self-determination is developed (Keleher, 2001). The principles of PHC include “empowerment of people alongside efforts to help them be more self-
determining” (Keleher, 2001, p. 59) which links to self-reliance (Nesbitt & Hanna, 2008). Walker et al. (2005 cited in Nesbitt & Hanna, 2008) challenges health professionals to consider how they can empower their clients to make healthy choices.

The WHO’s blueprint for PHC advocated a comprehensive PHC approach to address a whole range of social and environmental factors that lead to poor health as well as approaches that sustain and promote good health (Nesbitt & Hanna, 2008). However, a modified approach to PHC developed not long after the Alma Ata conference; known as selective PHC (very similar to primary medical care). It was argued that the more comprehensive approach to PHC was unworkable (Macdonald, 2004, referring to Walsh and Warren, 1979). An important difference between selective and comprehensive PHC is that the former is more focused on medical intervention by health professionals. These interventions include immunisations, screening for diseases and childhood surveillance, through the primary care sector (Keleher, 2001). A comprehensive PHC approach includes an individual and population approach, with attention to intersectoral and multi-sectoral collaboration (Nesbitt & Hanna, 2008). Some of the essential elements of primary care, selective PHC and comprehensive PHC are outlined in Table 3.5.

**Table 3.5: Essential elements of primary care, selective PHC and comprehensive PHC**

(adapted from St John, 2007; Nesbitt & Hanna, 2008; Macdonald, 2004; McMurray, 2007)

<table>
<thead>
<tr>
<th>Element of care</th>
<th>Comprehensive PHC</th>
<th>Selective PHC (SPHC)</th>
<th>Primary Care/primary medical care</th>
</tr>
</thead>
<tbody>
<tr>
<td>Focus of care</td>
<td>Essential care/population focus</td>
<td>Illness focus</td>
<td>Disease prevention approaches; Illness focus</td>
</tr>
<tr>
<td></td>
<td>Prevention of illness with dual role of treatment</td>
<td>Medical intervention</td>
<td>Medical intervention</td>
</tr>
<tr>
<td>Care/management concerns</td>
<td>Concerned with management of health</td>
<td>First level of care might be ongoing care</td>
<td>First line of care concerned with management of disease – does not consider underlying cause of disease</td>
</tr>
<tr>
<td>Principles of accessibility, affordability, availability, acceptability</td>
<td>These principles explicit part of approach</td>
<td>These principles not explicit part of approach</td>
<td>These principles not explicit part of approach</td>
</tr>
<tr>
<td>Health professionals</td>
<td>Multi-sectoral collaboration</td>
<td>Medical interventions by health</td>
<td>Medical interventions by health professionals,</td>
</tr>
</tbody>
</table>
Primary care and pregnancy

In regional Australia, most pregnant women seek care from health professionals within a primary care model. They may see a general practitioner, a specialist doctor, another health professional (midwife, doctor, dietician) at an antenatal clinic. A diagnosis of GDM often means that women require more frequent monitoring and support (Hoffman et al., 2003). These health professionals are part of a selective primary health domain of care where the focus of care is medical intervention, with the potential for some health education (Nesbitt & Hanna, 2008). This model of care is usually set by time-restricted appointments and often the practitioners are very busy. Minimal follow up is common within a disease management focus. Even though the pregnancy has ended, there is still a need for lifestyle support postpartum, especially for women who experience GDM (Lee et al., 2007; Stage et al., 2004).

Health professionals are in control within this model and the client’s participation within selective PHC is as an “individual passive recipient” (Nesbitt & Hannah, 2008, p. 37). In contrast, within a comprehensive PHC approach, the focus of care is empowerment and the consumer has an input as a partner in care (Macdonald, 2004). Macdonald has suggested that medical care needs to “contribute to strategies to prevent the problem more upstream” (p. 286) and as such PHC must incorporate a public health approach. The extent to which health services were oriented towards PHC, health promotion and empowerment influenced the framing of this research (see Figure 3.1).

The new public health movement: The Ottawa Charter for Health Promotion

PHC is a strategy for public health. Its concepts were derived from the social model of health sustained by the Declaration of Alma Ata (Keleher, 2001) and further strengthened through the Ottawa Charter for Health Promotion and
other Charters and declarations of health promotion through research into the social determinants of health (Keleher, 2007c). Since the 1970s, these developments have been part of what is called ‘the new public health’ (Baum, 2002a; Keleher, 2007b; Talbot & Verrinder, 2005).

The Ottawa Charter for Health Promotion is regarded as the formal beginning of the new public health movement (Talbot & Verrinder, 2005). It was built upon the progress of the PHC movement and continued to both challenge the narrow approach of the biomedical model and advocate for a social model of health (Baum, 2002 in Nesbitt & Hanna, 2008). Public health has been concerned with the broader determinants of health (Baum, 2008).

The first international World Health Conference on health promotion was held in Ottawa, Canada in 1986 and the outcome of this conference was ‘The Ottawa Charter for Health Promotion document. Health promotion was defined as “the process of enabling people to increase control over, and to improve their health” (WHO, 1986). Similar to the Declaration of Alma Ata, the Ottawa Charter for Health Promotion was a significant document (Talbot & Verrinder, 2005; Patterson, 2007) and remains a “blueprint for health promotion” (Patterson, 2007, p. 143). In the Charter, the commitment to PHC and health promotion was reaffirmed and it was also based on a clear commitment to the social view of health (Baum, 2008). The Ottawa Charter for Health Promotion reflected frustration with the limitations of the lifestyle and behavioural approaches that became increasingly prominent during the 1980s (Keleher & MacDougall, 2009a).

A new era in public health

Subsequent international conferences on health promotion (WHO, 1997, 2000, 2005) have built on the action areas of the Ottawa Charter for Health Promotion, which set the benchmark for health promotion.

However, the Ottawa Charter for Health Promotion was seen conceptually as a new era in public health (Talbot & Verrinder, 2005). The charter was subtitled ‘The move towards a new public health’ and has been the dominant influence over health promotion to this day (Richmond, 2002). Baum (2008) has asserted that its claim to be ‘new’ arose because of the “way it pulled together numerous and diverse movements to present a package that gave public health a more radical and cohesive direction” (p. 36). The Ottawa Charter did not “emerge in a vacuum” (Baum, 2008, p. 36) but according to Baum (2008) cleverly built on a number of 20th century social and health movements including feminism, the green and consumer movements and community development approaches.

The new public health and the social view of health

Within the ‘new’ public health movement, the role of medical and behavioural interventions were seen to be limited because of the inability of such interventions to bring about equitable outcomes between groups and populations (Talbot & Verrinder, 2005, p. 10). A social view of health was
embraced in the Charter which recognised the multiplicity of factors that influence and promote health and well-being. It moved away from an individual, biomedical focus and responsibility. Talbot & Verrinder (2005, p. 10) further state that: “[T]he social model of health sets very wide parameters for health promotion practice. This is very exciting because it means we can actually start dealing with health problems at their point of origin.”

Also termed a social determinants view of health, the social view of health (Keleher & MacDougall, 2009b) recognises that the causes of ill-health are linked to social context, social stratification, the differential exposure people experience and their vulnerability to health and injury (Baum, 2008). Furthermore, the social model of health as practised now is expressed in social-ecological models of health care which is concerned with social inequalities, community engagement and participation, and empowerment of individuals and communities (Keleher, 2007c).

The social view of health summarises the philosophy within this new public health and separates it from an approach to health that has been dominated by medicine (Baum, 2008) (and reflected within a primary care model of health care). This new public health movement embraces health promotion and PHC as key strategic areas within the health sector.

Within the Ottawa Charter for Health Promotion five key action areas for health promotion were outlined (WHO, 1986):

- Building healthy policy;
- creating environments;
- strengthening community action;
- developing personal skills and;
- reorienting health services.

The two action areas that are most applicable to this research are developing personal skills and reorientating health services. However, another fundamental component of the Ottawa Charter for Health Promotion was the focus on “conditions and resources for health” which were drawn from the Alma-Ata Declaration on PHC (WHO, 1978 in Keleher & MacDougall, 2009b). These components also frame this research.

**Developing personal skills – enabling and empowerment**

The Ottawa Charter calls for action from those who work in health to enable the development of personal skills (WHO, 1986). The provision of information, health education and the enhancement of life skills support, enables people to have more control of their health and their environment and to make informed choices about their health (WHO, 1986). Personal skills that enable people to make healthy choices are affirmed within the Charter and those associated with community organisations are called to analyse individual problems within a structural framework (Baum, 2008). The Ottawa Charter stresses the importance of enabling people to achieve their full health
potential (Baum, 2008). Unless people are able to take control of the things that determine their health which requires knowledge about ways to achieve this, people will not be able to achieve their fullest health potential (Keleher & MacDougall, 2009a).

Health promotion is based on the principle of empowerment and is linked to the concept of ‘enabling’ (Keleher, 2007b). As stated by Keleher (2007b, p. 16):

health promotion is about assisting people to take control of the factors influencing their health; and for that to be possible practitioners need a solid understanding or people’s experiences of everyday life, of the social factors that contribute to those experiences, including the systemic influences.

In practical terms, health practitioners need to develop practice that is based on an empowering partnership approach towards working with people (clients/patients) (Keleher, 2007b). Health professionals have a key role in assisting people to develop and increase their knowledge and skills and are “catalysts for the development of appropriate resources in the community” (Keleher, 2007b, p. 24).

The notion of empowerment underpinned the philosophical considerations of the research (see Figure 3.1). An exploration of pregnancy and physical activity during pregnancy, the role of physical activity as a way to manage GDM, and physical activity as a lifestyle issue following the birth of the baby were linked to promoting and supporting women’s health. Pregnancy is a point in women’s lives when women frequently engage with the health care system, and more so if the pregnancy is complicated by a diagnosis of GDM. It is an opportune time for health promotion, especially in relation to physical activity and a consideration of factors that enable this behaviour to occur is important. Attention given by health professionals to physical activity, health and healthy lifestyles may help to enable women achieve improved health in the short and longer term.

Reorienting health services

The Ottawa Charter highlights the role of individual behaviours and skills as well as the role of organisations, systems and communities in promoting health (WHO, 1986). The Ottawa Charter calls for a reorientation of the health system towards a focus on health (Keleher, 2007b) and highlights the need for the education of health workers to incorporate a holistic approach to health. A better balance between curative and clinical services and health promotion activities and a move towards a health promotion direction is needed (WHO, 1986). Health promotion in practice can be narrow or broad (Richmond, 2002; Talbot & Verrinder, 2005). Interventions can be focused at the individual level or be much more expansive to encompass legislation, community programs and bureaucratic interventions (Richmond, 2002). A reorientation towards health is the responsibility of many sectors.

Through the experiences of the women participants, this research sought to explore the health promotion role of health care professionals who supported
women during pregnancy. The ways in which women were supported to engage in physical activity following a pregnancy complicated by GDM were also investigated. This is a fundamental issue because women who develop GDM are at risk of developing Type 2 diabetes and there is a clear health promotion role in relation to supporting women to reduce their risk factors and to achieve optimum health.

**Measuring the outcomes of health promotion**

Within the various charters for health promotion, attention is drawn to the complexity of health promotion. Whilst the goal of health promotion is to improve health and to empower people to have greater control over their health, it is difficult to measure outcomes. Nutbeam (1998 cited in Patterson, 2007) has suggested that measuring health literacy is one way to assess the achievement or success of the outcomes of health promotion initiatives. Indicators of health literacy include knowledge, self-efficacy, self-empowerment, attitudes, future plans and involvement in planning and implementing health promotion programs (Nutbeam, 1998 in Patterson, 2007).

According to Patterson (2007, p. 151), this translates into assessing the following factors at an individual level:

- how well a person understands the determinants of his or her own health;
- how motivated he or she is to change to and/or maintain behaviours conducive to health;
- how much of today’s lifestyle is an investment in tomorrow’s health; and
- how much he or she participates in health promotion programs.

People with low levels of health literacy are usually those who experience other socioeconomic disadvantages, as McMurray has stated (2007, p. 19):

> Being unaware of information relevant to improving their health, or how to access health resources creates higher levels of disadvantage. For some people, a lack of education and the health literacy that would flow from education, prevents them from becoming empowered at any time during their lives.

Furthermore, measuring health literacy assumes in part that health messages have been communicated by health professionals. The provision of information by health professionals about the beneficial role of physical activity during pregnancy, and for women who develop GDM, information about physical activity that would help them to ameliorate their risk of developing Type 2 diabetes postpartum were explored in this research.
Health education and health promotion approaches

Health literacy is linked to empowerment and assisting people to develop personal skills through health education. Primary disease prevention that is concerned with health risks might include some form of opportunistic education to encourage the client towards better health (Wass, 2000 in Keleher, 2001).

Health education and health promotion have changed since the WHO Charters and, according to Keleher (2001, p. 58), health education has made a conscious shift from instruction to the facilitation of learning (referring to Davies et al., 2000). Moving away from traditional biomedical approaches, health education methods have moved towards achieving social change (Keleher, 2001) as opposed to delivering lifestyle messages and expecting people to change accordingly (McMurray, 2007). Richmond (2002) described the two polarised approaches to health promotion. At one end of the health promotion spectrum is a more conservative, individualistic health-promotion (IHP) approach, which targets individual risk-taking behaviours, mainly through education about lifestyle. The negative side to this is the tendency to victim-blame if lifestyle changes are not adopted (Richmond, 2002). Within a primary care framework, the focus of an intervention is on the individual. During pregnancy this can mean a very (albeit important) clinical focus. Risk factors (such as lack of physical activity), if explored at all in a health promotion context, can be seen as the result of poor lifestyle choices (Germov, 2002) and the social context of health and illness can be ignored. At the other end of the health promotion spectrum is a more structuralist-collectivist health promotion (SCHP) approach that encompasses a wide range of interventions (Richmond, 2002). According to Richmond, most health promotion in Western countries such as Australia has continued to be very narrowly focused around educating people to change their lifestyles. According to Richmond (2002), there has to be a meeting point of the two approaches where minimum empowering partnerships are developed.

Health promotion involves “enabling the conditions for healthy choices and ensuring that support systems are available to help people achieve the level of health to which they aspire” (McMurray, 2007, p. 39). As stated by Marmot (2005, p. 1103, cited in McMurray, 2007, 39) “if we know that the major determinants of health are social, so must be the remedies.” Keleher (2001, p. 58, referring to Wass, 2000) echoes this sentiment in relation to health education and suggests that “practitioner commitment to working with people in partnerships to help them change the things around them that are making them sick” (Keleher, 2001, p. 58) is needed.

Health education/’education for health’

The term ‘education for health’ reflects more of a health promotion focus and aims to empower people so they can exercise more control over the factors
that determine their health – especially the social determinants (Northern Territory Government, 2007). Education for health aims to:

- foster the motivation and confidence necessary to make decisions and take action to improve health;
- provide information about the underlying social, economic and environmental conditions impacting on health;
- enable people to take more control over their health;
- help people to reflect on their experiences and aspects of life that affect health; and
- help people acquire the skills needed to take action (Northern Territory Government, 2007).

Conclusion

Interpretive constructivist research was the methodological framework of this research which utilised mixed methods in order to answer the research questions. However, the research was informed by a commitment to PHC and health promotion (see Figure 3.1). Women’s health is viewed within a social context with an explicit consideration of the gendered social determinants which influence health, illness and lifestyle. Strategies to achieve health promotion as outlined in the Ottawa Charter for Health Promotion: developing personal skills, reorienting health care towards health, and developing partnerships framed the discussion of the findings and the research implications and recommendations. Education for health is one way health professionals can contribute to enabling women to take control of their health and their lives. Empowerment is a fundamental consideration within PHC and health promotion, theory, practice and research. In summary, this interpretive constructivist health promotion research was informed by PHC principles in the context of women’s health. While it is acknowledged that the ideologies inherent in the conceptual influences reflect elements of critical theory, the research intention was not the achievement of social emancipation or transformation. However, it is acknowledged that knowledge and understanding (Guba & Lincoln, 2005), either gained through a reflective process, or through health education, can enable, together with the other strategies of health promotion, the process of empowerment.

The next chapter explores in more depth the mixed methods used in this research. Stages of the research, research processes, instruments and the ethical context of the research are also discussed.
Chapter 4: Methods
Introduction

This chapter builds on the brief discussion of mixed methods design that was raised in the previous chapter. The appropriateness of choosing a mixed methods approach in relation to the research questions, the philosophical underpinnings of the study, and the advantages of using mixed methods in the emerging discipline of health promotion research are discussed. The chapter begins with a discussion of the feminist principles that influenced the research process. As discussed in the previous chapter, the methodological framework was influenced by principles of PHC whilst feminist principles influenced the way the research was undertaken in terms of the research process. An overview of the mixed methods research design and the three stages of the research are discussed. Recruitment of participants, ethics approvals, the development of research instruments, and key issues surrounding data analyses are described.

The influence and inclusion of feminist principles within the research process

Glass (2000) has identified the links between political action and social change. Consistent with constructivist research, my own values and beliefs that influenced the research design and processes are required to be revealed in an open and transparent way.

Referring again to Glass (2000, pp. 368-369), feminist research principles are outlined below in headings; with examples of the way these principles were included in the research. Although the principles discussed are obtained from one source only (Glass, 2000) they are common and fundamental feminist principles echoed by other feminist scholars, especially in relation women’s health (Boston Women’s Health Book Collective, 1984; Broom, 1991; Broom 1992; Hunt, 1994; Commonwealth Department of Community Services and Health, 1989; Weeks, 1994, Shaw & Tilden, 1990) and women’s health research (Oakley, Brown & Doran, 1996; Baum, 2002a; Roberts, 1986). Empowerment (Douglas, 1992: Weeks 1994); recognising that ‘the personal as political’ (Douglas, 1992; Frow & Morris, 2003); research that is clearly beneficial for women where women’s voices and experiences are explicitly acknowledged (Oakley, 1986; Bryman, 2004); equality in terms of the power dynamics between the research and the participants are key to a research process or research that is based on feminist principles (Roberts, 1986) which has also been described as feminist research practice (Maynard, 1998 in Bryman 2004).

Principle: A focus that is always on transforming and empowering the women involved.

The importance of women’s experiences was acknowledged in all interviews. Within all the surveys, space was provided for women’s written comments. Women’s individual experiences of GDM, pregnancy and physical activity
were discussed within a broader social context (especially lifestyle practices) and related to support systems; the opportunities available or not available to them (e.g. for physical activity); and factors that helped or hindered women (particularly relating to diet and physical activity). This was an empowering process in that it was a validation of women’s experiences contextualised within a broader social context. While this outcome was not the main focus of the research, Opie 1992 (in Grbich, 1999, p. 55) has contended that women can be empowered through “their contribution to the issue under research, [and] through the process of reflection and evaluation of their own experiences.”

**Principle: Efforts to validate women’s stories and engage in research ‘with’ women, not ‘on’ women.**

Interviews were arranged to suit the women in terms of time, day and place. The focus groups and semi-structured interviews were designed to be more conversational rather than a series of questions and answers that were driven by the researcher which would prohibit the development of a trusting relationship. Women were given the opportunity to be informed of the results of the research. After each stage of survey completion, women were sent thank you letters and their contribution was acknowledged.

**Principle: Building relationships based on mutual respect where women’s knowledge is valued.**

The researcher stressed to the women how valuable their experiences were to the study and also how significantly their information contributed to the body of knowledge in the area.

**Principle: Power relationships are equalised as the researcher shares information about herself.**

This was not possible in the surveys. However, where appropriate, during the interviews, the researcher did reveal personal information about herself related to physical activity, the experience of mothering and pregnancy, her background and interest in the topic, and views on health promotion.

**Principle: Awareness of and sensitivity to data collection about women’s lives is paramount.**

The researcher was committed to respecting women’s stories and experiences. Data collection was organised so that women were in the most amenable environment for speaking about their lives. Women were advised that all the information was confidential. At the end of one interview, the woman spoke of her marital problems. The researcher reassured her that this information was confidential and the tape recorder was turned off. A discussion about community resources/support and possible referral ensued.

**Principle: Research undertaken has benefits for women.**

In choosing a topic to investigate, an important consideration was that it would potentially be of benefit to women and have practical implications.
related to health promotion interventions. Women in the research were advised that the long-term results of this research would be used to inform the design of health promotion programs that would clearly benefit women. The ensuing discussion relates to the mixed methods used in the research.

**Mixed methods used in this research**

A mixed methods approach was used in this exploratory research. Qualitative interviews and focus groups were combined with quantitative survey data collection. As discussed in the previous chapter, the methodological framework was constructivist which is typical of a qualitative paradigm. However, the research was undertaken with pragmatic intention and therefore a practical commitment to health promotion and the principles of empowerment and partnership that underpin PHC.

A quantitative research orientation allowed for the collection of objective, numerical data. An objective snapshot of women’s activity levels was complemented with the collection of subjective data. Reality is complex and diverse (McMurray et al., 2004) and combining methods has the potential to add depth and provide a richer understanding of the subject matter (Halcomb & Andrew, 2005 in Andrew & Halcomb, 2008).

Combining the methods was the most suitable way to explore behavioural patterns of physical activity and to explore women’s views on physical activity during and after pregnancy and the factors that influenced participation in physical activity, especially for women who experienced a pregnancy with GDM where lifestyle changes were necessary.

The study started with focus groups to explore the subject of pregnancy, physical activity and gestational diabetes. The findings were used to develop quantitative research instruments which is typical of a sequence when the purpose of adopting a mixed methods approach is “development” (Polit & Beck, 2000, in Andrew & Halcomb, 2008). Qualitative and quantitative data were also used to enhance the meaningfulness of findings (Andrew & Halcomb, 2008). For example, women reported their levels and physical activity behaviour, or their reaction to a diagnosis of GDM in the surveys. Interviews enabled a more in-depth exploration of some of the issues and were able to complement the survey data (Andrew & Halcomb, 2008).

The combination of numerical and narrative data enabled confirmation of the emergent themes and results. Sampling was mainly purposive. Issues of dependability/credibility, confirmability, transferability, and inference are discussed further in this chapter.

**Classifying the four stages of a mixed methods research design**

According to Creswell (2003 in Andrew and Halcomb, 2008), mixed method designs can be classified according to the implementation sequence of qualitative and quantitative methods, the priority given to each method, the stage at which the data are integrated, and whether a theoretical perspective guides the research process.
**Stage 1: Implementation sequence**

The approach to employing mixed methods in this study was aligned to a sequential mixed method design, that is where the findings from one type of data collection provide the basis for the second set of data collection (Creswell, 2009). Within a sequential design, stages of data collection usually occur one after another. The first stage usually informs the subsequent data collection and both data sets inform the final study results (Andrew & Halcomb, 2008). The research questions for the qualitative and quantitative phases are related to each other and may evolve as the study unfolds (Teddlie & Tashakkori, 2009). There were three stages of research in this study and the findings from one stage informed the next stage of data collection. This sequential approach differs from a concurrent approach where qualitative and quantitative data are collected at the same or nearly the same time (Andrew & Halcomb, 2008).

In this research, two different sets of data were employed to address different but complementary aspects of the investigation. Qualitative data were used to understand the experience of GDM and explore the social processes related to pregnancy, physical activity and GDM. Quantitative data were employed to examine associations and their statistical generalisability. However, it was not the intent of the research to generalise to a wider or ‘parent’ population (Hammersley, 1996 in Brannen, 2004, p. 314) and statistical analysis was only applicable to the study participants.

**Stage 2: Priority**

The priority given to qualitative or quantitative methods of data collection was informed by the aims of the research. As the aims of the study were exploratory, the qualitative method was initially given the higher priority because there was limited knowledge of the issues (Andrew & Halcomb, 2008). However, as suggested by Bryman (2001, in Brannen, 2004), these distinctions are not always possible since in practice it may be difficult to identify which approach is more prominent. As the study progressed, the distinctions as to which method was more prominent were not as clear because each method yielded valuable data. On the value of this outcome, Denzin & Lincoln (2005) make the following point. They suggest that the trap of ‘methodological hierarchy’ is a potential risk when deciding on a mixed methods design, and that care needs to be taken in order to avoid favouring the “technocratic aim” of quantitative methods (p. 9). For example, data from the initial interviews were integrated with data from the results of the surveys to inform the development of the final stage of the research which involved in-depth individual interviews with women who had experienced GDM. The data sets (from the first two stages of the research) were mixed and informed the development of questions to guide the interviews (in the third stage of the research) to enable particular issues to be explored in more detail or to gain missing information. Each research stage is discussed in the next section of this chapter.
Stage 3: Integration

Integration relates to the stage when the qualitative and quantitative data sets are mixed (Andrew & Halcomb, 2008) which can occur at virtually any stage of the research process (Creswell et al., 2003 in Andrew & Halcomb, 2007, p. 149). In this study the responses to the quantitative questions (e.g. types and levels of physical activity) were combined with responses to qualitative questions (e.g. reasons for changes to physical activity levels, and attitudes towards physical activity).

Whilst the choice of methods is generally shaped by the research questions, Brannen (2004, p. 313 referring to Heshusius, 1996) suggests that justification of the process of using mixed methods warrants consideration because different types of data ”cannot be unproblematically added together in the context of justification to constitute a single truth or rounded reality” (Brannen, 2004, p. 314). Qualitative and quantitative data, whilst complementary, are not necessarily compatible (Brannen, 2004, p. 313 referring to Denzin, 1970). It is not acceptable to simply integrate the methods at the end of the data collection to strengthen the results (Andrew & Halcomb, 2008). In this study, data from each stage were integrated and informed the development of subsequent stages.

Stage 4: Theoretical perspective

A theoretical perspective can be used either implicitly or explicitly to guide the study (Creswell, 2003 in Andrew & Halcomb, 2008). Research methods are determined by the overall methodological orientation of the mixed method researchers (Teddlie & Tashakkori, 2009). This research was guided by an overall theoretical perspective (as discussed in the previous chapter).

The research design and overview of the stages of the research

The mixed methods design evolved from the research questions. The research design had three stages. Stage one was an exploratory stage of physical activity, pregnancy, GDM and lifestyle. Data were collected through focus groups and individual semi-structured in-depth interviews. Data analysis from this stage then informed the second stage of the research, the quantitative stage in which two surveys and a physical activity diary were developed and implemented. In the final stage of the research, semi-structured in-depth individual interviews were conducted with women who had developed GDM. Table 4.1 presents a brief summary of key aspects of the research. Each stage is then discussed in greater detail.
Table 4.1: Research process
(adapted from McMurray et al., 2004)

<table>
<thead>
<tr>
<th>Stage 1: Qualitative</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial exploration of the topic</td>
<td>Data collection method</td>
<td>Analysis and development of instrument</td>
</tr>
<tr>
<td>Stage 1.1</td>
<td>Focus groups</td>
<td>Thematic data analysis</td>
</tr>
<tr>
<td></td>
<td>With pregnant women</td>
<td>Data used to develop questions for GDM survey; pregnancy and physical activity survey (Pilot test of surveys and diary)</td>
</tr>
<tr>
<td></td>
<td>With high risk groups of women for developing GDM</td>
<td></td>
</tr>
<tr>
<td>Stage 1.2</td>
<td>Interviews with women who developed GDM</td>
<td></td>
</tr>
<tr>
<td>Stage 1.3</td>
<td>Semi-structured interviews</td>
<td>Thematic data analysis</td>
</tr>
<tr>
<td></td>
<td>With women in Tonga who developed GDM</td>
<td></td>
</tr>
<tr>
<td></td>
<td>With health professionals in Tonga who worked in GDM &amp; diabetes area</td>
<td></td>
</tr>
<tr>
<td>Stage 2: Quantitative</td>
<td>Data collection on physical activity and GDM</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Data collection method</td>
<td>Analysis</td>
</tr>
<tr>
<td></td>
<td>Survey on pregnancy and physical activity (PPAS)</td>
<td>Quantitative data analysis (SPSS)</td>
</tr>
<tr>
<td></td>
<td>Survey on GDM (GDM Survey) 7-day physical activity recall diary</td>
<td></td>
</tr>
<tr>
<td>Stage 3: Qualitative</td>
<td>In depth interviews with Australian women who developed GDM and had completed the surveys</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Data collection method</td>
<td>Analysis</td>
</tr>
<tr>
<td></td>
<td>In-depth exploration of GDM</td>
<td>Thematic data analysis</td>
</tr>
<tr>
<td></td>
<td>Explore some of the results from the GDM surveys</td>
<td></td>
</tr>
</tbody>
</table>

Methods used in each stage of the research

Stage 1: Exploratory stage
This stage consisted of:

Focus groups: Four groups with 17 women in total;

Semi-structured interviews with two women who experienced GDM in Australia; and

Semi-structured interviews with 11 women who experienced GDM and 10 health care professionals in Tonga.
**Focus groups**

In the beginning stage of the research, four focus groups were undertaken. Pregnant women, especially those who had a high risk of developing GDM were the target group. Indigenous women and women from the Pacific Islands were specifically targeted because they have a high risk of developing GDM (The Royal Australian and New Zealand College of Obstetricians and Gynaecologists, 2006). Focus groups were held at the university, in a community hall, at the Indigenous health centre and one in a private home.

**Recruitment of participants: Sampling approach**

Most of the participants of the focus groups were recruited from northern NSW. One group was recruited from southeast Queensland. A convenience sampling approach was undertaken to recruit pregnant women, including those who had experienced GDM.

It was problematic to gain access to antenatal or postpartum support groups for Indigenous women and women from Pacific Islander backgrounds without having networks with the community. Gaining access to ATSI populations can be problematic (Hecker, 2008; Humphery, 2003). As such, for populations at a high risk of developing GDM, a snowball technique of sampling to recruit Indigenous women and women from Pacific islander background, using word-of-mouth and networks was specifically used as this is often the only way to locate an nearly ‘invisible’ group or people who fit certain criteria (Grbich, 1999).

**Focus group numbers**

The groups ranged from three to five members. The smallest focus group was the one that relied solely on advertising. According to McMurray et al. (2004, p. 203) the ideal number for a focus group is seven to 10 people, yet smaller groups of four or five people can be used, especially when people gather in someone’s home. The range of ideas is broader with more members (McMurray et al., 2004).

**Participants**

**Pregnant women**

Advertisements were placed in local papers inviting pregnant women, particularly those who had experienced GDM to attend the focus groups in northern NSW. Information was sent to the co-ordinator of an antenatal group who informed pregnant women of the focus groups. A key person from the local women’s health centre who co-ordinated another pregnancy support group recruited the participants to one group.

**Women with a high risk of developing GDM: Pacific Islander women**

It was difficult to gain access to women from a Pacific Island background. Local community and health networks were explored with little success. The Australian Consulate for Pacific Island people was contacted and the name of a key Western Samoan woman who lived in southeast Queensland was given
to the researcher. Contact was made with this woman who was supportive of
the study. She organised a focus group and invited women from a Western
Samoan background to attend the group which was held at her own home.
This particular catchment area in southeast Queensland had a high number of
people from Pacific Islander backgrounds in residence (Queensland
Transcultural Mental Health Centre and Multicultural Centre for Mental

Aboriginal and Torres Strait Islander women

Links with an Indigenous health service in northern NSW were developed
and a key contact within the organisation invited women to participate in a
focus group. However, not all women who attended this group were
Indigenous women.

Ethics

Ethics approval for the study was obtained from the Southern Cross
University (SCU) Human Ethics Committee in March 2005. Participants were
asked to sign a consent form and provided basic demographic information
(age, number of children/pregnancies, number of pregnancies with GDM,
ethnicity) (see Appendix 4.1).

The focus group process

Women’s attitudes, beliefs, behaviours and factors that influenced
engagement in physical activity before, during and after pregnancy were
explored with all focus group participants. Women who had had GDM
discussed the experience of GDM, if and how it changed their lifestyle, how
the GDM was managed, any changes that were made to physical activity
levels, and their perceived risk of developing future Type 2 diabetes.

According to McMurray et al. (2004, p. 204) “good questions are critical to the
effectiveness of focus groups.” A question guide was developed and used to
ensure all questions were explored (see Appendix 4.2). The focus group
interview was tape-recorded and the researcher took notes. The length of the
group interviews ranged from 50 to 90 minutes. Refreshments were provided.

Interviews with women who experienced GDM in Australia – pilot for GDM
survey development

Two non-Indigenous women with a recent experience of GDM who did not
participate in the focus groups were interviewed. These interviews informed
the development of the GDM survey. Women were referred to the researcher
by a health service worker. Individual interviews allowed a more in-depth
exploration of women’s views regarding pregnancy, lifestyle and physical
activity. A change of the initial SCU Ethics protocol to interview individual
women with GDM was approved in 2005 (see Appendix 4.3). Interviews were
conducted in the participants’ homes. Interviews were guided by questions
(see Appendix 4.4).

The results of focus groups have been published (see Appendix 4.5).
Semi-structured interviews with 11 women who experienced GDM and 10 of their health care providers in Tonga

Women at high risk of developing GDM

The second part of the exploratory stage of the research examined key issues relating to GDM with women who were at a high risk of developing GDM since this was a key objective of the research.

Risk factors are common to all high-risk groups of women and include obesity, family history of diabetes, age, and cultural background. Pacific Islander women are a particular group of women at high risk of developing GDM, so women from the Kingdom of Tonga were recruited. The incidence of GDM in Pacific Islander women is estimated to be about 20% which is more than double the incidence for Anglo-Australian women (Australian Institute of Health and Welfare, 2003; Foliaki & Pearce, 2003). Diabetes in the Asia-Pacific region is epidemic (Cockram, 2000) with rising prevalence rates closely related to westernisation, urbanisation and mechanisation (Cockram, 2000).

Cultural changes in Tonga have had significant negative health consequences in Tonga and have contributed to the high incidence of diabetes including GDM. Reductions in physical activity, changes to diet and subsequent increased rates of obesity have contributed to an increase in lifestyle diseases (Cockram, 2000; Evans et al., 2001) including diabetes which is epidemic in the Asia-Pacific region (Cockram, 2000). Over the past twenty years in Tonga, changes to diet have included an increased consumption of imported foods with high sugar and fat content, an increased consumption of carbohydrates and traditional healthy foods eaten less (Evans et al., 2001). Many cultural shifts in terms of dieting have been driven by economics (Evans et al., 2001). An increased consumption of less-healthy foods has been found to be associated with cost and availability, despite educational programmes in Tonga to increase awareness about healthy diets and nutritional foods (Evans et al., 2001). The prevalence of chronic diseases including diabetes is predicted to increase exponentially in Tonga and strategies are urgently needed to combat the effects of these lifestyle diseases (Hufunga & Bennett, 2007).

Because of the high rates of diabetes and GDM in Tonga; high rates of obesity and lack of physical activity; risk factors for GDM, women from this Pacific Island were recruited. Furthermore, the researcher had previously lived and worked in a health clinic in Tonga and one of the PhD supervisors had undertaken consultancy work with the Tongan Ministry of Health. These experiences were beneficial in terms of familiarity with the country and culture which was advantageous in terms of seeking support to undertake research in Tonga.
**Ethics**

Ethics approval to undertake research with women in Tongan women who had developed GDM in the previous 12 months and their health care providers was granted in 2005 from the Ethics Committees from SCU, NSW (see Appendix 4.6a) and from the Tongan Ministry of Health (see Appendix 4.6b). A condition of the ethics approval in Tonga was that the researcher work closely with a Tongan counterpart, a specialist obstetrician and gynaecologist from the main hospital in Tonga. The research was undertaken in Nuku’alofa, the capital of Tonga.

**Recruitment**

The Tongan counterpart purposively recruited the participants for interview and organised the interviews with women who had experienced GDM.

By phone, the counterpart contacted 40 women who had developed GDM in the previous 12 months and attended the main hospital. Eleven women were subsequently interviewed. According to the counterpart, the main reasons women did not participate in the interviews were that, despite three phone attempts, contact was not made with the women and some women had difficulties travelling to the hospital. Ten health professionals who worked for the Ministry of Health were invited by the counterpart to also participate in interviews and all agreed to be interviewed. In Tonga, the researcher contacted the health care professionals and organised the interviews.
Interview participants

Each person was interviewed once. The experience of GDM, any lifestyle changes, how GDM was managed and the risk of developing future Type 2 diabetes were discussed in all the interviews, with a focus on prevention, screening, diagnosis and the management of GDM in interviews with the health care professionals.

The interview process

Preliminary development of the GDM survey that was designed to be completed by Tongan women who had experienced GDM was undertaken in consultation with the counterpart, prior to the researcher’s arrival to Tonga. However, this written survey was subsequently not used following the advice of the counterpart who reviewed the written survey in Tonga. According to the counterpart, even though most Tongans are well versed in conversational English, the reading skills of the women who had GDM may have been poor. As schooling in Tonga is conducted in English, the counterpart suggested that all participants would be able to answer questions in conversational English. The original idea of written surveys was subsequently abandoned and instead questions from the GDM survey were used to guide the verbal interviews for the women who had GDM (see Appendix 4.7).

Face-to-face individual interviews were conducted in English with women who had developed GDM in the previous 12 months, and also with the health care professionals. All participants provided informed consent. The consent forms (the ‘Savea Suka Feitama’) were written in the Tongan language (see Appendix 4.8). The interviews were tape-recorded and the researcher took notes. The interviews ranged from 20 to 50 minutes.

The women travelled to the main hospital to participate in the interviews with the researcher and were reimbursed for their travel expenses.

All except one of the health professionals were interviewed at the main hospital. One interview was held at a village community health centre, where one of the health professionals worked. A list of guiding questions again ensured the interviews were focused (see Appendix 4.9).

Stage 2: Surveys and physical activity diary

The research instruments developed for the second stage of the research included two surveys and a seven-day physical activity diary.

Discussion of the specific research instruments: Pregnancy and Physical Activity Survey, the GDM survey and the Physical Activity Diary

Pregnancy and Physical Activity Survey

The PPAS was developed by the researcher. Demographic information, attitudes and beliefs towards physical activity during pregnancy; information
on specific types of incidental physical activity (housework/childcare) and volitional physical activity (sports/exercise) undertaken; and the time spent/week on each activity before pregnancy, during each trimester, and after the baby was born (six to nine months) were explored in the PPAS. Some questions in the PPAS survey were adapted from a validated Pregnancy Physical Activity Questionnaire (Chasan-Taber et al., 2004) that explored the duration and frequency of physical activities performed by pregnant women in their current trimester of pregnancy. This validated survey aimed to measure patterns of physical activity across pregnancy and included household and care-giving activities, work-related activities and sports/exercise.

Some of the questions in this validated survey were included in the PPAS but the PPAS was more comprehensive and explored volitional as well as incidental (or unplanned) activity. The questions that were included in the PPAS that were in the validated survey related to physical activity questions when not at work (questions 24 – 39); physical activity in relation to going places (questions 40 – 42) and questions related to activity at work (questions 43 – 47). (See Appendix 4.10). Using a validated survey added credibility to the research instruments used. While this is so, because the surveys focused on different types of physical activity it was not possible to compare the results of this research with the validated survey. However, the use of a validated survey instrument was a measure to enhance the transferability of inferences and conclusions drawn from the data. Even though the purpose of this exploratory research was not to generalise the findings to a broader population than that under study, the research instrument could easily be applied to similar settings, people, time periods (in terms of pregnancy status) and contexts (Teddlie & Tashakkori, 2009). Inference transferability is a key aspect of mixed methods research and corresponds to generalisability and external validity in quantitative research and transferability in qualitative research (Teddlie & Tashakkori, 2009). These issues are discussed further in this chapter.

There were 68 questions in the PPAS. Most were closed-ended questions. Some open-ended questions were used for women to indicate specific types of physical activity not covered within the closed-ended responses and at the end of the survey women were invited to write down any additional comments. All closed-ended responses were clearly structured. Responses were carefully coded for statistical analysis. Some Likert scales were used. Careful attention was paid to optional design (e.g. clear lay out, plain language, clear instructions) (Borbasi et al., 2008) (see Appendix 4.10).

The survey was self-administered and easily understood and completed by 112 women. Most of the surveys (PPAS) were completed by women who attended the antenatal clinic. Women who had GDM and who had attended one of two community health centres for GDM management in the previous 18 months were sent a PPAS survey. To enhance clarity, the number of participants who participated in the research, the way in which participants
received any of the research instruments and return rates are presented in Table 4.2 further in this chapter.

The GDM survey
A separate survey, the GDM Survey was specifically developed for postpartum women who had experienced GDM. The GDM survey related to physical activity, lifestyle changes and factors that influenced whether behaviour altered or not as a result of a diagnosis of GDM. The development of the GDM survey was informed by the results of the focus groups and interviews and by a review of the literature.

Women completed the GDM survey in two ways.
1. 150 surveys were posted out to women who had attended two community health centres in the past 18 months and 32 were returned (see Appendix 4.11: GDM Survey).

2. Currently pregnant women who attended the antenatal clinic and who completed the PPAS survey ticked a box if they had GDM to indicate they would also be willing to complete the GDM survey, which was subsequently posted to them. Seven GDM surveys were posted to these women and all seven surveys were returned.

A seven-day physical activity recall diary
A seven-day physical activity recall diary (the diary) was developed by the researcher. Women were asked to record their stage of pregnancy, types of activity undertaken each day, the duration in minutes of the activity, and the intensity of the activity. The intensity options were gentle, moderate or vigorous. Definitions and examples were provided in the diary (see Appendix 4.12: Physical Activity Diary).

Ethics
Approval to undertake research with currently pregnant women and women who had developed GDM in the previous 18 months was granted from the North Coast Area Health Service (NCAHS) and SCU, NSW (see Appendix 4.13a: Ethics approvals from NCAHS for Surveys and Diary and Appendix 4.13b: Ethics approvals from SCU for Surveys and Diary).

Recruitment of participants for surveys and physical activity diary
Currently pregnant women – PPAS and physical activity diary
For six months, a survey package (which included the PPAS and diary) was placed in the waiting room of the antenatal clinic (which included a general midwives clinic and a high risk clinic) at a northern NSW hospital. Posters explaining the project were displayed on the notice board of the waiting room. Any pregnant women who attended the antenatal clinic could self-complete the survey and post it back to the researcher in the reply paid envelope provided. Forty-nine pregnant women were recruited from the antenatal clinic.
Several meetings were held with some of the antenatal clinic staff to advise them of the project, and to gain support. Staff were willing to inform the women who attended the antenatal clinics of the study and refer them to the survey package; however, the clinics were very busy and this was often overlooked. The researcher visited the antenatal clinic frequently. It was a condition of the Ethics Approval from the Northern Rivers Area Health Service that the researcher not directly approach pregnant women.

Information about the project was published in the on-line version of the Cosmopolitan magazine. Three women responded to this story in the Cosmopolitan (on-line version) magazine. Media releases and radio interviews were also undertaken; 31 women responded to these stories.

The sampling method used to recruit pregnant women was one of convenience. This sampling method was most suitable because it was economical, easy and amenable to the self-administered nature of the survey. Sampling by convenience is problematic as it can be biased in systematic ways and tends towards a homogenous sample (Liamputtong & Ezzy, 2005). Since the intention was not to generalise the results to a wider population, but to describe the sample of women who did complete the survey, this systematic bias was not such a problem. However, it is reasonable to assume that because the survey was completely self-administered, respondents did require a level of time, motivation and literacy to complete and return the survey.

Women who had experienced GDM

In order to recruit a larger sample of women who had experienced GDM, two community health centres in northern NSW participated in the project. A survey package was sent to women who accessed these centres for GDM management in the past 18 months. The purposive nature of this non-probability sampling method was appropriate in that women with GDM as a group were ‘handpicked’ (Schneider, 2003, p. 260) for inclusion in the study.

Of the pregnant women who completed the PPAS (as described above), some currently had GDM. These women had ticked a box within the PPAS, indicating their willingness to be contacted by the researcher who then posted them the GDM survey.

Return rates

As discussed, the participants received or accessed the research instruments in a number of different ways. Survey packages were either collected from the antenatal clinics or they were posted to women. In Table 4.2, this process is summarised and return rates are clearly presented.

Because the surveys (PPAS) were left at the antenatal clinic for women to self-collect and self-complete, it was not possible to determine how many women may have collected a survey but not filled it in and posted it back, nor the reason it was not posted back to the researcher. Over 200 survey packages were left at the antenatal clinics. It was not possible to collect information on
non-respondents. However, of the 150 PPAS and GDM surveys that were individually posted to women who had GDM, 32 of each survey were returned. The diary return rate was low: only six were returned from the women who had GDM who were posted survey material. Two hundred diaries were included in the survey package at the antenatal clinic and 150 diaries were posted out as part of GDM survey package. Overall, 48 diaries in total were completed.
Table 4.2: Return rates and response rates of PPAS, GDM Survey and Physical Activity Diary

<table>
<thead>
<tr>
<th>Instrument</th>
<th>How women received research instruments</th>
<th>Numbers received/collection</th>
<th>Response Rate</th>
<th>Total PPAS completed</th>
</tr>
</thead>
<tbody>
<tr>
<td>PPAS</td>
<td>Collected from antenatal clinic</td>
<td>Not known (&gt;200 placed at clinic for six months)</td>
<td>36%</td>
<td>N = 112</td>
</tr>
<tr>
<td></td>
<td></td>
<td>72 returned</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PPAS</td>
<td>Posted to GDM women who accessed 2 Community Health Centres</td>
<td>150 posted</td>
<td>21.3%</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>32 returned</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PPAS</td>
<td>On-line magazine/local media</td>
<td>28 posted 8 returned</td>
<td>28.5%</td>
<td></td>
</tr>
<tr>
<td>GDM Survey</td>
<td>Posted to GDM women who accessed 2 Community Health Centres</td>
<td>150 posted</td>
<td>21.3%</td>
<td>Total GDM Surveys Completed</td>
</tr>
<tr>
<td></td>
<td></td>
<td>32 returned</td>
<td></td>
<td>N = 40</td>
</tr>
<tr>
<td>GDM Survey</td>
<td>Posted to currently pregnant GDM women who attended the antenatal clinic</td>
<td>8 posted</td>
<td>100%</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>8 returned</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physical Activity Diary</td>
<td>Collected from antenatal clinic</td>
<td>Not known (&gt;200 placed at clinic for six months)</td>
<td>16%</td>
<td>Total Physical Activity Diaries Completed</td>
</tr>
<tr>
<td></td>
<td></td>
<td>32 returned</td>
<td></td>
<td>N = 48</td>
</tr>
<tr>
<td></td>
<td>Posted to GDM women who accessed 2 Community Health Centres</td>
<td>150 posted</td>
<td>6.6%</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>10 returned</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>On-line magazine/local media</td>
<td>28 posted 6 returned</td>
<td>21.4%</td>
<td></td>
</tr>
</tbody>
</table>

Pilot testing of surveys and diary

The surveys and diary were pilot tested for clarity, comprehension, length, ambiguity, time, and for potential difficulties completing either instrument (Punch, 2004) by 15 women known by or referred to the researcher (but who did not participate in study). Non-pregnant and pregnant women and women with babies less than 12 months old who may or may not have developed GDM were asked to pilot test the surveys and diary. The piloting of the self-completed research provided critical feedback on the questions, the predefined response categories of questions and the overall structure and format.
of the instruments (David & Sutton, 2004). The instruments were modified and refined according to feedback from pilot testing.

Because the GDM written survey was not used in the interviews with the Tongan women and instead was used as an interview guide, this provided an opportunity to further pilot test the GDM survey in terms of question content, flow and relevance.

Discussion of research instruments used

Why surveys?

Information about self-reported behaviour, beliefs and attitudes was collected through surveys. A small-scale, self-administered survey is a common method of data collection as a quantitative survey. Punch (2004) suggests that a non-experimental quantitative survey is, in essence, a study which focuses on the relationship between variables, how they are distributed, and their relationship to each other.

The surveys and diary were either mailed to the women or collected at the antenatal clinic. It was essential that the surveys and diary were easy to complete and easily understandable in order to minimise the typical low response rate associated with postal and self-complete surveys (Borbasi et al., 2008; David & Sutton, 2004). The advantages of the postal and self-complete survey were the relatively low costs, no interviewer effects, and the fact that respondents could complete the survey in their own time (David & Sutton, 2004). Given that the researcher was not able to contact the women directly to inform them of the project, as this was stipulated in the conditions of the Area Health Service Ethics Approval, the overall return rate of the research instruments left at the antenatal clinics is not surprising. The return rate relied on women’s interest in the project and relied entirely on self-completion.

In terms of respondent bias, Menneer (2004) suggests that most informants are anxious to help and can be flattered that their own experiences are being sought. On the other hand they may be “anxious to give what they believe to the ‘correct’ answer to whatever the question being posed” (Menneer, 2004, p. 47). Retrospective data in survey research may be influenced by such factors as memory, guilt (about low levels of physical activity), low interest in the subject or survey, under-stating the abnormal (Menneer, 2004).

Recall bias and self-report surveys

Women were asked to recall physical activity undertaken prior to becoming pregnant and during and after pregnancy. Recall bias may have influenced the validity of the retrospective estimates of level of activity, especially prior to becoming pregnant. Women may have over-estimated or under-estimated their levels of activity; however, ascertaining accurate measures of physical activity is difficult irrespective of the time frame. Washburn & Montoye (1986), after a review of the literature of physical assessment via questionnaire, suggested that, in terms of reliability and validity, it is difficult to determine levels of physical activity and it “is not known whether it is
necessary to ask questions regarding activity over the past year to estimate accurately an individual’s activity level or whether questions over the past day or week are sufficient” (Washburn & Montoye, 1986, p. 574).

**Why a seven-day recall physical activity diary?**

As the research aimed to explore the area of physical activity before, during and after pregnancy, it was felt that a diary would provide another source of data to complement the survey data on duration, type and intensity of physical activity. The seven-day physical activity recall diary was developed after a close review of the literature. The advantage of a diary is that it is less affected by recall bias and can be “a valuable check on the information collected retrospectively by questionnaire from a larger sample” (Bowling, 1997, p. 381). The disadvantage is that non-completion can be a problem as indicated in the above table which shows the low return rate of the diary.

**Stage 3: Interviews with women who developed GDM**

To explore in more depth some of the results that emerged from the surveys, particularly the GDM survey, individual face-to-face semi-structured interviews with Australian women who developed GDM were undertaken. The results of the interviews with these women have been published (see Appendix 4.14).

**Recruitment**

Women were purposively selected for interview, a common practice in qualitative research (Whitehead & Annells, 2007). Inclusion criteria were set by the researcher. Since women with newborn babies are often very busy and have little time to themselves, the researcher felt that mothers of babies between six to 12 months would be more likely to have established some sort of routine, including physical activity and, at 12 months postpartum, the experience of GDM was still relatively recent. Therefore, women whose babies were between six and 12 months old were purposively selected for interview. Only women who had indentified on the survey that had they agreed to be interviewed were recruited. Interviewing continued until the researcher was convinced that the appropriate level of depth and richness of data had been achieved. Eight interviews were completed and selection was based on the first eight that agreed to be interviewed. This was able to be arranged without difficulty.

Face-to-face, in-depth, semi-structured interviews, which enabled exploration of women’s subjective experience of GDM (Merriam, 2002), were guided by a list of questions derived from analysis of the GDM survey and the pregnancy and physical activity survey (see Appendix 4.15).

With consent, the interviews were recorded and notes were taken. Interviews were one to two hours in length and conducted at the participants’ homes; this was the preferred place for all women.
Methods of analysis

Mixed methods of data analysis involve the integration of statistical and thematic techniques (Teddlie & Tashakkori, 2009). The next section describes and critiques the data analysis techniques used.

Focus groups

The qualitative data were analysed in a structured fashion using a four-step process: organising, shaping, summarising, and explaining the data (Hawe et al., 1992). Audio recorded interviews were transcribed verbatim and supplemented with focus group and field notes prior to thematic analysis. Common themes were developed, based on the frequency in which they occurred in participant responses (Fern, 2001). Participants were allocated pseudonyms in order to maintain anonymity.

Interviews

A process of thematic content analysis was used to analyse and interpret the interview transcripts. Each interview was transcribed by the researcher. Because the women’s (and health care professionals’) words were the main source of interpretation, familiarity with the text required the researcher re-reading the text many times (Lathlean, 2007). Transcripts were examined and key words were highlighted. Themes were then developed from patterns that were consistent with key words.

Critique of methods

To judge positivist research, the terms ‘validity’, ‘reliability’ and ‘generalisability’ have been used but there is uncertainty about whether these terms can be adapted to qualitative research (Baum, 2008). Denzin & Lincoln (2003) have suggested using the alternate terms ‘credibility’, ‘transferability’, ‘dependability’ and ‘confirmability’ to replace the positivist criteria of internal and external ‘validity’, ‘reliability’ and ‘objectivity’. Because this study used a combination of methods, quantitative and qualitative methods have been critiqued and at times alternate and traditional terms are used. The ensuing critique section focuses mainly on the qualitative aspect of the research. A further critique of the quantitative research methods is presented in Chapter 8, the discussion of the quantitative results, and also in the concluding chapter.

Credibility

Credibility is a qualitative analogue for internal validity (Teddlie & Tashakkori, 2009). The credibility of research is assessed with reference to the rigor of the methods, the credibility of the researcher, and the philosophical orientation and assumptions that underpin the study (Patton, 1990 in Baum, 2008). Credibility of the research is also enhanced with the use of a number of methods, reflected in this mixed methods study (Silverman, 2000; Teddlie & Tashakkori, 2009).
Rigor of methods and credibility of researcher

Qualitative data collection methods included focus groups and semi-structured, individual, face-to-face interviews. The methods have been explained in detail and were suitable to the exploratory nature of the study.

Focus groups

According to Kleiber (2004, p. 97), “the major strength of the focus group method is its ability to elicit opinions, attitudes, and beliefs held by members of the sample.” The data generated in the focus groups are usually very rich because conversations and discussions build and the moderator has the unique chance to listen to people’s conversations (Kleiber, 2004). However, some of the problems with focus groups are the pressure the participants may feel to conform, the influence of group members, and the skills of the facilitator (McMurray et al., 2004). The synergy of the ideas that result from the interaction among the focus group participants is a strength of a focus group (McQuarrie, 1998 in McMurray et al., 2004) but often the success of the focus group depends on the skills of the facilitator. The researcher facilitated the focus groups and has over 20 years experience in education and group facilitation. Discussion was focused and participation and input from all members of the group was encouraged.

Individual, semi-structured, in-depth interviews

In-depth interviews can be a powerful way of obtaining detailed pictures of how people experience and explain their world, which can be crucial for understanding why people behave as they do and how structural factors impact on their health (Baum, 2008). Interviews can allow the researcher to “tap into the opinions, attitudes and belief systems of participants” (Jackson & Borbasi, 2008, p. 169).

Similar to focus groups, Jackson & Borbasi (2008, p. 169) propose that the real instrument in interviewing is the researcher and that the amount, type and quality of data retrieved depend on the skills of the researcher. The success of the interview relies on the experience and skills of the interviewer (Jackson & Borbasi, 2008). As the researcher was an experienced interviewer, the interview process was fairly flexible and intuitive and not all questions needed to be asked in the same way (Rapley, 2004 in Liamputtong & Ezzy, 2005).

The potential for both interviewee and interview bias was offset to a certain extent by the researcher who was an experienced interviewer who was able to make the interviewee feel comfortable so they spoke honestly and were willing to participate (David & Sutton, 2004). Fontana and Frey (2005, p. 697) contend that the interview can never be a “neutral tool” and that “researcher and respondent should work together to create a narrative – the interview.” Anonymity was not possible in the face-to-face interviews but the researcher guaranteed confidentiality. All interviews were guided by questions.
**Dissenting voices and efforts to use triangulation**

A number of methods were used to strengthen the credibility of the research and the data generated. The research conclusions were drawn from the focus groups, interviews, surveys and diaries which provided a method of constant comparison (Silverman, 2000) to identify key points.

The data from each stage of the qualitative research were treated comprehensively (Silverman, 2000). The use of mixed methods allowed a way to review key themes and strengthened the credibility (internal validity) of the findings. Every piece of qualitative data was reviewed and accounted for in the analysis. Although general themes were developed, Silverman refers to “deviant-case analysis” (Silverman, 2000), or cases that do not fit the general theme and suggests that the inclusion of these dissenting voices can strengthen the validity of the research (Silverman, 2000). Where applicable, the ‘dissenting voices’ are included in the discussion of the results. One example is in relation to the results of interviews with women who experienced GDM. Dissenting voices are presented in relation to different views expressed by some women concerning the perceived credibility of dietary advice provided by their health professionals, to manage their GDM.

**Generalisability**

The purpose of this mixed methods study was exploratory and the findings are only applicable to the study participants. A larger, random, representative sample would be required to generalise findings. Qualitative research makes no claims to generate knowledge that is statistically significant or absolute (Taylor, 2006a). Within qualitative research, it is made explicit that people and things may change according to their circumstances and therefore it is inappropriate to generalise the findings to people outside the study setting (Taylor, 2006a).

**Dependability/reliability**

Dependability and reliability refer to the consistency over time of the research and whether the research would be consistent across researchers and methods (Baum, 2008). The research methods have been described in detail so it is possible that the research process would be consistent over time and between different researchers. However, in opposition to the quantitative view of replicating the study, or controlling variables, qualitative data enriches the results by providing contextual information to redress this imbalance (Guba & Lincoln, 1998). The data are reliable because they are based on the idea that knowledge is relative and is dependent on all of the features of the people, place, time and other circumstances (context) of the setting. People are valued as sources of information and this subjectivity is integral to meaningful qualitative research (Roberts & Taylor, 2002).

The researcher was individually responsible for all data analysis. Although it would have been ideal to have two people assess the data (Baum, 2008), the reliability of the data is evident in terms of the degree of consistency with which similar themes were developed (Silverman, 2000) over time in different
stages of data collection. In terms of the reliability of research instruments, some argue that if social reality is treated as always in flux, then it makes no sense to measure the research instruments (Silverman, 2000). Nevertheless the research instruments used and the research process have been described and the consistent development of themes has been outlined.

**Confirmability**

Confirmability is assessed when the research results have been confirmed with a source outside of the research team, such as with the research participants (Baum, 2008). There are parallels between estimating confirmability of results and measures to ensure internal validity (Teddlie & Tashakkori, 2009) which involve asking the participants to confirm that the interpretations are an accurate representation of what the experience was like for them (Roberts & Taylor, 1998).

In both quantitative and qualitative research, the validity, truthfulness (Silverman, 2000) and confirmability of results need to be ensured (Baum, 2008). A qualitative researcher has in-depth access to single cases and the findings need to be convincing, not just the result of a few well-chosen examples (Silverman, 2000). Common patterns in relation to pregnancy, GDM and physical activity emerged in the focus groups, interviews, surveys and the physical activity recall diary. Whilst it was not possible to confirm the results with each of the group or interview participants, confirmability of results is evidenced by similar themes that emerged through all the mixed methods of data collection.

**Quantitative data analysis**

The quantitative data from the surveys were analysed using the SPSS computer package, version 14.0 for Windows. Parametric and non-parametric tests were performed.

Data were screened for missing data and outliers. Interval level data were assessed for measures of central tendency and frequency distributions. Box plot analysis was used to assess for univariate outliers. Histograms were also used to assess normality. Non-parametric tests, including the chi square test for independence to explore the relation between two categorical variables were used. The Mann-Whitney U test was used to test for difference between two independent groups on a continuous measure. The groups were: women who had never had GDM (non-GDM group) and women who had experienced GDM (GDM group). The parametric alternative was also used (the independent sample t-test).

Basic descriptive statistics including frequency, percentage and cumulative percentage were ascertained. Descriptive statistics including means, medians and standard deviations were calculated for all variables. Box plots were used to compare the distribution of scores on variables.

Demographic characteristics of the entire sample were analysed, and the differences between the GDM group and the non-GDM group were tested.
To compare the mean score of some continuous variables between the GDM and the non-GDM group, independent sample t-tests were undertaken. All statistical tests were Sig. (two-tailed) with alpha set at .05. In order to assess the importance of a ‘statistically significant’ result, the effect size was also calculated. The test used was eta squared which determined the magnitude of the difference in the means. Cohen (1998 in Pallant, 2005) proposes guidelines for interpreting the eta squared value as: .01=small effect; .06=moderate effect; and .14=large effect.

The significance level and eta squared

The power of the test is dependent on the sample size of the study (Stevens, 1996 in Pallant, 2005). If there are smaller numbers (e.g. \(n=20\)), then a non-significant result may actually be due to insufficient power. In the case of small group sizes, the researcher may need to set the alpha level higher to compensate (rather than setting the cut-off point at the traditional level of .05, the cut off could be set at .10 or .15). Every group, however, did have a sample size \(n>30\). However, even when the researcher set the alpha level at .15, there were very few significant differences in mean scores between the GDM and non-GDM groups.

Due to the small sample, attempts were made to normalise or reclassify data rather than delete data. For more valuable and succinct analysis many variables were recoded. True missing data were not included in the analysis for this study. Data were not imputed.

Reclassification of some of the data explained

Data from the PPAS

There were five possible response categories for each question for different levels of physical activity (as indicated below).

**Original categories**

1=none
2=<30 minutes a day/week
3=\(\geq30\) minutes a day one to two times/week;
4=\(\geq30\) minutes a day, three to four times/week or
5=\(\geq30\) minutes or more a day, most days of the week)

For more meaningful data analysis, these five categories were condensed into three categories: none (no physical activity); minimum levels of moderate physical activity; and moderate (moderate to recommended levels of moderate physical activity) (see Table 4.3).

**Table 4.3: Reclassified levels of physical activity**

<table>
<thead>
<tr>
<th>Categories</th>
<th>Reclassification of original categories and equivalent level of physical activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>
Comparisons before pregnancy, third trimester and after the baby was born

Women were asked to estimate their levels of activity before pregnancy, during first, second and third trimesters, and after the baby was born. Although all data were analysed, only comparisons between before pregnancy, trimester 3 and after pregnancy were reported. Trimesters 1 and 2 are not reported because a diagnosis of GDM usually occurs in the third trimester. Exploring any differences in physical activity levels before pregnancy, after a diagnosis and then after the baby was born was the main objective of the research, as well as exploring any differences between women who had had GDM with those who had never had GDM.

Seven-day physical activity recall diary

After frequency analysis was undertaken on all the different types of activity women reported, the data were then reclassified into five types of activity: walking, swimming, childcare, housework and ‘other’. The total number of minutes for all activity was calculated. Frequency analysis was undertaken to determine the total of activities at a gentle, moderate or vigorous intensity level.

Factor analysis: PPAS

Purpose of test

Factor analysis was undertaken to explore the factors women reported that helped them to engage in physical activity during and after pregnancy and those factors that hindered women engaging in physical activity during and after pregnancy.

The useful aspect of factor analysis is that it is a data exploration technique, so “the interpretation and the use you put to it is up to your judgment, rather than any hard and fast statistical rules” (Pallant, 2005, p. 183). Factor analysis is not designed to test a hypothesis or indicate if one group is significantly different from another but can be used as a “data reduction technique” (Pallant, 2005, p. 172). It can take a large set of variables and look for groups among the intercorrelations of variables.

The results indicated by factor analysis refer to the group or clump of related variables. ‘Factor analysis’ is a general term that refers to the entire set of techniques. According to Pallant (2005), there is debate about the preference towards the approaches to factor analysis concerning principal components analysis. The different approaches calculate the shared variance between the

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Categories 2 and 3 were grouped together (that is &lt;30 minutes a day/week to ≥30 minutes a day 1-2 times/week)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moderate</td>
<td>Categories 4 and 5 were grouped together (that is ≥30 minutes a day, 3-4 times/week or most days of the week)</td>
</tr>
</tbody>
</table>
variables differently. Pallant (2005) suggests the principal components analysis approach which is how the data are presented in the next section.

Sample size

Ideally the sample size should be >150 but, according to Pallant (2005), there is little agreement on how large a sample should be; although the general rule is the larger the better. On the other hand, some authors suggest that it is not the overall sample size that is the main concern but the ratio of cases to each item. Nunnaly (1978) recommends a 10:1 ratio and Tabachnick & Fidell (2001) recommend a 5:1 ratio (cited in Pallant, 2005). The factors were analysed with a relatively smaller sample size \( n > 70 \) for factors after pregnancy and \( n > 100 \) for factors during pregnancy.

Conclusion

Combining the methods was the most suitable way to explore behavioural patterns of physical activity and to explore women’s views on physical activity during and after pregnancy and the factors that influenced participation in physical activity, especially for women who experienced a pregnancy with GDM in which lifestyle changes were necessary. An overview of feminist research principles that influenced the research, the mixed methods research design, a discussion of the three stages of the research, recruitment, ethics approvals, critique and development of research instruments, and key issues surrounding data analyses have been described. A discussion of Stage 1, the first stage of the qualitative component of the research, is presented in the next chapter.
Chapter 5: Qualitative research – results and discussion
Introduction

The qualitative stages of the research are discussed in this chapter. There were three stages of qualitative data collection. Stage one involved focus groups and interviews with Australian women. Stage two was conducted in Tonga where women who had experienced GDM were interviewed, along with their health care providers. Stage three involved in-depth individual interviews with Australian women who had experienced GDM in a previous pregnancy. The results of each stage and a concluding summary of the overall issues are presented.

The themes to be discussed in this chapter identified in the focus groups include cultural influences; attitudes to exercise; beneficial exercises; exercises to avoid; barriers to exercising; problems with weight; uncertainty / lack of knowledge; weight gain and GDM; exercise and GDM and follow-up.

The themes to be discussed as a result of research in Tonga with women who developed GDM relate to lifestyle changes in general as well as specific concerns for the baby that influenced lifestyle changes during pregnancy; concerns about diabetes. Themes to be discussed that emerged from interviews with the health care providers, relate to positive GDM management strategies; barriers to GDM management; GDM as a warning signal for future type 2 diabetes; weight issues and lifestyle changes within Tongan culture.

Comments from the two written surveys were analysed and themes developed. The themes to be discussed in this chapter relate to postpartum barriers to physical activity; GDM management and prevention and avoiding type 2 diabetes post-partum.

The final stage of the qualitative research involved in-depth interviews with women who developed GDM. Themes to be discussed in this chapter that emerged from this stage of the research relate to the need for appropriate information (about GDM management); how to prevent type 2 diabetes; engaging in physical activity postpartum and follow-up issues in the postpartum period.

Stage one (A): Focus groups and interviews

There were four focus groups of three to five members, plus two women with GDM who were individually interviewed. Eight of the women involved in the research project were having their first baby (prima gravida). Indigenous women and women from Pacific Islander backgrounds were some of the participants in the groups. Participant demographics are presented in Table 5.1.

Table 5.1: Focus group and individual interview participant demographics
Themes identified in the focus groups

The following themes highlight issues relevant to the majority of participants. In the case of interviews with the two women who had experienced a pregnancy complicated by GDM, themes were developed on the basis of commonality of issues for both of these women in relation to GDM.

**Cultural influences**

No specific cultural influences were identified by Indigenous women. All of the Samoan women agreed that pregnancy is generally considered a time of rest. One of the Samoan women likened being pregnant in her culture to ‘a cotton wool experience’.

**Attitudes to exercise**

Participants’ attitudes to physical activity varied. Whilst one participant commented that exercise was “too beat up ... (and it had) ... gone too far”, several others thought exercise was really important and had profound benefits for physical and emotional wellbeing. One woman stated that “it helps in the long run.”

**Beneficial exercises**

Walking, yoga and swimming were mentioned as the safest and most beneficial exercise to do. Exercising in moderation was a common theme. One participant thought that “if you're just going for a stroll or swimming I don't think there are any risks.” Some enjoyed the feeling of weightlessness in the water and spoke highly of aqua aerobics.

**Exercises to avoid**

Women were fearful of doing anything that might hurt the baby and/or increase the risk of miscarriage. Team sports, jolting exercises, squats,
running, squash, weight training, football, stomach crunches and generally anything too strenuous were mentioned as exercises to avoid.

**Barriers to exercising**

The most common barriers to exercise mentioned related to the physical changes related to pregnancy such as “tiredness, nausea, getting bigger, feeling uncomfortable and having problems breathing.” One woman thought that being overweight was actually a barrier to doing exercise in the sense of being embarrassed or being seen out in public going for walks.

**Problems with weight**

Weight gain during pregnancy was mentioned as a problem. One woman stated she put on so much weight she felt like a “beached whale.” Another woman (who subsequently developed GDM) stated:

“... when I found out I was pregnant I just sat on the couch and ate. I put on a kilo a week up to 12 weeks ... I always thought when I got pregnant that's what I'd do [eat] ... I knew I'd be as big as a side of a house. Next time it's going to be a hell of a lot different.”

Three women were aware of starting a pregnancy already being overweight and those who had previous pregnancies stated it was very hard to lose weight after the baby was born.

**Uncertainty/lack of knowledge as a barrier**

Lack of knowledge about what a woman can do when pregnant was also mentioned as a barrier to exercising. For example, one participant stated, “I am actually wondering how much I can improve my body tone while I am pregnant. I'd like to experiment to see how much I can do ... I imagine I can do some strengthening work”, but she was not sure.

A few women stated that their General Practitioners (GPs) did not provide much information, if any, about exercise. The advice given, in the words of one participant was to “walk and do a bit of exercise”; or “no running, that was it.” Another said “my Doctor was really vague – he said light yoga was OK but don't do anything too strenuous.” One woman stated there was “not a lot out there” and “no-one says too much about it.”

There was an expressed desire for more information about pregnancy and physical activity. As one participant said, “they should give you a handout sort of earlier ... if you are not sure what exercise you can do ... because people don't realise what they can do.”

**A diagnosis of GDM**

The two women interviewed who had had a recent experience of GDM commented on their experiences of a diagnosis of GDM and the impact it had had on their lives, particularly in relation to physical activity.
Weight gain and GDM

Attention to weight gain was an area identified by both women. As one woman stated, her doctor did not say too much about her weight gain before the test but after the diagnosis, she became “pretty full on and she [the GP] pulled me up on certain things.” For the other woman:

“It was only when the glucose tolerance test was done they said – bingo – you need to watch your diet, exercise, blah, blah ... I knew when I was pregnant I needed to be careful with my weight ... and when the diabetes was thrown into the equation I had to be extra cautious.”

Exercise, diagnosis and GDM

After the diagnosis of GDM, both women became conscious of doing more exercise and the general advice they received was that exercise had an influential role in the managing of their BSL. The main advice was to walk. One woman used this knowledge about exercise to directly influence her higher blood sugar level readings. In her words: “I found that if I went downstairs and walked [around a large room] ... about 20-30 times it would come down” [from 8.5 mmol/L to 7 mmol/L]. The other woman said she had trouble exercising as she was fairly large and “waddled, not walked.”

Follow up

Apart from post-birth BSL checks by the diabetic educators (DE) whilst the women were in hospital, there was no follow up at all from either the DEs or their GPs for either woman. Both women were surprised at the lack of follow up, given their intense monitoring during pregnancy and their increased risk of developing Type 2 diabetes.

Discussion of focus groups and interviews

The results of the focus group research have been published (see Appendix 4.5).

The participant themes provide insight into women’s attitudes towards pregnancy and physical activity and the experience and impact of a diagnosis of GDM, particularly in relation to physical activity.

The themes concerning women worrying about diet and weight during and after pregnancy are supported in the literature (Cartwright, 2004; Catalano & Ehrenberg, 2006; Derbyshire, 2008; Kac et al., 2004; Siega-Riz et al., 2004), particularly for women who develop GDM (Artal et al., 2007; Dye et al., 1997; Stage et al., 2004). Although not specific to pregnancy, obesity has been reported as a barrier to physical activity (Ball & Crawford, 2000) which was mentioned also as a barrier to exercise by women in the focus groups.

Attitudes to exercise varied and it is clear from the literature that attitudes, support and encouragement influence the levels of physical activity undertaken before, during and after pregnancy (Clarke et al., 2004; Dempsey
et al., 2005; Smith et al., 2005; Symons Downs & Ulbrecht, 2006). There is evidence in the literature that women do not receive enough information from their physicians about lifestyle behaviours including exercise during pregnancy (Kirkby & Symons, 2000; Siega-Riz et al., 2004) and inaccurate advice received from family and friends negatively influences women’s physical activity levels during pregnancy (Clarke et al., 2004; Evenson et al., 2009).

Virtually none of these women had any clear understanding, or guidance in the form of information from health care professionals, on how to incorporate physical activity into the gestational lifestyle period. This was evident in all groups. Cultural differences were not obviously distinguishable from the results for the Indigenous women and Samoan women, and it is likely that the sample size was too small to elicit culturally specific themes. Data were not collected on educational background or socioeconomic status which could have affected participant’s knowledge, attitudes and behaviours.

In general, the exercises the participants believed to be beneficial parallel the general recommendations and evidence for moderate exercise during pregnancy, particularly walking, swimming and yoga (Artal, 1996; NSW Health, 2000; VICFIT, 2004). The participants realised the dangers of over-exercising and knew to avoid certain activities such as jarring exercises, which is also reported in other studies (Clarke et al., 2004) and is reflected in various guidelines for exercise during pregnancy (ACOG, 2003; Royal College of Obstetricians and Gynaecologists, 2006; Toole, 2002).

Women with GDM became aware of the influential role exercise had in managing GDM. One woman used this knowledge to directly influence her blood sugar level readings. The link between physical activity in the management of GDM is evident (Dawes, 2006; Mottola, 2007). On an individual level, this woman found almost immediate benefit from exercising to lower her blood sugar level reading.

Summary

The diagnosis of GDM can be a prime time for opportunistic health education to promote behavioural change, especially for sustained and healthy levels of physical activity, diet and weight management. However, the associated risks of GDM go beyond pregnancy. For women with GDM who have an increased risk of developing Type 2 diabetes postpartum, follow up and monitoring is essential (Kitzmiller et al., 2007; McElduff, 2003). The women interviewed reported concerns over the lack of follow up postpartum. This is discussed in more detail at the end of the chapter since these were also concerns mentioned by women who had experienced GDM, who agreed to participate in in-depth interviews after completing the PPAS.
Stage two (B): Tongan research

Semi-structured individual interviews with women who developed GDM, and interviews with their health care providers

Face-to-face interviews were conducted with 11 women who had developed GDM in the previous 12 months and 10 health care professionals who worked in the GDM/diabetes area in Nuku'alofa, the capital of Tonga. Results have been presented in a way that participants are not able to be identified.

Women who had experienced GDM

Most women who had experienced GDM were ≥30yrs. Nearly all the women had a family history of diabetes and two women had a mother or a sister who had developed GDM (see Table 5.2).
Table 5.2: Characteristics of participants in Tonga who developed GDM in the previous 12 months

<table>
<thead>
<tr>
<th>Pseudonym</th>
<th>Age</th>
<th>Number of children</th>
<th>Number of GDM pregnancies</th>
<th>Family history of diabetes</th>
<th>Family history of GDM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alisi</td>
<td>24</td>
<td>2</td>
<td>2</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Fatina</td>
<td>25</td>
<td>4</td>
<td>1</td>
<td>✓</td>
<td>✓</td>
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<td>30</td>
<td>5</td>
<td>1</td>
<td>✓</td>
<td>✓ ~</td>
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<td>Ofa</td>
<td>30</td>
<td>3</td>
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<tr>
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<td>1</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
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<td>3</td>
<td>1</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Mira</td>
<td>37</td>
<td>4</td>
<td>1</td>
<td>✓</td>
<td>✓ ~</td>
</tr>
<tr>
<td>Salesi</td>
<td>38</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lia</td>
<td>39</td>
<td>6</td>
<td>1</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Akesiu</td>
<td>39</td>
<td>6</td>
<td>2</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Topou</td>
<td>40</td>
<td>8</td>
<td>2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Symbols: ✓=Mother □=Father ~=Sister ♦=Aunty ❁=Uncle

Health care professionals

A range of health professionals who worked in the general diabetes and gestational diabetes area, and who were employed by the Tongan Ministry of Health were interviewed. Most worked at the Vaiola’ hospital, the main hospital in Nuku’alofa, the capital of Tonga. Table 5.3 indicates their profession and place of work.

Table 5.3: Health care professionals interviewed

<table>
<thead>
<tr>
<th>Profession</th>
<th>n</th>
<th>Role</th>
</tr>
</thead>
<tbody>
<tr>
<td>Obstetrician and Gynaecologist (O&amp;G)</td>
<td>3</td>
<td>O&amp;G Medical specialist/consultants</td>
</tr>
<tr>
<td>Midwife/Registered Nurse</td>
<td>2</td>
<td>Conduct antenatal clinic; take random BSL</td>
</tr>
<tr>
<td>Midwife/Registered Nurse</td>
<td>1</td>
<td>In charge of Maternity Ward; OGTT screening, health promotion and education</td>
</tr>
<tr>
<td>Health Promoter, Registered Nurse</td>
<td>1</td>
<td>Health education on GDM to groups of women who attend GDM screening</td>
</tr>
<tr>
<td>Dietician</td>
<td>1</td>
<td>Screening, education, research</td>
</tr>
<tr>
<td>Registered Nurse</td>
<td>1</td>
<td>Diabetes education, clinical services</td>
</tr>
<tr>
<td>Registered Nurse/Health Education Officer</td>
<td>1</td>
<td>Clinical services, screening, health promotion &amp; education, outreach, public health</td>
</tr>
</tbody>
</table>

Results from interviews with women who developed GDM

These results are presented according to themes related to lifestyle changes developed on the basis of commonality.

Lifestyle change

Recommendations following a diagnosis of GDM

After a diagnosis of GDM, all women reported being advised by their doctors to make dietary changes. Advice was to eat more fruit and vegetables; eat
more fish and ‘pulu’ (cow) and less ‘buaka’ (pork); drink water rather than soft drinks; reduce sugar, fat and starch intake; and to eat smaller meals, particularly at night. All women reported being advised to lose or manage weight and to become more physically active, mainly to walk. Matalita commented that she shouldn’t eat so much during pregnancy and they (the doctor) told her that “a big baby is not a healthy one.” Salesi said it was a Tongan thing to eat a lot during pregnancy but she then found out that “lack of exercise and too much eating is why I put on weight and got GDM.”

**Barriers to lifestyle change**

Making lifestyle changes and laziness

“Laziness” (the women’s words) was seen as a reason for not making changes to diet or activity and was viewed as part of the Tongan culture.

Lia commented: “I don’t like doing too much exercise, I felt too lazy” and Topou stated that she “learnt not to be lazy – don’t eat unhealthy foods even if you are not pregnant.” Akesiu commented that her husband (who was a school teacher) told her to do more exercise as it was good for her.

The theme was that even though it was hard to change, all women reported an awareness of the need to make some changes to diet and to become more physically active following a diagnosis of GDM. Uinise commented that “it was hard to change but now I try not to eat so much fat or sugar.”

**Support for lifestyle change**

Recognising the benefits of lifestyle change

All women commented on the benefits of positive lifestyle change which included improved health for the women and their families. A few quotes below capture some of the benefits the women mentioned:

Topou: “Good for body to be strong and healthy.”

Lia: “Now the whole family is healthier – I don’t buy lollies for the kids anymore – sick of getting tooth aches.”

Salesi: “Now I eat smaller meals, no sugar in tea, drink only water – not coca-cola and fanta, no more sweet things, eat more green leaves, veges and fruit … I look better.”

Ofa: “Changes are good – I feel better and healthier and not so tired at work when I lose weight … I feel better because now I hardly eat sugar.”

Concerns for baby influenced lifestyle changes during pregnancy

All women commented that their motivation to make any recommended changes to diet and/or to increase physical activity during pregnancy was because of concerns for the health of the baby. Fatina and Matalita were scared of having a caesarean section. Mira was worried that “if the sugar became too high they would take the baby out earlier.” Salesi was worried
that the baby “would not be born alive” and Uinise feared that the “baby would die if the sugar gets too high.”

Knowledge, motivation and time influenced lifestyle changes postpartum

Factors that influenced lifestyle changes after the baby was born related to knowledge, motivation and time. Mira mentioned that too much eating and lack of exercise were reasons for her being so overweight. Two comments presented below relate to knowledge and motivational influences.

Fatina: “I stopped exercising – no time and no-one to look after the baby.”

Ofa: “I am too lazy – I go to the bush and do cleaning at home – I think it’s enough but it’s probably not enough.”

Concerns about diabetes

All the women were very concerned about developing future diabetes. Concerns were linked to witnessing the effects that diabetes had on friends and loved ones. Polima mentioned a woman in her village that “had her foot cut off because of diabetes.” Polima was motivated to continue with dietary changes and commented: “I am afraid that if I keep eating buaka (pig) I might get diabetes.” Lia commented that her mother who had diabetes was very sick and had to go to hospital and because she was “scared of getting diabetes [she] stopped drinking so much sugar. I stopped because I know it’s bad.”

Matalita thought that making lifestyle changes was “hard for the lazy people but not hard for the people afraid of death.”

Government programs

All women thought the current ‘Walk for Health’ program organised by the Tongan Ministry of Health was a good strategy to promote awareness of healthy lifestyles. As Alisi commented, it was good for “showing people what to do.” Topou commented that the Ministry of Health “should let people know if they don’t do this [lose weight, eat well, exercise] then they get that [diabetes].”

Results of interviews with health care professionals

In Tonga, the resource scarcity, especially human resources is absolute (Epping-Jordan et al., 2005). Tonga is a relatively small country and those who work within the Ministry of Health, particularly in the GDM, diabetes area and obstetrics and gynaecology areas are relatively few in number. Therefore, in order to avoid identification of any particular health professional and to ensure confidentiality, the results of interviews with the health professional are presented generally. Their place of work and profession is not reported. Results are presented as themes, developed according to commonality.
Health professionals spoke about positive management strategies and barriers to best practice management.

**Positive management strategies**

**Screening – process and initial management after a diagnosis of GDM**

All health professionals commented positively on universal screening for GDM via a glucose tolerance test that is routinely performed at 28 weeks of pregnancy in Tonga. Two health professionals explained that glucose supplies were not part of the Tongan Ministry of Health’s budget and were funded by WHO and that when supplies ran low, selective screening occurred. If a woman had a high reading, she was advised to stay overnight in the obstetric ward where she received intense lifestyle education on ways to manage her GDM. After two weeks, blood glucose levels were re-checked and if they were still too high and GDM had not been well managed by lifestyle changes, insulin therapy was commenced.

One health professional commented that screening was a very cost-effective package for the “national battle against diabetes” and important not only for its obstetric value but as “a predictive factor for the future.” Another commented that “universal screening is important – more importantly – what it does for us is identify those who are at risk of Type 2 diabetes later in life.”

**Lifestyle management of GDM**

Lifestyle changes to diet and exercise were mentioned by all health professionals as very effective for the management of GDM and sustained lifestyle change was reported by all to be beneficial for women and their families. Three health professionals commented on the apparent evidence that attention to diet and weight during pregnancy and, to a lesser extent, physical activity are effective in managing GDM in Tonga.

One health professional commented: “Most of them [the women with GDM] are controlled by diet – so there is already evidence that is does make a difference.” Another commented that:

“Physical activity is a given – it has to do with reducing weight; diet alone is not enough. Exercise is just as important as diet and if the mother understands the risk and she has witnessed for herself that her diet has controlled her BSL then that is a good sign because she will be the one caring for the baby and passing on the message.”

One health professional commented on the British guidelines for GDM management which advocate that women continue doing what they were doing before pregnancy. These guidelines were seen to be not always applicable in Tonga because most Tongan women are overweight and do little physical activity prior to pregnancy. In contrast to the British guidelines, antenatal advice provided to Tongan women is often to start being active and to lose weight when they become pregnant.

Another health professional commented on the benefits of lifestyle change:
“When women lose weight, they reported feeling better and looking better. On an individual level this is a motivating factor that helps women to sustain positive lifestyle changes.”

**Barriers to positive management**

*Lack of follow up*

Four health professionals reported that postpartum women do not attend for their follow-up screening appointments. One suggested that preventative screening (for diabetes in general) is “a foreign idea for most Tongans – they have the idea that if you are well you do not need to go … [to the health service] … you only go if you are sick.” Two other health professionals commented on problems with follow up which were that most people present to clinics with advanced stages of diabetes (or another GDM pregnancy), despite a variety of strategies that were in place to remind people to turn up for their appointments.

One health professional’s comment related to young women: “We have a problem chasing young Mums who don’t come for follow up – they don’t come until they fall pregnant again.”

**GDM is not a significant ‘warning signal’ for the prevention of Type 2 diabetes**

Although all health professionals viewed diabetes as the most significant health problem in Tonga, GDM was not seen to be a significant warning signal for women’s perceived risk of developing future diabetes. It was thought that most women were already acutely aware of diabetes, as it is in most people’s families and there is hardly anyone who does not have a risk factor for Type 2 diabetes in Tonga. As one health professional commented: “They are not really ignorant of diabetes as most of them have relatives with diabetes” and believed that “most people know the seriousness of the problem.” The following two comments reflect the general views of those interviewed.

“They [the women who have had GDM] know what to do but doing it is a different story … Unfortunately diabetes is a silent killer … they feel fine so why should they make changes until it is too late … it is hard to do anything because they feel OK – they lose a leg and then they make changes – it’s really sad as many of these things are preventable.”

“Diabetes is a big problem … there is too much eating and doing nothing.”

**Being overweight**

Being overweight was viewed as a serious health issue by all health professionals. Comments related to women eating too much during pregnancy and/or eating for two, excess weight gain during pregnancy not lost between pregnancies, and especially weight gained in the first pregnancy. One health professional’s comment captures the chronic nature of the problem:
“Weight gain in pregnancy coupled with idleness contributes to obesity which then increases the risk of another GDM pregnancy and future Type 2 diabetes.”

*Lifestyle changes within the Tongan culture – laziness and obesity*

‘Laziness’ was mentioned by all health professionals as a contributing factor to high rates of obesity, poor diet and lack of physical activity in Tonga. The general consensus was that there had been a lot of changes to the Tongan way of life over the past 20 years which contributed to laziness, poor health, lack of physical activity, obesity and diabetes. One health professional commented specifically on changes to the Tongan culture over the past twenty years; “no-one walks now – lots of people have cars and they even drive to church and around the corner.”

Changes to eating patterns were mentioned by all health professionals as reasons for obesity. An increase in the consumption of unhealthy, fatty takeaway foods, more people eating out, and changes in diets away from traditional foods to more processed and refined foods with a high sugar and fat content were factors cited.

*Lack of broad public health initiatives*

The need for broader education campaigns in Tonga was highlighted by all health care professionals, as well as the need to train health workers to educate people at the local village level. Health promotion programs on the radio that focus on nutrition and physical activity, in addition to walking programs at the community level supported by the Ministry of Health, were seen as effective tools for delivering messages on healthy weight, healthy eating and the importance of being physically active.

**Discussion – Tonga**

**Adverse delivery outcomes**

Concerns mentioned by the women who developed GDM about adverse delivery outcomes and perinatal morbidity were supported by evidence in the literature on the risks involved for mother and baby with a pregnancy complicated by GDM (Crowther et al., 2005; Hollander et al., 2007; Saydah et al., 2005; Watson et al., 2003). Adverse birth outcomes were linked to obesity (James, 2005). An increased weight gain between pregnancies and a short interval between pregnancies were risk factors for the development of GDM (Nohira et al., 2005).

**Risk factors**

Results from these interviews highlighted the significance of GDM and diabetes in Tonga and the need to support women to reduce their risk factors. Most women had common risk factors for GDM: a relative with Type 2 diabetes (many first degree relatives); aged over 35 years; overweight, belonging to a high-risk population (Hoffman et al., 2003; Saydah et al., 2005)
and a previous history of GDM (Hollander et al., 2007). An increase in pre-pregnancy weight between the first and following pregnancies is a risk factor for GDM (MacNeill et al., 2001). Obesity is the most common risk factor for GDM which may be linked to a first degree relative (Scollan-Koliopoulos et al., 2006). Weight management was cited by health care professionals as an issue during pregnancy, especially weight not lost between pregnancies and weight in the postpartum period.

**Dietary changes**

Dietary changes were mentioned as part of the standard and effective management of GDM in Tonga, which is the primary therapeutic strategy, with insulin added if required to achieve glycaemic control (Hoffman et al., 2003). Women were encouraged to eat more healthy (including traditional) foods and less imported unhealthy foods. Although the study did not examine economics that influenced dietary choices, the effect of globalisation has influenced dietary changes and choices related to the cost of food in Tonga (Evans et al., 2001). Traditional foods are eaten less (such as fish, taro greens, breadfruit, octopus, yam, cassava) and there has been an increased consumption of imported foods (pork, corned beef, salt beef) and imported simple carbohydrates (bread, biscuits, flour noodles) (Evans et al., 2001). Often the imported foods are relatively inexpensive compared to traditional foods (Evans et al., 2001).

**Obesity**

Obesity is a significant health issue in Tonga (Cockram, 2000; WHO International Association for the Study of Obesity International Obesity Task Force, 2000) and a risk factor for the development of GDM (Chu et al., 2007; Hedderson et al., 2008). A review of the records of 30 women who had presented with GDM to the Vailoa’ hospital from January to May 2006 (Puloka, 2006) indicated that that the average weight of the woman at the beginning of her pregnancy was 92.2 kgs (which ranged from 59 to 115 kgs) compared to 95.5 kgs at the end of pregnancy (which ranged from 66 to 118 kgs). Average weight gain during pregnancy was 3.3 kgs but this ranged from a 4 kg loss to a 12 kg gain (Puloka, 2006). Although actual BMI was not ascertained for the women who experienced GDM in Tonga, most were large women.

In 1992, the rates of obesity (defined as a BMI>30.0 kg/m²) in Tongan women exceeded 60% (Secretariat of the Pacific Community, 2000). In a later 2003 report by the Meeting of Ministers of Health for the Pacific Island Countries, it was suggested that obesity is so common in Pacific societies as to appear normal (WHO, 2003). The results of a study undertaken by Craig et al. (2001) which explored the differences in body composition between Tongans and Australians indicated that the standard healthy weighty ranges recommended for international use by WHO may not be appropriate for Tongan people because of differences in body size and body composition. Pacific Islander people do have a larger frame and are generally more muscular compared to...
people of European origin (Secretariat of the Pacific Community, 2000). Traditionally, ‘bigness’ was due to muscularity but as a result of the modern, sedentary lifestyle, ‘bigness’ is now a result of over-fatness (Secretariat of the Pacific Community, 2000). Even though obesity has been traditionally valued “as a symbol of social status and prosperity” (McCarty & Zimmet, 2001) in Polynesian and Melanesian countries for many centuries, this view is changing (Secretariat of the Pacific Community, 2000).

The reasons for the increase in obesity are the result of complex social and economic change in the Pacific Islands. These changes include reduced physical activity; changes in manual employment; an increase in the availability of high-fat, energy foods and foods that have changed towards westernised diets of high fat, and vegetable oils, alcohol, confectionary, soft drinks, as well as mutton flaps and turkey tails (which are very high in fat and are sold almost exclusively to the Tongan market by western countries unable to sell them anywhere else) and an increase in imported foods since the mid-1990s (Secretariat of the Pacific Community, 2000).

Laziness

‘Laziness’ was seen to contribute to obesity, physical inactivity, an increased consumption of unhealthy foods with a decreased intake of traditional, healthier foods. Increased urbanisation (McCarty & Zimmet, 2001) contributes to decreased levels of physical activity and higher rates of obesity (York et al., 2004) in Tonga, despite the fact that many residents continue to have some rural component to their lives (Colagiuri et al., 2002). Laziness and being over-fat is related to diabetes (Secretariat of the Pacific Community, 2000).

Universal screening

Universal screening for GDM was seen to be a cost-effective strategy for its predictive and preventive value in relation to the future development of Type 2 diabetes. The public health benefits associated with universal screening have been identified in the far-reaching risk assessment for Type 2 diabetes and the opportunity for early education about lifestyle modifications (England et al., 2009).

However, financial commitment to ensure necessary glucose supplies for universal screening was noted as a concern that limited universal screening. Funds for glucose supplies were not part of the Ministry of Health’s budget and were funded by WHO which had a regional office in Tonga. Selective screening was noted by the health professionals as a concern. Usually selective screening is targeted towards women at high risk for GDM (Hoffman et al., 2003), which is a problem, given the high prevalence of risk factors for GDM for Tongan women. However, resource scarcity is a major impediment in Tonga. It is country of 100,000 people that is very dependent on remittances and foreign aid (Epping-Jordan et al., 2005).
Screening practices in Tonga

Other problems associated with screening reported in the interviews with health care professionals were poor postpartum follow up and the view that screening is a foreign idea to most Tongans. Colagiuri et al. (2002, p. 1382) suggests that the high rate of undiagnosed Type 2 diabetes in Tonga “probably reflects the lack of available routine medical services, the general lack of community awareness of diabetes, and the prevailing attitude of seeking medical advice only for advanced problems.” Surveillance of those at high risk is important (Mafi et al., 2001) and ongoing education about the symptoms of diabetes and the importance of screening even when there are no apparent symptoms of diabetes is needed (Secretariat of the Pacific Community, 2000). In this study, although public awareness of diabetic symptoms was reported by the women who had experienced GDM, women would clearly benefit from a greater awareness of glycaemic symptoms to allow early self-referral, knowing that diabetes frequently occurs in the absence of symptoms, hence the importance of regular blood glucose checks (Dornhorst & Rossi, 1998). Developing personal skills through education is recognised as a key strategy to enable health promoting behaviours (WHO, 1986). However, Dornhorst and Rossi (1998, p. 46) argues that “compliance to lifestyle changes to prevent Type 2 diabetes will only be achieved if women understand the potential benefits to be gained. This will only occur through education, which must be both comprehensible and culturally relevant.”

Follow-up screening – problems and opportunities

Women, particularly obese women, who develop GDM are a prime target for intervention to postpone or prevent the development of Type 2 diabetes (Lauenborg et al., 2004). Developing strategies to encourage follow-up screening would provide an opportunity to provide this ongoing support and education (Chittleborough et al., 2005).

Screening frequency must reflect the population and is particularly important for population groups with a high prevalence of diabetes (Dornhorst & Rossi, 1998) such as women in Tonga. Follow-up screening was reported as problematic in Tonga and is also problematic in other populations (Mc Elduff, 2003). More research is needed on how to maximise follow-up compliance for postpartum screening (England et al., 2009).

Although women often receive intense antenatal education, it usually ends with the delivery. There is an obvious challenge in Tonga (and other populations) for education on how to support women who experience GDM to minimise their risk of developing future diabetes which needs to extend to the postpartum period (Dornhorst & Rossi, 1998).

Lifestyle interventions – effective in GDM/diabetes management and prevention

Women who are overweight (Lauenborg et al., 2004; Löbner et al., 2006) and belong to a high-risk group (Dornhorst & Rossi, 1998; Simmons et al., 1995;
Yue et al., 1996) such as Tongan women are at an increased risk of developing Type 2 diabetes (Hoffman et al., 2003). Obesity is one of the modifiable risk factors for GDM and Type 2 diabetes (Dornhorst & Rossi, 1998; MacNeill et al., 2001). In the Pacific region, the obesity rate is well over 20% and high rates of obesity are paralleled by a high prevalence of diabetes: almost 30% for women (Secretariat of the Pacific Community, 2000).

Lifestyle interventions targeted towards reducing obesity and engaging in more physical activity have been shown to delay or prevent the development of diabetes (DPP Research Group, 2002a; Dornhorst & Rossi, 1998; Fan et al., 1997; Tuomilehto et al., 2001), particularly in overweight women (Dye et al., 1997) and are useful in the management of GDM (ACOG, 2001; Brankston et al., 2004; Hoffman et al., 2003). Lifestyle changes were seen by the women to be difficult to achieve even though they were aware of the benefits of changes. The radio programs and the Walking Program in Nuku’alofa supported by the Ministry of Health and the WHO were seen by all participants to be excellent strategies already in place in Tonga to promote the benefits of lifestyle changes. Health promotion strategies at the broader level including building healthy public policy, creating supportive environments and strengthening community action (WHO, 1986) can support individual efforts to change behaviour.

As one of the health professionals commented, when women lose weight, they reported feeling better and looking better. This was seen as a motivating factor for sustained change. Beliefs and attitudes do influence people’s decisions towards changing their behaviour (Egger et al., 2005) and knowledge alone is not generally sufficient to motivate people to adopt healthy lifestyle alternatives (Egger et al., 2005).

Health promotion programs that highlight the positive benefits of lifestyle changes (weight loss as a result of changes to diet and increased levels of physical activity) may complement strategies already in place in Tonga. Even though more knowledge is needed about how to improve commitment and individual motivation to assist people to make lifestyle changes, Colagiuru (2004) suggests a population approach to diabetes has the potential to reap gains across the continuum of wellness. Lifestyle changes are difficult and individual changes require broader public health support to maximise success (Stage et al., 2004 referring to Ellis, 1999).

In Tonga – GDM not seen as a warning signal for Type 2 diabetes

GDM parallels the incidence of Type 2 diabetes in any country (Asian Pacific Cohort Studies Collaboration, 2007) and women who develop GDM are at a high risk of developing Type 2 diabetes (Kim et al., 2002; Ratner, 2007; Smirnakis et al., 2005). However, within the cultural context of Tonga, GDM was not perceived to be a significant warning signal for future Type 2 diabetes because of the high prevalence of diabetes in Tonga. However, because of the high conversion rates which increase over time from GDM to Type 2 diabetes GDM (Feig et al., 2008; Kim et al., 2002; Lee et al.,
GDM has been identified by some authors as a ‘warning signal’ for the development of future Type 2 diabetes and is viewed as an “excellent marker” (McElduff, 2003) for targeted preventive strategies, both during pregnancy and postpartum.

**Diabetes is an epidemic**

All the health professionals viewed diabetes as the most significant health issue in Tonga and the women interviewed were concerned about the possibility of developing Type 2 diabetes. Fear of developing diabetes (and especially amputation) are not without cause because complications associated with diabetes, particularly severe diabetic foot damage are common in Tonga (Mafi et al., 2001). According to a WHO (2005) report on preventing chronic illnesses (cited in the Asian Pacific Cohort Studies Collaboration, 2007), it is estimated that deaths from diabetes in the South-East Asia region and Western Pacific will increase by 39% and 51% respectively over the next 10 years.

McCarty & Zimmet (2001, p. 243) suggest that the:

> diabetes epidemic in the Pacific region coupled with the significant morbidity and mortality associated with diabetic complications heralds the need for increased attention and resources to primary prevention of diabetes. The fact that the strongest environmental risk factors are potentially modifiable, points to lifestyle intervention, with the incorporation of a healthy diet and increased physical activity as a means of curbing this epidemic in the Pacific region. Promotion of healthy lifestyles, while respecting local culture, poses an enormous challenge but it is essential to optimize health for all Pacific Islanders.

The overall rate of diabetes in Tonga is 15.1% (Colagiuri et al., 2002) which is one of the highest rates in the WHO Asia-Pacific region (Asian Pacific Cohort Studies Collaboration, 2007). The current rate of diabetes in women aged 30 to 64 years is 17.6% (Hufanga & Bennett, 2007). Although the exact estimate of GDM in Tonga is not clear, the frequency of GDM usually reflects the frequency of Type 2 diabetes in the underlying population (Ben-Haroush et al., 2003; Ferrara, 2007). In Tonga, women experience higher rates of diabetes than men (Hufanga & Bennett, 2007) and GDM then becomes another risk factor for Type 2 diabetes (Kim et al., 2002).

**Changes in the Tongan culture – influence on epidemic of diabetes**

Rising prevalence rates of diabetes in the Melanesian, Micronesian and Polynesian populations are closely related to westernisation, urbanisation and mechanisation (Cockram, 2000 p. 43). Whilst this discussion does not come from a neo-colonialist perspective, it is evident that most of the Pacific Island countries have undergone dramatic demographic and epidemiological changes in recent decades. McCarty & Zimmet (2001) suggest three main reasons for this diabetes epidemic in the Pacific:
1. Demographic transition including increasing longevity; shifts in population age structures towards older people; increasing urbanisation and decreases in physical activity;

2. An epidemiological transition (citing Omran, 1971) with changes from communicable to non-communicable disease; and

3. Global economic development with more people adopting a westernised lifestyle to encompass “high-fat, energy-dense diets” (McCarty & Zimmet, 2001 p. 239).

Global chronic disease strategy

Preventing chronic diseases is a global concern. In 2002, a WHO global strategy on diet, physical activity and health to curb the burden of non-communicable diseases, including diabetes was released. The overall goal of this global strategy was to reduce the risk factors that stem from unhealthy diets and physical inactivity and to promote and protect health by guiding “the development of an enabling environment for sustainable actions at individual, national and global levels” (WHO, 2002, p. 3).

Specific strategies in the Asia-Pacific region to encourage the development of new policies that address the prevention and management of obesity and to initiate healthy lifestyle and prevention programs are also in place (WHO, 2002). Preventing chronic diseases including Type 2 diabetes and obesity is on the political, economic and health agenda of the Tongan Ministry of Health (Epping-Jordan et al., 2005; WHO Regional Office for the Western Pacific, 1998).

Conclusion

These results of the interviews with Tongan women who had experienced GDM and health professionals who work in the GDM/diabetes area highlighted the significance of GDM and diabetes in Tonga, and showed the need to support women to reduce their risk factors and some of the factors that influence behavioural change. A diagnosis of GDM often led to intense education and monitoring during pregnancy but changes to diet, physical activity levels and weight management were difficult to achieve. Broad social, economic and demographic changes have negatively influenced patterns of physical activity and dietary changes in Tonga. Public health approaches were seen to be valuable initiatives to support individual behaviour change. Lifestyle interventions are effective for the management of GDM in Tonga and warrant consideration for preventing or delaying the risk of GDM and Type 2 diabetes and need to extend into the postpartum period. Strategies to promote postpartum screening and screening in general emerged as particular areas requiring attention in Tonga.
Stage Two: Comments from the PPAS and the GDM survey

Within the two surveys (the GDM survey and the PPAS), women had the opportunity to respond to an open-ended question inviting further comment of issues raised from the surveys. Themes that emerged from these responses are reported according to commonality. Selected quotes are presented to illustrate the themes.

Postpartum barriers to physical activity

*The intensity of parenting (extrinsic factors)*

Women mentioned many barriers to physical activity postpartum. One of the themes that emerged was the ‘intensity of parenting’ which was associated with various aspects including childcare, housework and lack of time for oneself and lack of support which was incrementally harder with more children. This was a common theme that was articulated regardless of whether the woman had experienced GMD or not.

Jane: 28 years, two small children, no GDM, stated:

“It isn’t so much lack of childcare that stops me from attending classes but the intensity of parenting a six-month old.”

Sally: Age not stated, three small children, had GDM, wrote:

“You really hit the nail on the head – it took me 5½ months for me to start exercising again … it’s been so full on. I’m (almost) ready to put him into the free gym crèche.”

Elizabeth: 33 years, first pregnancy, no GDM, indicated that:

“Many Mums would exercise more if they had support/childcare – lack of time for ourselves is a big problem – but we love our babies!”

Sara: 39 years, five children at home, no GDM, stated:

“The more children you have the harder it is to organise.”

Natasha: 38 years, six children under eight years, had GDM last pregnancy, wrote:

“I don't engage in physical activity outside of childcare/housework which is a necessity. I have no time, no support and no resources for structured exercise.”

Anj: 36 years, two small children, no GDM, said:

“I’ve always enjoyed activity. If I had completed the survey prior to my first pregnancy I would have spent a lot more time being active and far less doing housework! (where there was less to do!)”

Women reported adjusting their physical activity according to the needs of their children.

Susan: 27 years, first pregnancy, with GDM, wrote:
“Not as much time once baby was born, but I have a carrier and I regularly walk with him.”

Bobbie: 34 years, one child, no GDM, said:

“I was very active during my pregnancy but find that now most of my physical activity involves cleaning or walking around with my daughter … activities I used to enjoy I take for granted (like cycling and kayaking) are just too difficult to ‘fit in’ without someone to look after her.”

Breastfeeding

Women’s opportunity and ability to engage in physical activity was further compounded by breastfeeding.

Karlie: 27 years, one pregnancy, no GDM, stated:

“One obstacle to exercise you didn’t consider was breastfeeding. Exercise whilst feeding can be incompatible, affect your milk supply and if the baby is not in a structured routine, difficult to co-ordinate times.”

Rebecca: 21 years, first pregnancy, no GDM, indicated that:

“The biggest barrier to my exercise is breastfeeding especially in the first six months. By the time I had fed my daughter and driven to the gym, I had little time to do much exercise. I found it much easier just to go for long walks with her.”

Advice during pregnancy

Advice emerged as a theme which related to two different things: seeking information about physical activity during pregnancy and being advised against engaging in physical activity. For one woman, the cost of going to the gym precluded accessing information from gym instructors during her pregnancy.

Hannah: 33 years, one child, no GDM, wrote:

“Although I don’t feel money affects my ability to exercise I feel that if it was not an issue at all I would join a gym and exercise more than I do … and get some further advice.”

Nikki: 41 years, first pregnancy, no GDM, stated:

“One of the barriers mentioned was friends saying ‘don’t overdo it’ - even for quite moderate exercise.”

Physiological changes during pregnancy

Physical activity patterns during and after pregnancy were influenced by physiological changes women experienced at different stages of pregnancy. These changes related to feeling uncomfortable, tired and stressed and to getting bigger; the hot weather also made physical activity difficult for some women. Several comments are reported below as examples of common physiological changes.
Darya: 41 years, first pregnancy, no GDM, wrote:

“it seems that my body intelligence was saying slow-down.”

Renae: 23 years, three children, no GDM, stated:

“This is my third pregnancy – my previous two pregnancies I felt awesome, maintained a good running/swimming program up to seven months pregnant – this time I was very sick with morning sickness – not being able to exercise affects me greatly – makes pregnancy much more arduous, tiresome and exhausting!”

Allie: 35 years, first pregnancy, no GDM, indicated that:

“The baby got bigger and the weather got hotter so I exercised less often.”

April: 37 years, first pregnancy, no GDM, said:

“I was quite fit before pregnancy and enjoyed moderated physical activity – maintained bike riding 20-30 kms 3 x week early but then slowed down to walking trimester 3.”

Cath: 38 years, first pregnancy, no GDM, stated:

“Morning sickness in trimester 1, big and uncomfortable in trimester 3.”

Gemma: 36 years, second pregnancy, no GDM, wrote:

“I felt restricted by my body not feeling comfortable while doing any form of vigorous exercise.”

**Vigorous activity is individual**

A theme that emerged was that engaging in vigorous activity is very individual. It was viewed as either harmful or helpful depending on the stage of pregnancy and what the woman was doing before pregnancy.

Katrina: 38 years, second pregnancy, no GDM, wrote:

“Depends on what the woman has been doing before – if she has been active prior to pregnancy, than vigorous physical activity is OK.”

Traci: 34 years, first pregnancy, no GDM, indicated that:

“Vigorous physical activity is a little helpful but it depends on what care you take … adequate fluid intake, not overheating, not putting ligaments at risk late in pregnancy.”

**Intrinsic factors**

Personal benefits of engaging in physical activity during and after pregnancy

Women mentioned a number of personal benefits they gained as a result of participation in physical activity. These benefits were linked to stress and weight management, general fitness, keeping strong and healthy and helpful as preparation for childbirth.

Mia: Age not stated, four pregnancies, no GDM, wrote:
“Yoga and walking keep me fit, healthy and strong. Mentally they both de-stress me, give me quality time on my own – all this contributes to me feeling less frazzled and more able to cope with 4 children and a husband.”

Fiona: 33 years, one baby, no GDM, stated:

“I don’t know whether staying active has allowed me to have a good, healthy pregnancy or having a good healthy pregnancy has allowed me to stay active!”

Louise: Age not stated, first pregnancy, no GDM, elaborated:

“Maintaining a moderate level of physical activity before, during and after pregnancy helped me immensely in staying healthy and keeping my weight in a healthy range. Continuing exercise during pregnancy has helped me to feel more agile in pregnancy, have a positive body image and keep strong and fit for the impending birth.”

April: 37 years, first pregnancy, no GDM, stated:

“My son is now 26 weeks and he is unsettled so I power walk him in the stroller along with the dog. At least this way I achieve ‘something’ and I’m in a better mood as a result – less likely to drop my cornflakes!”

Comments specific to women who experienced GDM

Concerns following a diagnosis of GDM

Women were concerned about being diagnosed with GDM. Concerns were associated with stress, not knowing what to do, putting on weight, and worry about the baby.

Colleen: 34 years, two small children, one instance of GDM, suggested that:

“I was worried about everything; I was pricking my finger all the time and I was scared of putting on weight.”

Melissa: 33 years, one baby, had GDM, considered that:

“Having GDM had a great affect on my pregnancy. I felt a lot of stress around the time of the diagnosis, mainly concern of the effect on the baby.”

GDM management and prevention – physical activity and diet

Women spoke of lifestyle changes they made to physical activity and diet to manage GDM. Changes to diet included adopting a low glycaemic index (GI) diet, reducing portion sizes, and reducing carbohydrate (CHO) intake. The perceived role of changes to physical activity levels or diet in relation to the management and prevention of GDM were evident. Women thought GDM was most effectively controlled though changes to diet rather than physical activity.

Ina: 37 years, six children at home, one instance of GDM, stated:
“I think exercise is part of the answer to help with GDM but I think the main issue is food. No matter how much exercise you do, if you don’t eat the right foods than exercise isn’t going to do much - sticking to the diet is the answer.”

Sharyn: 33 years, two small children, had GDM, wrote:

“I’m not sure about physical activity reducing or eliminating GDM as I was not overweight before I fell pregnant or during my pregnancy. I am and was quite active.”

Ruby: 34 years, two small children, one instance of GDM, considered that:

“Managing weight was never an issue but changing my diet to a low GI diet was the main thing that helped me to manage my GDM. I am also involved in physical activity. It was the portion sizes and CHO that affected my BSL’s as I had no sugar in my diet.”

Natalie: 33 years, one baby, had GDM stated:

“I did more exercise as I wanted to feel healthier, to change my blood sugar levels so I didn’t have to go on insulin and it helped me manage my weight.”

Avoiding Type 2 diabetes postpartum

The possibility of developing Type 2 diabetes after the baby was born emerged as a theme. Women were generally aware of their increased risk of developing Type 2 diabetes and some continued with lifestyle changes made during in pregnancy. Women wanted more information about how to reduce their risk of developing Type 2 diabetes and thought that follow up was very inadequate.

Stephanie: 36 years, one baby, GDM, said:

“Post pregnancy, I felt the diabetic educators didn’t have time or resources to follow patients up. You were asked to hand back the blood glucose monitor and that was it. There was little to no post pregnancy education in relation to GDM and the risks etc. in developing Type 2 diabetes.”

Simone: 34 years, four children at home, one instance of GDM, indicated that:

“After the baby was born I exercised to increase my fitness and energy, to lose baby weight and I want to avoid Type 2 diabetes.”

Natalie: 33 years, one baby, GDM, stated:

“I was told exercise helps control GDM but no information about reducing or eliminating GDM or Type 2 diabetes later on. As I have one child and I am keen for more children the area of preventing this is extremely important for me.”

Natasha: 38 years, six children under eight years, GDM last pregnancy, wrote:

“If I am diagnosed with Type 2 diabetes my husband and I will have to put my health including exercise opportunities on the priority list.”

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Discussion of themes

Issues related to GDM

The themes that emerged from women’s written comments specifically related to GDM (management and prevention, concerns following a diagnosis of GDM, and avoiding Type 2 diabetes postpartum) are discussed in the next section since similar themes emerged from the in-depth interviews with women who had developed GDM.

Barriers and facilitators to physical activity during and after pregnancy

Barriers to physical activity or facilitators to physical activity during and after pregnancy were identified by women in all stages of the qualitative research as well as the quantitative aspect of this research. Within the quantitative research, factor analysis was undertaken to encapsulate the main barriers and facilitators of physical activity both during and after pregnancy. These factors are discussed in more detail in the quantitative aspect of the research. However, the themes cut through every stage of this research. Barriers to physical activity during pregnancy – health related and non-health related.

Health-related concerns

During pregnancy, physiological changes (health-related concerns) were noted by women in the focus groups, in interviews and via women’s written comments as a barrier to physical activity. These changes have been noted in other studies (Evenson et al., 2009). Concerns about the safety of undertaking certain types of physical activity were also mentioned which was reflected in results of other studies about women’s beliefs and attitudes towards physical activity during pregnancy (Clarke et al., 2004; Duncombe et al., 2007).

Non-health-related concerns

Non-health-related concerns including inaccurate advice, lack of advice, and the cost of going to the gym postpartum were identified by women as factors that negatively influenced physical activity postpartum. Conflicting advice, cost of going to the gym, lack of knowledge about activity, and lack of motivation have been identified as barriers to physical activity during pregnancy in other research (Evenson et al., 2009).

In relation to information about physical activity during pregnancy, Clarke et al. (2004) found that advice received from family and friends was largely inaccurate and the lay consensus was to limit physical activity during pregnancy.

Barriers to physical activity after the baby was born – the intensity of parenting

The major barrier women identified to engaging in physical activity after the baby was born related to the intensity of parenting. Similar barriers related to the intensity of parenting have been reported in other studies, especially lack
of time, childcare constraints postpartum (Smith et al., 2005; Symons Downs & Hausenblas, 2004) and personal and family/parenting duties (Albright et al., 2005). Breastfeeding, although beneficial to the mother and the baby (Gunderson, 2007), was identified as a barrier to organising participation in childcare.

Albright (2005) explored physical activity before pregnancy and after childbirth with new mothers in a multi-ethnic sample of 79 healthy women in Hawaii. Women completed surveys and participated in focus groups. Activity levels substantially decreased after pregnancy. The main barriers mentioned overall were personal and family barriers and postpartum lack of and/or unaffordable childcare (Albright et al., 2005).

In this study, one woman commented on the intensity of parenting in that it had taken her 5½ months for her to start exercising postpartum. The challenges of optimising health behaviours whilst caring for a new baby are reported in a study that explored health behaviours of 124 postpartum women (Gennero & Fehder, 2000). The aim of the study was to compare changes in weight loss, nutrition, exercise, caffeine intake, and smoking over the first four months of the postpartum period between mothers of pre-term, very low birthweight babies and mothers of healthy babies. The results showed no differences between the two groups and indicated that whilst mothers were successful in losing weight and managing sleep (but it was <8 hrs), over the four-month period, mothers did minimal exercise, consumed high-fat diets and increased smoking. The authors note the women in the sample were a relatively high-risk group of women who, on average, were poor and unmarried. Even though these women were successful in losing weight, no correlation was found between weight loss and health. At delivery, 22% of women exercised; at one month postpartum, 39% of women exercised; this increased to 42% of women at two months postpartum; then decreased to 37% at four months postpartum (Gennero & Fehder, 2000). The study highlights the need to support mothers in the postpartum period to incorporate exercise into their lifestyles, particularly in high-risk groups of women, and demonstrates that many mothers need to change their health behaviours in the first four months postpartum (Gennero & Fehder, 2000). How this could be achieved was not explored.

Benefits of physical activity

Women in these interviews identified benefits of engaging in physical activity during pregnancy and in the postpartum period that related to stress and weight management, general fitness, preparation for birth and general wellbeing. Similar benefits have been reported in the broader literature and relate to psychological wellbeing (Da Costa et al., 2003; Poudevigne & O' Connor, 2005); improved birth outcomes (Dempsey et al., 2005; Leifer eman & Evenson, 2003); weight management (Owe et al., 2007; Siega-Riz & Hobel, 1997); general fitness; and health outcomes, which outweigh the risks (Brown, 2002). Furthermore, physical activity may reduce the occurrence of GDM (Dempsey et al., 2005; Zhang et al., 2006).


Vigorous activity – individual

Participation in vigorous activity during pregnancy was viewed as individually focused, which parallels discussion in the broader literature. Women who engage in vigorous activity prior to becoming pregnant can benefit from continued vigorous activity during an uncomplicated pregnancy (Kardel, 2004) but information about strenuous activity during pregnancy is scarce (ACOG, 2003). Kishino (2003) suggests that the upper level of safe activity has not been established but the benefits of continuing to be active seem to outweigh any potential risks (Koshino, 2003). There is also evidence to suggest that women who engage in regular physical activity before pregnancy (Zhang et al., 2006) or during pregnancy (Oken et al., 2006) have a lower risk of GDM. In general, vigorous activity confers significant health benefits (Bauman, 2004) but vigorous activity in pregnancy is not recommended without strict medical supervision (Australian Government Department of Health and Ageing, 2005). Even for women who do engage in vigorous physical activity during pregnancy, it tends to decrease in trimester 3 (Borodulin et al., 2008; Schmidt et al., 2006).

Conclusion

Health-related and non-health-related barriers to physical activity, including the intensity of parenting, physiological changes and the quality of information which influenced participation in physical activity, were clearly identified by the women in this study in an analysis of their written comments. Vigorous activity was seen to be specific to the individual woman’s capability and history of pre-pregnancy engagement in physical activity. Benefits of physical activity were also reported. These key issues similarly emerged as themes in other stages of this research and are expanded upon in the discussion of the quantitative results.

Stage 3: In-depth interviews with women who had developed GDM

The results of the interviews with women who had had GDM (Stage 3) have been published (see Appendix 3.).

Eight Australian non-Indigenous women who had experienced GDM were individually interviewed. They were all aged 30 years or over and two women had experienced GDM three times. Demographic data on the interview participants are presented in Table 5.4.
Table 5.4: Characteristics of women in Australia interviewed who experienced GDM

<table>
<thead>
<tr>
<th>Pseudonym</th>
<th>Age at diagnosis (yrs)</th>
<th>Number of children/pregnancies</th>
<th>Number of GDM pregnancies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sue</td>
<td>37</td>
<td>5</td>
<td>1 (last one)</td>
</tr>
<tr>
<td>Cathy</td>
<td>28, 30, 34</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Molly</td>
<td>32</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Amelia</td>
<td>37</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Candy</td>
<td>29, 32, 35</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Toni</td>
<td>40</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Phillipa</td>
<td>30</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Deb</td>
<td>36</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

The principle findings are presented as themes. Direct quotes of women’s words are presented to illustrate key ideas.

Reaction to a diagnosis of GDM

Women’s reactions to a diagnosis of GDM ranged from surprise, to not being surprised, to shock. Margaret, Toni and Deb commented that they were surprised because they felt they had healthy diets and engaged in regular physical activity. They perceived their age as their risk factor for GDM. For Amelia, the diagnosis was devastating, as indicated in the following quote.

“I was devastated – I was shocked … I was desperately hoping it wouldn’t be so high – I was absolutely gutted, I was extremely obsessive and exercised.”

Cathy was not surprised because of her previous history of GDM and Sue thought that being very overweight contributed to the diagnosis.

Need for appropriate information

Information and factors influencing lifestyle change

The strong theme that emerged was that health professionals mainly focused on recommendations for dietary changes with less attention to physical activity.

As Molly stated: “They may have mentioned it [physical activity] but it wasn’t emphasised.”

All women reported adjusting their diets and all except one woman followed the advice of the health professionals.

Deb reported that she “loved the diabetic diet and everyone commented on how well I looked.” Toni did not agree with the dietician’s advice.

Toni commented:

“They sent me off to the dietician and I came out depressed … I went nuh - if I eat what you’re telling me … [to eat carbs with every meal] … I knew it wouldn’t control my BSL … hadn’t they read the latest
research about a high protein diet being more beneficial that a high carb diet?"

Insulin therapy positively and negatively influenced behaviour change. Some wanted to avoid going on insulin (Deb, Amelia and Molly) and some relaxed their diets when insulin therapy did commence. Deb commented:

“I really wanted to control it through my diet and exercise. I was strongly motivated to do all I could so I didn’t have to introduce another needle ... But when I went on insulin I relaxed.”

Whilst all women reported taking advice seriously, or taking the consequences of the advice seriously, several commented that attention to physical activity was difficult. Sue said:

“There’s that ‘E’ [exercise] word – I found it hard.”

**Information about risk of developing Type 2 diabetes**

Women were aware of their increased risk of developing Type 2 diabetes. They commented on the types of information the health professionals had provided in relation to risk reduction, which related to managing weight, eating a healthy diet and engaging in physical activity. Several women had also done their own research into GDM and were aware of their increased risk for diabetes.

Two women commented on the stern approach taken by their endocrinologists who emphasised the risk of Type 2 diabetes. Candy said:

“I was strictly told [by the Endocrinologist] to pull my head in and start doing some things or else I would end up with Type 2 diabetes.”

Dani commented:

“The Endocrinologist reminded me every single time I saw him that there was a high risk of developing Type 2 diabetes and to keep up the diet and the exercise.”

However, Toni was not at all happy about the information provided at the (high risk) antenatal clinic and likened the clinic to a “meat market.”

“Nobody told me anything about Type 2 diabetes ... they were so focused on the immediate pregnancy problems; within a medical model ... OK, if we don't get it under control, we will just put you on insulin ... just a drug solution.”

Women commented on the positive aspect of a diagnosis of GDM in terms of preventing future type diabetes. Sue said:

“GDM was a hidden blessing for me ... GDM can go away after you have the baby but diabetes is not so easily fixable I am much more aware of the need to prevent it.”

**Managing the risk of a potential diagnosis of Type 2 diabetes**

Even though women were aware of the risk factors for developing Type 2 diabetes, changes made during pregnancy were not always maintained
postpartum, mainly because of lifestyle management factors. Key points that emerged under this heading were women’s ability to cope if they were diagnosed with diabetes and the lack of public health information about the dire consequences of diabetes which may contribute to complacency about the need to reduce risk factors for Type 2 diabetes. Deb said:

“There is a recovery phase after having the baby; it is hard for women to manage their lives after the baby.”

Women reflected on whether or not Type 2 diabetes could even be prevented. Candy wondered if there was a genetic inclination towards diabetes. Sue thought she would inevitably develop Type 2 diabetes because of her ongoing difficulties in losing weight.

Candy commented that because she coped with the insulin for managing GDM, she thought she would be able to cope if she did develop diabetes. However, because the possibility of developing diabetes was a “long way off” she believed there was a need for people who were not coping to be more visible:

“I need to see people who aren’t coping with it and how it’s affected their lives … with the smoking there’s heaps of advertising and it’s really scary – there’s nothing like that for diabetes.”

Engaging in physical activity postpartum

**Barriers**

Lack of child-care, lack of affordable childcare, lack of time and feeling tired were the major constraints mentioned by women to engaging in physical activity postpartum.

**Assistance**

Having a supportive partner and family; having enough money to go the gym and/or paying for childcare; and walking with other women in the form of mothers’ groups or general walking groups were factors that supported women to engage in physical activity postpartum.

**Follow up post GDM – individual and health care professional’s responsibility**

Four of the eight women interviewed had their six-week follow-up screening test. Women thought that health professionals could be more supportive of women postpartum but there was a tension between individual responsibilities versus the responsibility of health professionals in relation to follow up.

The absence of postpartum follow up unless initiated by the woman was reported. Whilst Candy stated that there “is no follow up”, Sue was not even sure that health professionals had a role in follow up:

“The antenatal clinic managed me when I was pregnant but I don’t belong to them anymore.”
Phillipa commented about individual responsibility:

“I mean they’ve given you what you need to do and they are not really responsible for you after that – they just look at their side as getting you through the pregnancy … I guess they think you are responsible for your own actions.”

Sue commented that her GP was aware that she had GDM. The follow-up screening test, however, was left up to Sue who made the link with the health service herself. As for Candy, who had developed GDM three times, she was unsure about follow-up screening.

Some women suggested that health professionals could have a role in follow up. It was thought that a reminder letter for the follow-up screening test, sent at recommended screening times would provide an opportunity for support and encourage positive sustained lifestyle changes. A recall reminder system similar to the Pap-smear recall reminder system was suggested or some kind of register for the GPs but Molly reflected that “the GPs are already so overworked.” Amelia thought that “perhaps Diabetes Australia could be the body to take carriage of this.”

**Discussion of themes related to the interviews with women who had experienced GDM**

**Concerns following a diagnosis of GDM**

The diagnosis of GDM was of concern to women who participated in the interviews. Women’s experience of the impact of a diagnosis of GDM are minimally explored in the literature (Exelbert, 2008), as are women’s concerns about how to manage blood glucose levels. However, the broader literature does reflect concerns about pregnancy outcomes as a consequence of a pregnancy complicated by GDM (Kwik et al., 2007; Saydah et al., 2005), risks to the baby (Crowther et al., 2005; Watson et al., 2003) compared to women who do not develop GDM and the mother’s risk of developing future Type 2 diabetes (Löbner et al., 2006), another GDM pregnancy (Cheung & Byth, 2003; MacNeill et al., 2001; Nohira et al., 2005), and worries about developing future Type 2 diabetes (Albright et al., 2005; Evans & O’Brien, 2005; Stage et al., 2004).

One study specifically explored the meaning of an at-risk GDM pregnancy (Evans & O’Brien, 2005) through interviews with 12 women who had experienced GDM. The diagnosis of GDM was found to have had a “deep impact” on the lives of these women (Evans & O’Brien, 2005, p. 72). Similar to the results reported by women in this study who had had GDM, one of the themes that emerged in the study by Evans & O’Brien (2005) was “being a responsible mother” where most of the concerns about GDM were related to the baby. Other themes that emerged in the study by Evans & O’Brien (2005) was of “living a controlled pregnancy” in terms of surveillance and monitoring by a range of people (including themselves, their families and the medical profession), “balancing” the control with required lifestyle changes.
and “being transformed” in terms of planning future changes about their lifestyles as a result of having GDM (Evans & O’Brien, 2005).

Lifestyle changes – diet and physical activity

All women who had GDM who were interviewed in this study were managed within a primary care model, by their specialists, or within a high-risk antenatal clinic. Most women were seen by a dietician. The GDM ADIPS guidelines advocate a team approach (comprised of about six health professionals) (Hoffman et al., 2003); yet, this is not often possible, as was reflected in this group of women.

The advice for lifestyle changes reported by women to manage GDM mainly related to diet, with less attention given to physical activity. Dietary management is the main therapeutic strategy for glycaemic control of GDM (Hoffman et al., 2003); yet, despite the considerable evidence that physical activity is helpful in managing GDM (Avery & Walker, 2001; Mottola, 2007) and has many benefits in pregnancy generally (Brown, 2002; Hegaard et al., 2007), women in this study reported the relatively scant attention given to physical activity. As discussed in the literature review, within the ADIPS GDM management guidelines, there is arguably minimal attention given to physical activity as a serious part of GDM management (Hoffman et al., 2003).

Health education/health promotion

Supporting a woman to adopt healthier behaviour patterns during pregnancy can positively affect her for the rest of her life (Gavard & Artal, 2008), particularly in relation to reducing modifiable risk factors for Type 2 diabetes (Hu et al., 2001). Health promotion in the form of opportunistic health education by health professionals to help women manage GDM was reported by women interviewed. Women’s motivation to follow the advice varied; some were keen to avoid commencing insulin therapy and others were motivated to do their own health research. Although “helping people to know about a problem does not necessarily help people to do something about it” (Keleher, 2001, p. 58 referring to Ritchie & Short, 2000), the provision of health information by health professionals at a micro level (during consultations) can empower women to adopt healthier lifestyles and to raise awareness of health issues (Keleher, 2007a). Empowerment is a key principle of health promotion which is part of the Ottawa Charter of ‘enabling’ (Keleher, 2007b).

Avoiding Type 2 diabetes: Follow-up issues

From these interviews, postpartum follow-up support for women was not evident despite the evidence that this group of women are at risk of developing Type 2 diabetes. The issue of responsibility for health and health care postpartum was highlighted by women. Some women reported that they were not sure if the health professionals had a role in follow up and that unless women initiated the follow up, it would not happen. ADIPS GDM management guidelines recommend that women with GDM are counselled regarding their increased risk of developing permanent diabetes and given
advice on healthy eating and physical activity (Hoffman et al., 2003). When and how this happens warrants further consideration as this was an area of lack for women interviewed.

Postpartum screening was inadequate for women in this study and in general is problematic (Kim et al., 2002). Follow-up screening is essential for women who have had a pregnancy complicated by GDM (The Royal Australian and New Zealand College of Obstetricians and Gynaecologists, 2006). If diabetes is detected earlier, intervention can begin earlier to prevent or reduce the possible serious long-term complications. “Consistent recommendations, together with a professional and public health campaign to raise awareness of GDM as a diabetes predictor, will be necessary to improve past-partum care of women at highest risk” (Ratner, 2007, S.244).

Managing the risk of a potential diagnosis of Type 2 diabetes

Even though women were aware of the risk factors for developing Type 2 diabetes, changes made during pregnancy were not always maintained postpartum, mainly because of lifestyle management factors. Lack of lifestyle change (mainly to dietary change) for women postpartum GDM has been reported in other research. A prospective study reporting on a dietary intervention for women with women who had GDM, which also collected data on physical activity, revealed that physical activity levels did not change at all during pregnancy and although some dietary changes were made initially these were not sustained postpartum (Fehler et al., 2007). The study involved a pre-test collection of baseline information on physical activity. Dietary intake during pregnancy was then followed by dietary intervention only. Data were recollected at two weeks post-dietary intervention, six weeks, and six months postpartum. The study, although very small (19 women were initially recruited but this dropped to 11 women postpartum), nevertheless highlights the lack of lifestyle changes made postpartum for women who are at a high risk of developing future diabetes (Fehler et al., 2007).

The risks associated with a diagnosis of GDM

Women in the interviews expressed conflict that, even though they were aware of their increased risk of Type 2 diabetes, the disease was perceived to be a long way off and some felt confident they could cope if they did develop Type 2 diabetes (as they had already managed diabetes in pregnancy). Women noted the lack of public health information about the dire consequences of diabetes. One woman suggested that a public health campaign to educate people about the effects of diabetes was needed to curb this significant public health issue, similar to the current graphic campaigns on the television about speeding and smoking cigarettes (NSW Roads and Traffic Authority, 2006; QUIT Victoria, 2007). Much of the health promotion/public health focus to date has targeted the modifiable lifestyle risk factors for diabetes such as promoting physical activity (and also to promote weight loss) and eating a healthy diet. In Australia, there has been little public health attention on education about the silent nature of the
disease and the need for preventive screening, or the dire health consequences of Type 2 diabetes. Type 2 diabetes is referred to as a silent epidemic (Australian Consumers Association CHOICE, 2005) and is one of the most challenging public health problems of the 21st century (Miller & Dunstan, 2004).

Barriers to physical activity

Women are presented with real barriers to physical activity when caring for a newborn baby even they are aware of the benefits gained from participation in physical activity. The main barriers, which are also supported in the literature, were: lack of support from their partner, being too busy, not having enough time, and lack of childcare (Albright et al., 2005; Evenson et al., 2009). These barriers not only impinge on women’s opportunity to engage in physical activity but make it difficult to attend a doctor’s appointment for follow-up screening. As stated before, the factors that influence participation in physical activity are discussed in more detail in quantitative research results chapter.

Conclusions from interviews with women who experienced GDM

The insights gained from the women who had experienced GDM provided clear indications that support for lifestyle change, including physical activity, for women is an important component of antenatal care. An understanding of the social determinants that influence women’s lives and their ability to manage GDM and participate in physical activity may inform a more empowering approach to antenatal care. This approach needs to extend into the postpartum period in order to support women to reduce their risk of developing future Type 2 diabetes.

Knowledge about the risk of possibly developing Type 2 diabetes in the future does not necessarily transpose into lifestyle changes. Follow-up screening is essential for women who have had a pregnancy complicated by GDM. Comprehensive approaches are needed on both an individual and broader level to support and empower women to adopt and sustain healthy lifestyle changes during pregnancy and in the postpartum period. Women’s empowerment is important and there is a need to develop strategies for self-management. Given the absence of adequate health education for these women, it is recommended that self-management strategies are developed to support women in the post-partum period. It is also recommended that these strategies include a set of self-management tools that will further assist women to participate in physical activity.

Individual support for lifestyle change needs to be complemented with broader public health and health promotion initiatives that improve public awareness of the silent nature of the symptoms of diabetes with attention drawn to ways to reduce the modifiable risk factors which includes physical activity. The strong theme that emerged from these interviews was that health professionals mainly focused on recommendations for dietary changes with
less attention to physical activity. A better balance is needed to target the key modifiable risk factors for diabetes, not just diet.

**Conclusion of all stages of the qualitative research**

Similar themes emerged in all stages of the qualitative research. All women reported that, during pregnancy, minimal attention was given to physical activity, despite their frequent interaction with their health care providers. Women were aware of the benefits of physical activity; some were not sure what they could safely do during pregnancy and some received inaccurate advice from friends and family. For pregnant women who experienced a diagnosis of GDM, the common theme reported was that they were then advised to make lifestyle changes to manage GDM, but most of the attention was directed towards dietary changes.

Although dietary management is the standard management of GDM, the beneficial role of physical activity is evident in terms of management of GDM, prevention of GDM, and to ameliorate women’s increased risk of developing future Type 2 diabetes. Given the low prevalence of recommended physical activity levels in the Australian population, coupled with the benefits to be gained from participation in physical activity during pregnancy irrespective of a diagnosis of GDM, the lack of attention to physical activity reported by all women in this study was disconcerting.

Concerns with weight emerged as a common theme for women in all stages of the qualitative research. Obesity and lack of physical activity were issues highlighted in interviews with the Tongan health professionals. In Tonga, the health professionals did not see GDM as a significant warning signal for the development of GDM, given the high prevalence of diabetes in Tonga, which was considered to be the most significant health issue in Tonga. However, the evidence is clear that a diagnosis of GDM places women at an increased risk of developing Type 2 diabetes and that obesity and lack of physical activity are significant modifiable risk factors for both GDM and Type 2 diabetes. Diabetes is also a significant public health issue in Australia. All women who had experienced GDM in this study were aware of their increased risk for Type 2 diabetes but difficulties in making lifestyle changes during pregnancy and in the postpartum period were reported.

Health care providers have a unique opportunity to encourage pregnant women to become active. An empowering partnership between health professionals and women, reflective of an ‘education for health’ approach may enable women to develop the necessary personal skills to make informed choices about adopting healthy lifestyle practices both during pregnancy and in the postpartum period. Furthermore, attention to the factors women identified in all stages of this research that both support and hinder their participation in physical activity is essential to maximise support for behavioural change. An understanding and recognition of the social determinants which influence women’s opportunities to engage in physical activity during pregnancy and in the postpartum period warrants...
consideration by health professionals so that strategies can be developed to support women’s participation in physical activity. Effective health promotion at an individual level is most effective with broader public health initiatives (WHO, 1986), which were positively commented on by the health professionals and the women interviewed in Tonga.

Surveillance of all women at high risk of developing Type 2 diabetes is important (Mafi et al., 2001). Ongoing education on the importance of screening even when there are no apparent symptoms of diabetes is needed (Secretariat of the Pacific Community, 2000). This was particularly evident in Tonga but is an issue for all women who develop GDM. Public awareness of diabetic symptoms would be clearly beneficial, together with education that diabetes frequently occurs in the absence of symptoms, hence the importance of regular blood glucose checks (Dornhorst & Rossi, 1998). As Dornhorst and Rossi (1998) argue, compliance with lifestyle changes to prevent Type 2 diabetes will only be achieved if women understand the potential benefits to be gained. However, clear strategies to encourage women to attend postpartum screening need to be developed. Australian women who experienced GDM suggested recall strategies or reminder systems as ways to promote postpartum screening and lifestyle support. The need for clearer responsibilities for this support was also highlighted in these interviews.

The next chapter

Chapter 6 reports on the results of the quantitative stages of the research: the GDM survey, the PPAS and the seven-day recall physical activity diary. Patterns and types of physical activity before pregnancy, during pregnancy, and in the postpartum period; information about physical activity provided to women by health professionals; women’s attitudes towards physical activity; follow-up issues; and factors that hinder and facilitate women’s participation in physical activity were explored via quantitative data collection methods.
Chapter 6: Quantitative data analysis
Introduction

In this chapter, the results of the second stage of the research, the quantitative research are reported. The research instruments used in the quantitative stage of research were the Pregnancy and Physical Activity Survey (See Appendix 4.10), the GDM Survey (See Appendix 4.11) and the seven-day Physical Activity Recall Diary (see Appendix 4.12). As discussed in the methodology section, statistical analysis was undertaken using the SPSS computer program. In line with the usual convention of reporting results of quantitative research, the results are presented in the first instance without any discussion or interpretation. The results are discussed in relation to the broader literature in Chapter 7.

Characteristics

One hundred and twelve women participated in the study. Of these, 32 women had developed GDM in a previous pregnancy and eight were currently pregnant with GDM. Over 70% of women (n=81) who participated in the study attended a northern NSW health centre.

Table 6.1 indicates the characteristics of the sample.

Table 6.1: Characteristics of participants in quantitative stage

<table>
<thead>
<tr>
<th>Sample size</th>
<th>112</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean age ±S.D. (years) (n=104)</td>
<td>32.65 ±5.337</td>
</tr>
<tr>
<td>Mean number of children ±S.D.)</td>
<td>1.35 ±1.456</td>
</tr>
<tr>
<td>Attended northern NSW health centre</td>
<td>72.3%</td>
</tr>
<tr>
<td>Percentage married</td>
<td>74%</td>
</tr>
<tr>
<td>Family income ≥$40,000 per annum (%)</td>
<td>74%</td>
</tr>
<tr>
<td>Percentage with undergraduate or post-graduate degree</td>
<td>58%</td>
</tr>
<tr>
<td>Percentage completed Year 12</td>
<td>73%</td>
</tr>
<tr>
<td>Ethnicity/country of birth ATSI (n=1)</td>
<td>1%</td>
</tr>
<tr>
<td>Australian (n=97)</td>
<td>86.6%</td>
</tr>
<tr>
<td>Current or previous GDM (%)</td>
<td>35.7%</td>
</tr>
<tr>
<td>Family history of diabetes (%)</td>
<td>36.6%</td>
</tr>
<tr>
<td>Family history of GDM (%)</td>
<td>11.6%</td>
</tr>
</tbody>
</table>

Over 67% of women were over 30 years of age (range=18-45 years) (see Figure 6.1).
Results from cross tabulation for ‘age’ and ‘ever had GDM’ showed that a greater percentage of women with GDM were ≥30 years (80%) compared to 59.4% without a history of GDM.

The mean number of children women had in this study was 1.35. Less than 15% of women had more than two children and 30% were pregnant for the first time.

Marital status

Twenty-five percent of the women in the study reported their marital status as single. However, in the survey there was no response category for de facto relationship. Women who wrote down they were in a de facto relationship (on the survey) were coded as married. As such, the results indicate that 74% of women were married.

Educational background and income

Almost 50% of women held a degree of some kind (27% bachelor degree; 20% post-graduate degree). Thirty percent of women had a certificate and 10% of women had a graduate certificate/diploma level of education. Almost 75% of women had completed Year 12. Almost 74% of women reported a family income level of ≥$40,000 per annum.
Family history of diabetes

Forty-one women (36.6%) in the study reported a family history of diabetes. A higher percentage of women in the GDM group (52.5%) had a family history of GDM compared to women who had never had GDM (27.8%), although this was not statistically significant. The relationship between having had GDM (as measured by ‘ever had GDM’) and having a family history of diabetes (as measured by ‘family history of diabetes’) was investigated using Pearson product-moment correlation coefficient. Preliminary analyses were performed to ensure no violation of the assumptions of normality, linearity and homoscedasicity. There was not a strong positive association between the two variables ($r=.246, n=112, p<.009$).

GDM and family history of GDM

Thirteen women reported a family history of GDM; 10 of these were in the GDM group. The relationship between having GDM (as measured by ‘ever had GDM’) and having a family history of GDM (as measured by ‘family history of GDM’) was investigated using Pearson product-moment correlation coefficient. Preliminary analyses were performed to ensure no violation of the assumptions of normality, linearity and homoscedasicity. There was a strong positive association between the two variables ($r=.311, n=106, p<.001$).

Levels of physical activity: Incidental and volitional

Women were asked to estimate the time for incidental and volitional activity undertaken each day over an average week before pregnancy, during trimester 3, and after the baby was born.

Incidental activity

Frequency counts were undertaken for all activities. Self-reported time of a period of ½ hour to two hours for each activity was calculated for the most commonly undertaken activity (see Table 6.2). There were very small numbers in some activities which excluded comparisons between the GDM and non-GDM groups.
Table 6.2: Time (½ to two hours) on incidental activity

<table>
<thead>
<tr>
<th>Activity</th>
<th>Pre-pregnancy</th>
<th>Trimester 3</th>
<th>Post-pregnancy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>% (n)</td>
<td>% (n)</td>
<td>% (n)</td>
</tr>
<tr>
<td>Cleaning (light)</td>
<td>69.5% (77/108)</td>
<td>80% (56/85)</td>
<td>68% (56/82)</td>
</tr>
<tr>
<td>Cleaning (heavier)</td>
<td>30% (32/107)</td>
<td>30% (30/100)</td>
<td>34.5% (28/81)</td>
</tr>
<tr>
<td>Preparing meals</td>
<td>78% (85/109)</td>
<td>74.5% (77/103)</td>
<td>70% (54/82)</td>
</tr>
<tr>
<td>Dressing children (whilst sitting)</td>
<td>25% (27/107)</td>
<td>30.7% (38/81)</td>
<td>47% (38/81)</td>
</tr>
<tr>
<td>Dressing children (while standing)</td>
<td>27% (29/108)</td>
<td>24% (25/103)</td>
<td>46% (51/82)</td>
</tr>
<tr>
<td>Shopping</td>
<td>34% (36/107)</td>
<td>39% (38/97)</td>
<td>26.5% (22/83)</td>
</tr>
<tr>
<td>Playing with children (while sitting or standing)</td>
<td>38% (36/107)</td>
<td>22% (23/104)</td>
<td>49.5% (41/83)</td>
</tr>
<tr>
<td>Playing with children (while walking or running)</td>
<td>18.5% (20/108)</td>
<td>16.5% (17/1030)</td>
<td>51% (43/82)</td>
</tr>
<tr>
<td>Sitting, reading, talking, on the phone</td>
<td>53.5% (60/109)</td>
<td>50% (56/102)</td>
<td>28% (31/82)</td>
</tr>
<tr>
<td>Watching TV</td>
<td>58.1% (65/109)</td>
<td>54% (60/101)</td>
<td>32% (36/82)</td>
</tr>
<tr>
<td>Driving or riding in car or bus?</td>
<td>50.5% (54/107)</td>
<td>42% (43/102)</td>
<td>34% (28/82)</td>
</tr>
</tbody>
</table>

Women spend less time after the baby is born driving, shopping, talking on the phone, reading, and watching TV. After the baby was born, women’s activity increased for child-related activities (dressing and playing with children). Time spent on light and heavy cleaning was fairly similar across all stages except for light cleaning which slightly increased during trimester 3.

When all activity was calculated (activity reported/total number of women); 43% (521/1186) of women spent ½ to two hours of incidental activity during trimester 1, 42.8% (463/1081) in trimester 2 and 46% (428/902) in trimester 3.

Volitional activity

Volitional activity women reported undertaking before pregnancy, during trimester 3, and after the baby was born were categorised as follows:

None = no activity

Minimum = <30 minutes a day/week to ≥30 minutes a day one to two times/week

Moderate = ≥30 minutes a day, three to four times/week or most days of the week

Walking slowly for fun or exercise: All women

Nearly all women reported spending no time walking slowly before pregnancy (90.4%). Few women reportedly engaged in minimum or moderate levels of walking slowly before pregnancy (9.6%). This changed during
pregnancy and after the baby was born. Women reported spending more time walking slowly at minimum and moderate levels throughout their pregnancy (69.3%) and after the baby was born (72.2%) compared to before pregnancy (9.6%) (see Figure 6.2)

**Figure 6.2: Walking slowly for fun or exercise – all women**

Walking slowly: Comparisons between GDM and non-GDM groups

Both GDM and non-GDM groups of women reported a much higher incidence of walking slowly at minimum and moderate levels during trimester 3 and after the baby was born compared to before pregnancy (see Figure 6.3). There was a clear increase for walking at minimum levels for GDM women: (from 3% pre-pregnancy to 65% during trimester 3, to 67.5% post-pregnancy). Women without GDM also reported similar increases in walking at minimum levels (from 13% pre-pregnancy to 42% during trimester 3, to 47% post-pregnancy). Moderate levels also increased for both groups (see Figure 6.3).

The results indicated that women who did not walk (at a slow pace) before they were pregnant did more walking during their pregnancy which was sustained after the baby was born, especially the group of GDM women.
To test if there were any significant differences between the GDM group and non-GDM group for walking slowly after the baby was born, an independent samples t-test was conducted. At the p<.05 level there were no significant differences in scores for those with GDM ($M=2.0$, $SD=.58554$) and those without GDM ($M=1.7907$, $SD=1.7907$, $t(1.413)=.010$, $p=.162$). The magnitude of the difference in the means indicated a large effect size ($\eta^2=.105$).

Furthermore, when independent t-tests were performed for walking slowly, walking quickly, swimming and vigorous levels of physical activity (discussed in the next section) for each of the three stages to compare difference in means for the two groups, no significant differences in means were found between the two groups for an alpha level set at either $p<.05$ or even at a higher level of $p<.15$.

Attitudes towards gentle physical activity
All women (n=108) believed gentle physical activity was helpful during pregnancy; most believing it was very helpful (81.5%).

Moderate levels of physical activity
This was defined as activity that made it harder to breathe but not puff or pant.

Frequency counts were undertaken for questions associated with moderate level of volitional physical activity: walking quickly, team sports jogging, swimming, supervised exercise class, aqua aerobics or any other moderate
intensity exercise. There were very small numbers in most of the activities which precluded comparisons between the GDM and non-GDM groups.

A review of the frequency counts showed the most frequently reported physical activities were walking and swimming. Further frequency counts on these activities were undertaken.

Walking quickly for fun or exercise: All women

Overall, more women reported spending more time walking quickly at minimal and moderate levels before they were pregnant (77%), compared to trimester 3 (63%), and after the baby was born (69%).

Women spent most time engaging in moderate or recommended levels of walking quickly before pregnancy (36.8%). This dropped to 12.9% during pregnancy and then increased to 30.9% after pregnancy.

Time spent walking quickly was lowest during pregnancy and after the baby was born. After the baby was born, women did not resume their pre-pregnancy levels of walking quickly (see Figure 6.4).

Figure 6.4: Walking quickly for fun or exercise – all women

Walking quickly for fun or exercise: Comparison between GDM and non-GDM group

The percentage of both groups of women who reported walking quickly before pregnancy was similar (67% GDM, 70% non-GDM). During trimester 3, this increased for the GDM women, especially at the minimum level (52% compared to 23% for the non-GDM group) and, similarly, after the baby was born, a greater percentage of GDM women reported walking quickly at
minimum and moderate levels compared to women who had never had GDM (74% GDM, 55% non-GDM) (see Figure 6.5).

**Figure 6.5: Walking quickly for fun or exercise: comparison between GDM and non-GDM group**

A smaller percentage of all women swam after their babies were born (35.4%) compared to before pregnancy (41%). Slightly more women swam at the minimum level during trimester 3 (37%) compared to before pregnancy (32.4%) but this declined after the baby was born (29.3%) (see Figure 6.6).
Swimming for fun or exercise: Comparison between GDM and non-GDM group

Over 50% of women in the GDM group and approximately 60-70% of women in the non-GDM group did not swim at any stage.

Women in the non-GDM group swam less after the baby was born (70%) compared to before the baby was born (56%). Women in the GDM group swam more at the combined minimum and moderate levels during trimester 3 (50%) compared to non-GDM (43%) with a similar pattern after the baby was born between the two groups (43% and 32% respectively) (see Figure 6.7).
Attitudes and beliefs towards moderate levels of physical activity

Ninety-five percent reported they either moderately enjoyed (40.7%) or extremely enjoyed (54.6%) moderate levels of physical activity before pregnancy. Just fewer than 5% (5/108) of women indicated lack of enjoyment of moderate physical activity before they were pregnant.

An independent samples t-test was conducted to compare the enjoyment of moderate physical activity for women with and without GDM. There was no significant difference in scores for the GDM group ($M=2.4872$, $SD=.60139$) and the non-GDM group ($M=1$, $SD=2.5072$, $p=.867$).

Similarly, when women were asked their beliefs about moderate physical activity during pregnancy, 99% believed moderate physical activity was beneficial during pregnancy to some extent (a little helpful, 10.2%; somewhat helpful, 24.1%; or very helpful, 64.8%). Only one woman believed moderate physical activity during pregnancy was harmful.

Advice from health care provider to engage in more regular, moderate levels of physical activity

All women were asked to report if they had ever been advised by their health care provider, either during pregnancy or after the baby was born, to engage in more regular, moderate levels of physical activity. Of 107 women who answered this question, >77% ($n=83$) reported not being given such advice.

An independent samples t-test was conducted to compare any difference between the GDM group and non-GDM group in advice received either during or after the baby was born from a health care provider to engage in more regular, moderate levels of physical activity. At the $p<.05$ level, there was a significant difference in scores for those with GDM ($M=1.69$, $SD=.614$) and those without GDM ($M=1.93$, $SD=.434$, $t(105)=-2.831$, $p=.023$, eta squared=.04).
Vigorous levels of physical activity
This was defined as activity that made breathing harder and to puff or pant.

**Vigorous activity: All women**

Most women (>80%) reported not engaging in vigorous levels of physical activity for any stage. Slightly more women reported moderate to recommended levels of vigorous physical activity before the baby was born.

Only a small percentage of all women reported engaging in vigorous activity during each stage. Women did less in trimester 3. Women did not return to their pre-pregnancy minimum to moderate levels of vigorous physical activity (16.5%) after the baby was born (13%) although the differences are small (see Figure 6.8).

**Figure 6.8: Vigorous physical activity – all women**

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**Vigorous activity: Comparison between GDM and non-GDM groups**

There are very few differences between the two groups. Approximately 85% of women in both groups reported engaging in no vigorous physical activity across all stages (see Figure 6.9).
Attitudes and beliefs towards vigorous levels of physical activity before and during pregnancy

Women were asked if they enjoyed vigorous levels of physical activity before they were pregnant. Seventy-nine percent reported they either enjoyed (either moderately, 47% or extremely, 32%) vigorous levels of physical activity before pregnancy. Around one in five women (23/108) did not enjoy physical activity at a vigorous intensity before pregnancy.

Of the 107 who reported their beliefs about vigorous physical activity during pregnancy, over half (54.2%) believed vigorous physical activity was harmful during pregnancy and just less than half of the women believed vigorous physical activity was helpful to some extent during pregnancy (a little helpful, 29%; somewhat helpful, 10.3%; and very helpful 6.5%).

Physical activity diary

Two hundred diaries were made available for women to complete (150 were posted to the GDM group and 100 were included in the general survey packages which were voluntarily collected by women mainly at the antenatal clinic). Forty-eight completed diaries were returned (see Table 6.3).
Table 6.3: Stage physical activity diary completed

<table>
<thead>
<tr>
<th>Stage</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trimester 1</td>
<td>4</td>
<td>8.3</td>
</tr>
<tr>
<td>Trimester 2</td>
<td>10</td>
<td>20.8</td>
</tr>
<tr>
<td>Trimester 3</td>
<td>21</td>
<td>43.8</td>
</tr>
<tr>
<td>After baby born</td>
<td>13</td>
<td>27.1</td>
</tr>
<tr>
<td>Total</td>
<td>48</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Women were asked to indicate the type of activity undertaken and the intensity level of the activity over the previous seven days. The types of physical activity were later re-classified into six categories which were determined after an examination of the frequency analysis for all types of activity (see Table 6.4).

The percentage of types of activity reported (as a percentage of the total activity) showed the most common activities were housework (38%) (which included cleaning, vacuuming, mopping, tidying up, washing up, laundry); walking (27%); childcare activities (15%); yoga/pilates (5%); and any ‘other’ activity (9%). The numbers in each cell were too small to explore any difference (when correlation and chi square analysis was undertaken) in levels of activity for different stages (see Table 6.4).

Table 6.4: Frequency of types of physical activity

<table>
<thead>
<tr>
<th>Type of activity</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Walk</td>
<td>187</td>
<td>27%</td>
</tr>
<tr>
<td>Swim</td>
<td>39</td>
<td>6%</td>
</tr>
<tr>
<td>Childcare</td>
<td>104</td>
<td>15%</td>
</tr>
<tr>
<td>Housework</td>
<td>262</td>
<td>38%</td>
</tr>
<tr>
<td>Yoga/pilates</td>
<td>33</td>
<td>5%</td>
</tr>
<tr>
<td>Other</td>
<td>66</td>
<td>9%</td>
</tr>
<tr>
<td>Total</td>
<td>691</td>
<td>100%</td>
</tr>
</tbody>
</table>

For each activity women were also asked to indicate the level of intensity. Women could refer to the description of gentle, moderate or vigorous level of intensity which was outlined in the diary. Almost two-thirds of the activity was reported to be at the gentle intensity level (63%) (see Table 6.5). Very few activities were undertaken at a vigorous level of intensity. Women did not report a level of intensity for every activity mentioned.
Table 6.5: Level of intensity of physical activity

<table>
<thead>
<tr>
<th>Level of intensity of activity</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gentle/steady pace (does not leave you out of breath)</td>
<td>407</td>
<td>63%</td>
</tr>
<tr>
<td>Moderate (leaves you slightly out of breath but not that you puff or pant)</td>
<td>214</td>
<td>33%</td>
</tr>
<tr>
<td>Vigorous (makes you breathe harder so you puff or pant)</td>
<td>251</td>
<td>4%</td>
</tr>
<tr>
<td>Total</td>
<td>646</td>
<td>100%</td>
</tr>
</tbody>
</table>

Stages of change

Women were asked to reflect on their intention to engage in physical activity before they became pregnant (see Table 6.6). Almost 20% of women reported that they did not engage in any physical activity before they became pregnant but they did intend to start. Over half the women reported that they had been participating in regular physical activity for the past six months and they intended to continue this activity.

Table 6.6: Stages of change

<table>
<thead>
<tr>
<th>Intention</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>I don't currently engage in any regular physical activity and don't intend to start</td>
<td>4</td>
<td>3.7%</td>
</tr>
<tr>
<td>I don't currently engage in any regular physical activity and do intend to start</td>
<td>21</td>
<td>19.6%</td>
</tr>
<tr>
<td>I do engage in physical activity and I am prepared to increase this to five times per week for 30 mins or longer</td>
<td>15</td>
<td>14%</td>
</tr>
<tr>
<td>I currently participate in regular physical activity and have done so for the last 6 months and intend to continue</td>
<td>61</td>
<td>57%</td>
</tr>
<tr>
<td>Total</td>
<td>107</td>
<td>100%</td>
</tr>
</tbody>
</table>
Factor extraction – results

According to Pallant (2005) the researcher determines the number of factors that they believe best portrays the underlying relationship between the variables, which involves “balancing two conflicting needs: the need to find a simple solution with as few factors as possible, and the need to explain as much of the variance in the original data set as possible” (Pallant, 2005, p. 175). There are a number of tests which can assist in the decision as to how many factors to retain (Kaiser’s criterion, the Scree test and an additional test of Parallel analysis). The first two tests were used.

Tabachnick & Fidell (2001 in Pallant, 2005) advocate an exploratory approach to determine the smallest number of factors that can best represent the interrelationship between variables, that is to experiment with a number of factors until a clear or satisfactory solution is found.

The items that helped or hindered women to engage in physical activity during and after pregnancy were subjected to principal components analysis (PCA) using SPSS version 14. Prior to performing PCA, the suitability of data for factor analysis was assessed. Inspection of the correlation matrix was reviewed for coefficients .3 and above. The Kaiser-Meyer-Okkin value (for a value .6 or above) and the Bartlett’s Test of Sphericity (that is for a Sig. value .05 or smaller) (Bartlett, 1954 in Pallant, 2005) were reviewed to determine if statistical significance was reached to support the factorability of the correlation matrix.

PCA was undertaken to examine eigen. An inspection of the screeplot was examined to reveal clear breaks after one or two components. A change in shape of the plot was assessed. Using Catell’s (1996) scree test (as outlined in Pallant, 2005), it was decided to retain two components for further investigation in each of the analyses.

To aid in the interpretation of these two components, rotation was performed. Rotating the factors does not change the underlying solution but presents patterns of loadings which aid an easier interpretation (Pallant, 2005). Varimax rotation was performed first. The rotated solution revealed the presence of simple structure (Thurstone, 1947 in Pallant, 2005), with both components showing a number of strong loadings and all variables loading substantially on only one component when the coefficient values were suppressed at less than >.5. In some analysis, the coefficient level at <.5 revealed many cross loadings where variables loaded on one or more component. With a coefficient level that was suppressed for values not less than >.5, the identification and labeling of the two components became clearer.

However, when Oblimin rotation is performed and a strong correlation between factors is found, Pallant (2005) suggests presenting the results according to the Oblimin rotation which will reduce discrepancies between
the two forms of rotation. This is how the results are presented. Factors that hinder and facilitate women’s participation in physical activity are labelled.

Inference

Factor analysis yielded interesting data about the factors that both hindered and helped women to engage in physical activity during pregnancy and in the postpartum period. The factors that emerged from the quantitative aspect of the research were similar to factors identified by women in the qualitative component of the study. The inference process in mixed methods research “is the process of making sense out of the data analysis … (which) … consists of a dynamic journey from ideas to data to results in an effort to make sense of data by connecting the dots” (Teddlie & Tashakkori, 2009, p. 287). In the next chapter, the ‘dots are connected and an integrated discussion of the results of different stages of the research is presented.

The strength of these results is linked to inference quality, which is evident in this mixed methods study. In quantitative language, this is known as internal validity and statistical conclusion validity; in qualitative language, the term is related to credibility and trustworthiness (Teddlie & Tashakkori, 2009). Inferences, which are conclusions and interpretations made on the basis of the data collected, are presented in the final chapter.

Factor analysis of items that helped and were barriers to engaging in physical activity during pregnancy and after the baby was born

Items that helped women to engage in physical activity during pregnancy

The 12 possible items used in the survey that helped women to engage in physical activity during pregnancy were subjected to PCA.

PCA (see Appendix 6.1) revealed the presence of two components with eigen values exceeding 1, explaining 59.794% of the variance (45.276% and 14.518%) respectively. An inspection of the screeplot (see Appendix 6.2) revealed a clear break after the second component. Using Catell’s (1996) scree test, it was decided to retain two components for further investigation.

Varimax rotation was performed (see Table 6.7). The rotated solution revealed the presence of a simple structure (Thurstone, 1947 in Pallant, 2005), with both components showing a number of strong loadings and all variables loading substantially on only one component when the coefficient values were suppressed at less than >.5. The two-component solution explained a total of 59.794% of variance, with Component 1 contributing to 31.670% and Component 2 contributing to 28.124%.
Table 6.7: Rotated Component Matrix(a) with coefficient suppressed at values not less than >.5

<table>
<thead>
<tr>
<th>Component</th>
<th>1</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>look better/healthier when exercise</td>
<td>.858</td>
<td></td>
</tr>
<tr>
<td>helps manage weight</td>
<td>.838</td>
<td></td>
</tr>
<tr>
<td>enjoy exercising</td>
<td>.769</td>
<td></td>
</tr>
<tr>
<td>helps manage stress</td>
<td>.749</td>
<td></td>
</tr>
<tr>
<td>to prevent later health problems</td>
<td>.619</td>
<td></td>
</tr>
<tr>
<td>scared of getting Type 2</td>
<td></td>
<td>.844</td>
</tr>
<tr>
<td>support from friends</td>
<td></td>
<td>.788</td>
</tr>
<tr>
<td>have someone to exercise with</td>
<td></td>
<td>.764</td>
</tr>
<tr>
<td>support from family</td>
<td></td>
<td>.764</td>
</tr>
<tr>
<td>support from doctor/diabetes educator</td>
<td></td>
<td>.616</td>
</tr>
<tr>
<td>having a place to exercise</td>
<td></td>
<td>.608</td>
</tr>
</tbody>
</table>

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
A Rotation converged in 3 iterations.

The interpretation of this research suggests the scale is useful to explore and identify the factors that most help women to engage in physical activity during pregnancy.

The factors that mainly helped women to engage in physical activity in one component are associated with the personal benefits (or positive intrinsic factors) of engaging in physical activity. The factors identified in Component 2 are external factors (or extrinsic factors) that help women engage in physical activity during pregnancy.

The factors have therefore been labelled ‘intrinsic’ and ‘extrinsic’.

Items that helped women to engage in physical activity after the baby was born

The 12 possible items used in the survey that helped women to engage in physical activity after the baby was born were subjected to PCA.

PCA (see Appendix 6.3) revealed the presence of two components with eigen values exceeding 1, explaining 63.8% of the variance, 48.177% and 15.625% respectively. An inspection of the screeplot (see Appendix 6.4) revealed a clear break after the second component. Using Catell’s (1996) scree test, two components were retained for further investigation.

Varimax rotation was performed. The rotated solution revealed the presence of simple structure (Thurstone, 1947 in Pallant, 2005), with both components showing a number of strong loadings and all variables loading substantially on only one component when the coefficient values were suppressed at less than >.5. The two-component solution explained a total of 63.8% of variance,
with Component 1 contributing to 38.379% and Component 2 contributing to 25.423%.

When Direct Oblimim rotation was performed, a strong correlation (>0.3 as defined by Pallant, 2005) between the two components was found (0.450) (see Table 6.8).

The interpretation of these two components is very similar to the components that women identified as factors that helped them to engage in physical activity during pregnancy. The factors in Component 1 related to intrinsic factors that helped women to engage in physical activity after pregnancy; factors in Component 2 related to extrinsic factors. However, being scared of getting diabetes was an item that was part of Component 1 after pregnancy, whereas it did not show up as a factor during pregnancy.

Table 6.8: Rotated Loadings for coefficient value not less than >0.5

<table>
<thead>
<tr>
<th>Pattern Matrix(a)</th>
<th>Component</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>feel better when I exercise</td>
<td>.905</td>
</tr>
<tr>
<td>helps manage weight</td>
<td>.885</td>
</tr>
<tr>
<td>look better/healthier when exercise</td>
<td>.878</td>
</tr>
<tr>
<td>enjoy exercising</td>
<td>.776</td>
</tr>
<tr>
<td>to prevent later health problems</td>
<td>.762</td>
</tr>
<tr>
<td>helps manage stress</td>
<td>.737</td>
</tr>
<tr>
<td>scared of getting Type 2</td>
<td>.550</td>
</tr>
<tr>
<td>have someone to exercise with</td>
<td>.929</td>
</tr>
<tr>
<td>support from friends</td>
<td>.918</td>
</tr>
<tr>
<td>having a place to exercise</td>
<td>.695</td>
</tr>
<tr>
<td>support from family</td>
<td>.549</td>
</tr>
<tr>
<td>support from doctors/diabetes educator</td>
<td>.548</td>
</tr>
</tbody>
</table>

Extraction Method: Principal Component Analysis.
Rotation Method: Oblimin with Kaiser Normalization.
A Rotation converged in 5 iterations.

Further analysis of ‘scared of getting GDM’

An independent samples t-test was conducted to compare ‘scared of getting Type 2 diabetes’ as a factor that helped women to engage in physical activity during pregnancy for those women who had ever had GDM and those in the non-GDM group. There was a significant difference in scores for the GDM group (M=3.282, SD=1.48996) and the non-GDM group (M=1.8406, SD=.11792, t(106)=5.410, p=0). The magnitude of the difference in the means was very large (eta squared=.21)
Items that were barriers to engaging in physical activity during pregnancy

The 14 possible items that were used in the survey that were barriers to women engaging in physical activity during pregnancy were subjected PCA. PCA (see Appendix 6.5) revealed the presence of three components with eigen values exceeding 1, explaining 66.648% of the variance: 50.145%, 8.628% and 7.875% of the variance respectively.

An inspection of the screeplot (see Appendix 6.6) revealed a clear break after the first component and then two very small breaks after the second and third components. Using Catell’s (1996) scree test, it was decided to initially retain two components for further investigation.

To aid in the interpretation of these two components, Varimax rotation was performed (see Table 6.9). The rotated solution revealed the presence of simple structure (Thurstone, 1p47 in Pallant, 2005), with Component 1 showing a number of strong loadings and all variables loading substantially on only one component when the coefficient values were suppressed at less than >.6. The two-component solution explained a total of 58.733% of variance, with Component 1 contributing to 40.44% and Component 2 contributing to 13.972% of variance respectively. Direct Oblimin was not used because the correlation was -1.73 which indicates that the strength of the relationship between the two factors is low; therefore, it is appropriate to use the Varimax rotation.

Table 6.9: Rotated Component Matrix(a) Coefficient >.6

<table>
<thead>
<tr>
<th>Component</th>
<th>1</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>feeling unwell</td>
<td>.683</td>
<td></td>
</tr>
<tr>
<td>feeling uncomfortable</td>
<td>.687</td>
<td></td>
</tr>
<tr>
<td>no time</td>
<td></td>
<td></td>
</tr>
<tr>
<td>caring for others</td>
<td>.627</td>
<td></td>
</tr>
<tr>
<td>don’t enjoy physical activity</td>
<td>.836</td>
<td></td>
</tr>
<tr>
<td>too hard</td>
<td></td>
<td></td>
</tr>
<tr>
<td>don’t know what to do</td>
<td>.823</td>
<td></td>
</tr>
<tr>
<td>not that important</td>
<td>.847</td>
<td></td>
</tr>
<tr>
<td>being overweight</td>
<td>.695</td>
<td></td>
</tr>
<tr>
<td>lack of money</td>
<td>.742</td>
<td></td>
</tr>
<tr>
<td>nowhere to exercise/lack of facilities</td>
<td>.718</td>
<td></td>
</tr>
<tr>
<td>family not supportive</td>
<td>.821</td>
<td></td>
</tr>
<tr>
<td>lack of/no childcare</td>
<td></td>
<td></td>
</tr>
<tr>
<td>previous injury/mobility ltd</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization. a Rotation converged in 3 iterations

The items in Component 1 related to personal constraints and caring for others. Component 1 is difficult to interpret. The items in Component 2 are
clearly related to physical constraints to engaging in physical activity during pregnancy. The factors have been labelled as ‘personal/family limitations’ and ‘physical limitations’.

Items that were barriers to engaging in physical activity after the baby was born

The 14 possible items that were used in the survey for barriers for women to engaging in physical activity after the baby was born were subjected to PCA. Principal components analysis (see Appendix 6.7) revealed the presence of one component with two eigen values exceeding 1, explaining 66.438%, and 9.283% of the variance respectively. An inspection of the screeplot (see Appendix 6.8) revealed a clear break after the second component. Using Catell’s (1996) scree test, it was decided to retain two components for further investigation.

Varimax rotation was performed. The rotated solution revealed the presence of simple structure (Thurstone, 1947 in Pallant, 2005), with both components showing a number of strong loadings and all variables loading substantially on only one component when the coefficient values were suppressed at less than >.3. The two-component solution explained a total of 59.794% of variance, with Component 1 contributing to 31.670% and Component 2 contributing to 28.124%.

When Oblimin rotation was performed, a strong correlation (>.3) between the two components was found (.450) (see Table 6.10).

Table 6.10: Pattern Matrix(a) Coefficient values suppressed at less than >.3

<table>
<thead>
<tr>
<th>Component</th>
<th>1</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feeling uncomfortable</td>
<td>.925</td>
<td></td>
</tr>
<tr>
<td>feeling unwell</td>
<td>.901</td>
<td></td>
</tr>
<tr>
<td>too hard</td>
<td>.899</td>
<td></td>
</tr>
<tr>
<td>don't enjoy physical activity</td>
<td>.882</td>
<td></td>
</tr>
<tr>
<td>don't know what to do</td>
<td>.880</td>
<td></td>
</tr>
<tr>
<td>family not supportive</td>
<td>.850</td>
<td></td>
</tr>
<tr>
<td>being overweight</td>
<td>.806</td>
<td></td>
</tr>
<tr>
<td>nowhere to ex/lack of facilities</td>
<td>.768</td>
<td></td>
</tr>
<tr>
<td>lack of money</td>
<td>.700</td>
<td></td>
</tr>
<tr>
<td>caring for others</td>
<td></td>
<td>.950</td>
</tr>
<tr>
<td>no time</td>
<td></td>
<td>.767</td>
</tr>
<tr>
<td>lack of/ no childcare</td>
<td></td>
<td>.623</td>
</tr>
</tbody>
</table>

Extraction Method: Principal Component Analysis.
Rotation Method: Oblimin with Kaiser Normalization.
A Rotation converged in 4 iterations.

The interpretation of the two components

Similar to the barriers to physical activity during pregnancy, Component 1 is mainly related to personal/family limitations but Component 2 relates to
responsibilities (lack of time and caring for others). Component 1 has been labelled as ‘personal/family limitations’ and Component 2 ‘personal/family responsibilities’.

**Women who had experienced GDM**

Forty women completed the GDM survey.

**Reaction to a diagnosis of GDM**

Women were asked their reaction when they first found out they had GDM. Over 60% were quite or very concerned (See Figure 6.10).

**Figure 6.10: Reaction to a diagnosis of GDM**

![Bar chart showing reaction to GDM diagnosis]

**Main concerns about having GDM**

Women’s main concerns following a diagnosis of GDM are listed in Table 6.11.

**Table 6.11: Main concerns about having GDM**

<table>
<thead>
<tr>
<th>Main concerns following a diagnosis of GDM</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>The health of the baby</td>
<td>75%</td>
</tr>
<tr>
<td>Scared of developing Type 2 diabetes</td>
<td>67.5%</td>
</tr>
<tr>
<td>Having a big baby</td>
<td>50%</td>
</tr>
<tr>
<td>Worried about going on insulin/not knowing what was going to happen</td>
<td>40%</td>
</tr>
<tr>
<td>The birth</td>
<td>37.5%</td>
</tr>
<tr>
<td>Managing BSL</td>
<td>35%</td>
</tr>
</tbody>
</table>
Concerns linked to motivation during pregnancy

Women were asked if their concerns about GDM motivated behaviour or other changes during their pregnancy. All women reported that their concerns about GDM motivated them to take the management of GDM seriously (see Table 6.12).

Table 6.12: Concerns about GDM that motivated change during pregnancy

<table>
<thead>
<tr>
<th>Concerns about GDM that motivated change during pregnancy</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Take GDM management seriously</td>
<td>100%</td>
</tr>
<tr>
<td>Take notice of the advice of the doctor or diabetic educator</td>
<td>97%</td>
</tr>
<tr>
<td>Prevent Type 2 diabetes/eat healthier food</td>
<td>90%</td>
</tr>
<tr>
<td>Engage in more physical activity</td>
<td>72.5%</td>
</tr>
<tr>
<td>Lose/manage weight</td>
<td>67.5%</td>
</tr>
</tbody>
</table>

Concerns about diabetes linked to motivation post-pregnancy

Women’s concerns about diabetes motivated them to change three aspects of behaviour as follows:

1. Eat healthier food (77.5%)  
2. Lose/manage weight (65%)  
3. Engage in more physical activity (50%)

Information about physical activity in relation to GDM after diagnosis?

Women were asked if they were given any information from a doctor, midwife, nurse, dietician or diabetic educator about physical activity in relation to GDM. Seventy-five percent (30/40) said they were given advice, 20% (8/40) reported being given no advice, and 5% (2/40) could not remember.

Advised to engage in physical activity: Before and after diagnosis

Women were asked if they were actually advised to engage in physical activity during pregnancy before or after a diagnosis of GDM. More women reported being advised to engage in physical activity after a diagnosis (77.5%, n=31) compared to before they were diagnosed (30%, n=13).

Women were asked if they were given information from their health care providers about physical activity in general, that is types to do/to avoid, time to spend being active per day (see Table 6.13).
Table 6.13: Advice about physical activity received from health care providers

<table>
<thead>
<tr>
<th>Advice received from health care provider (doctor, midwife or dietician)</th>
<th>Percentage – Yes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Given advice by health care provider about physical activity and GDM</td>
<td>70%</td>
</tr>
<tr>
<td>Advised to engage in physical activity</td>
<td></td>
</tr>
<tr>
<td>Before diagnosis</td>
<td>30%</td>
</tr>
<tr>
<td>After diagnosis</td>
<td>77.5%</td>
</tr>
<tr>
<td>Advised about activities to do</td>
<td>77% (mainly to walk)</td>
</tr>
<tr>
<td>Advised about activities to avoid doing</td>
<td>47.5% (mainly avoid strenuous activity and don’t jump)</td>
</tr>
<tr>
<td>Advised about time to spend being active/day</td>
<td>51% (mainly 30 minutes/day)</td>
</tr>
<tr>
<td>Advised that physical activity could help prevent the progression of Type 2 diabetes</td>
<td>52.5% (yes) 40% (no) 7.5% (can’t remember)</td>
</tr>
</tbody>
</table>

Physical activity levels during trimesters 1, 2 and 3

Women were asked if they engaged in physical activity during each trimester (see Figure 6.11). There were very few differences in physical activity across the three trimesters. The numbers were too small to estimate any significant differences in activity across the stages. More women reported engaging in no physical activity in trimester 3 (8/39 or 20.5%) compared to trimester 1 (2/40 or 5%).

Figure 6.11: Physical activity in each trimester
Follow-up screening (blood sugar level test) postpartum

Twenty-two women (22/30) women reported they had a follow-up diabetes screening test postpartum but not all indicated the stage at which the test was performed. Seven out of 23 women indicated they had the test between zero to six weeks postpartum, and 15/23 indicated the test was undertaken between six weeks to one year postpartum.

The next chapter

A discussion of the results of the quantitative research is presented in Chapter 7. The discussion is linked to themes in the broader literature and also to similar themes that emerged from analysis of the qualitative data.
Chapter 7: Quantitative research – discussion
Introduction

The results of the quantitative stage of the research – the PPAS, the seven-day physical activity diary completed by all women (that is those with and without GDM), and the GDM survey completed by women who experienced GDM – quantify patterns of physical activity, attitudes towards physical activity in relation to pregnancy and GDM, and factors that help and hinder participation in physical activity. This chapter discusses the results of the quantitative aspects of the research. Themes from the results of the qualitative research were congruent with results from the quantitative data, thus enhancing convergence validity of the study. Where relevant, this discussion also makes links to the qualitative results and there is a unifying chapter that concludes the thesis.

Demographics/risk factors

Of the 112 women who participated in the study, over one-third had experienced a pregnancy complicated by GDM and a family history of diabetes. A higher percentage of women in the GDM group had a family history of diabetes and a significantly higher family history of GDM. These results reflect the common genetic risk factors for GDM, that is a family history of GDM and Type 2 diabetes (AIHW, 2008; Lee et al., 2008). A greater percentage of women (80%) with GDM were ≥30 years compared to 59.4% of women with no history of GDM, which is not surprising given that increasing maternal age is a risk factor for GDM (AIHW, 2008). However, it could also reflect the sample selection.

The mean age of women in this study population was 32 years, with a mean number of children of 1.35. Women in this study were slightly older when they had their first babies compared to women in the general Australian population where the mean age of women having their first baby was 29.8 yrs in 2005. Again, this could reflect the sample self-selection (Office for Women NSW Premier’s Department, 2007) given that it was a volunteer sample.

Compared to the NSW population of women where, in 2006, 65.6% had completed Year 12 (Office for Women NSW Premier’s Department, 2007), more women in this study had completed Year 12 (74%). The percentage of women in this study with a degree or post-graduate degree (58%) was similar to the 56.6% of Australian women with university qualifications (Office for Women NSW Premier’s Department, 2007). Even though the convenience sampling approach was designed to encourage any pregnant woman to complete the survey, data were not collected on women who chose not to complete the survey. It is therefore perhaps not surprising that women who did participate in the study were relatively well educated because of the self-complete nature of the survey.
Factors that were barriers to participation in physical activity during and after pregnancy

The results of this study help in an understanding of some of the factors that negatively influence women’s engagement in physical activity during and after pregnancy. Physical activity generally declines during pregnancy but barriers during this time are not well understood (Evenson et al., 2009).

In this study, during pregnancy, the main factors that negatively influenced participation in physical activity were identified as ‘physical limitations’ (which included feeling unwell/uncomfortable) and ‘personal/family limitations’ (see Table 7.1).

Table 7.1: Factors that were barriers to participation in physical activity during and after pregnancy

<table>
<thead>
<tr>
<th>Stage</th>
<th>Factors</th>
<th>Physical limitations</th>
</tr>
</thead>
<tbody>
<tr>
<td>During pregnancy</td>
<td>Personal/family limitations</td>
<td>Feeling unwell, uncomfortable</td>
</tr>
<tr>
<td></td>
<td>Too hard; don’t know what to,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>don’t enjoy, overweight, money,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>nowhere to exercise, unsupportive family.</td>
<td></td>
</tr>
<tr>
<td>After pregnancy</td>
<td>Personal/family limitations</td>
<td>Personal/family responsibilities</td>
</tr>
<tr>
<td></td>
<td>Feeling uncomfortable, unwell.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Too hard, don’t know what to,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>don’t enjoy, overweight, money,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>nowhere to exercise, unsupportive family.</td>
<td></td>
</tr>
</tbody>
</table>

‘Health-related changes’ during pregnancy were similarly identified as the main barrier to physical activity by Evenson et al. (2009) who grouped these barriers under a category of intrapersonal barriers. Similar to the factor defined as ‘personal/family limitations’ in this study, ‘intrapersonal – not health related factors’ (including low motivation, not enough time, lack of enjoyment of physical activity, and lack of childcare) as well as lack of social support were common barriers similarly identified by Evenson et al. (2009). Personal and family/parenting duties were the most frequently mentioned barriers identified by new mothers in Hawaii (Albright et al., 2005). In another study, the main factor that obstructed physical activity during pregnancy resulted from physical limitations and restrictions, followed by tiredness and time limits (Symons Downs & Hausenblas, 2004).

In this study, the main factor that negatively influenced participation in physical activity after pregnancy was categorised as ‘personal/family responsibilities’ (which includes lack of time, caring for others), followed by ‘personal/family limitations’. Barriers identified during and after pregnancy are similar (see Table 7.1).

No time (Smith et al., 2005; Symons Downs & Hausenblas, 2004), lack of childcare or lack of assistance with childcare (Albright et al., 2005; Smith et al.,
2005), priority given to family needs at expense of own needs and no motivation have also been reported in other studies (Albright et al., 2005; Evenson et al., 2009). Given these barriers, Stage et al. (2004) comment that “mothers with small children may find it difficult to find time and energy to implement a significant amount of exercise in their busy schedule” (p. 70).

Interestingly, tiredness was not reported as a specific barrier to physical activity during pregnancy by women in the present study, despite having been reported in other studies (Duncombe et al., 2007; Evenson et al., 2009; Symons Downs & Hausenblas, 2004). However, as a result of the interviews with women who had GDM, feeling tired as well as lack of childcare, lack of affordable childcare, and lack of time were reported as the main barriers to physical activity by women in the postpartum period.

Factors that helped women to engage in physical activity during pregnancy and after pregnancy

In this study, the factors that helped women to engage in physical activity both during and after pregnancy were almost the same. The factors are labelled as intrinsic factors (where women derived personal benefits from physical activity) and extrinsic factors (which related to external support) (see Table 7.2). Similar issues are identified in the broader literature about facilitators of physical activity during pregnancy, particularly in relation to extrinsic support from a partner/husband (Duncombe et al., 2007) and in the postpartum period (Albright et al., 2005).

Table 7.2: Intrinsic and extrinsic factors that supported engagement in physical activity during and after pregnancy

<table>
<thead>
<tr>
<th>Stage</th>
<th>Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Intrinsic Factors (personal benefits)</td>
</tr>
<tr>
<td>During and after pregnancy</td>
<td>Look better/healthier; manage stress/weight, enjoyment.</td>
</tr>
<tr>
<td>Only after pregnancy</td>
<td>Scared of getting Type 2 diabetes.</td>
</tr>
</tbody>
</table>

Social support for exercise, having an exercise ‘buddy’, and adequate childcare were facilitators to physical activity as reported by Albright (2005). Symons Downs & Hausenblas (2004) reported that a woman’s husband/partner and other family members most strongly influenced their postpartum exercise behaviour.

In a very recent cross-sectional Australian study with 384 women who had been diagnosed with GDM ≤3 years prior to the study, postpartum women completed a survey that explored health-enhancing physical activity behaviour and related factors (Koh et al., 2008). It was found that women who reported higher social support and self-efficacy were more likely to be sufficiently active (Koh et al., 2008).
Smith et al. (2005) also found that the type of helpful support women reported receiving often was verbal encouragement (~39%), assistance with childcare (32%), help with household chores (21.3%), and being accompanied during physical activity (20.5%).

Similarly, in this study, as a result of interviews with women who had experienced GDM, having a supportive partner and family, having enough money to go the gym and/or paying for childcare, and walking with other women in the form of mothers’ groups or general walking groups were identified as factors that supported women to engage in physical activity in the postpartum period.

Is fear of developing diabetes as a motivator for activity in the postpartum period?

In this study, fear of developing diabetes after pregnancy emerged as an issue after pregnancy that supported women to engage in physical activity and was significantly different (at the \( p < 0.05 \) level) between women with and without GDM. This finding is interesting when compared to other studies that explored women’s perceived risk of developing Type 2 diabetes following a pregnancy complicated by GDM. Albright (2005) clearly identified new mothers as a high risk for inactivity (Albright et al., 2005) and reported that although women interviewed were concerned about Type 2 diabetes and aware of their increased risk, not all changed their lifestyles postpartum to ameliorate their risk (Albright et al., 2005); this is a theme mentioned in other studies (Fehler et al., 2007; Stage et al., 2004).

Stage et al. (2004) explored lifestyle changes after GDM. Their results indicated that more than one-third of the 112 women who completed a survey 11 to 42 months after pregnancy did not do any exercise in their leisure time either during or after their pregnancy (Stage et al., 2004). Whilst the majority of women reported being concerned about developing Type 2 diabetes, only a few had changed their lifestyle or lost weight. Given that some women completed the interview at 42 months postpartum, the lack of reported lifestyle changes is a concern.

A broader study was undertaken with 150 predominately low-income African-American adult patients with diabetes (it was not focused on GDM) which explored barriers to physical activity. Seventy-seven percent of respondents were female and the mean age was 53.42 years. The most common barriers included lack of time, social support and equipment. Although it was found that 60% of participants thought it very likely that exercise would prevent future complications and 75% thought it was extremely important for controlling diabetes, barriers were not significantly related to participants’ beliefs that exercise could prevent future diabetes complications (Dutton et al., 2005). These results are similar to the lack of postpartum lifestyle changes to prevent Type 2 diabetes for women who experienced GDM, despite an awareness of the increased risk and knowledge of the beneficial role of physical activity to ameliorate this risk.
Patterns of activity

The above discussion highlighted some of the factors that supported and hindered women’s participation in physical activity during pregnancy and in the postpartum period. In the next section, women’s activity patterns are explored in relation to both volitional and incidental activity.

Incidental activity: Data from PPAS

Household and childcare activities

Women are involved in different forms of activity including volitional (or planned ‘exercise’) and incidental activity as a result of housework and childcare which can contribute to time spent participating in moderate intensity activity (Ainsworth et al., 2000). However, the inclusion of women’s occupational, childcare and household activities as measurements of physical activity have traditionally been ignored (Chasan-Taber et al., 2002; Chasan-Taber et al., 2004).

In this study, time (½ to two hours) spent on total household and childcare activities were reported by over 40% of women at every stage (43% before pregnancy, 42.8% during pregnancy, and 46% after pregnancy). Time spent doing light cleaning and shopping slightly increased during trimester 3 compared to before or after pregnancy, and childcare related activities increased in the postpartum period. These findings were similarly found in other studies that explored women’s household and care-giving activities (Borodulin et al., 2008; Chasan-Taber et al., 2007; Schmidt et al., 2006).

Schmidt et al. (2006) used a validated survey designed by Chasan-Taber et al. (2004) which explored the duration and frequency of physical activities performed by pregnant women to identify physical activity patterns during pregnancy across a diverse population of 233 pre-natal women. In a cross-sectional study, bilingual interviewers administered 24-hour physical activity recalls among women in each stage of their pregnancies (Schmidt et al., 2006). Household and care-giving activity were the largest contributors of activity among women in every trimester. Household and care-giving contributed 24-40% of total energy expenditure which decreased slightly during trimester 3. The numbers of women in each stage of their pregnancy varied: trimester one (11%), trimester two (36%), and trimester three (53%) which, as reported by the authors, may have limited the observed differences in women across the trimesters.

Another study was undertaken by Borodulin et al. (2008) to explore physical activity patterns during pregnancy. The study was part of a broader pregnancy, infection and nutrition study. During two phone interviews, 1,482 women were asked to recall their activity in the week prior to interview in trimesters 1 and 2 (Borodulin et al., 2008). It was found that child and adult care giving, indoor household, and recreational activities were the main types of activity reported. Overall physical activity decreased during pregnancy and women did not reach the recommended levels of activity during
pregnancy (30 minutes of moderate activity each day of the week) (Borodulin et al., 2008).

Much of women’s time, particularly in the early postpartum period, is spent caring for others and attending to household duties, often with little support. Smith et al. (2005) note that more than half the women interviewed by phone, postpartum GDM, about a range of psychosocial factors reported never receiving assistance with housework. An older but significant study into women’s unpaid work indicated that women with newborn babies will never be as busy with unpaid housework at any other time of their lives and during this period, men will never spend more time at work (Bittman, 1992). The current pattern of a large proportion of women’s time being spent on housework and childcare activities is likely to be not too dissimilar to that reported by Bittman (1992), given that it has only been in the last two decades that men have become more involved in shared parenting and that parental leave has only became part of the Australian industrial relations context since 1990 (Bittman, 1992).

**Seven-day physical activity recall diary**

As previously discussed in the methods chapter, problems associated with self-report data on physical activity include recall, in that women may over or underestimate the level of activity actually undertaken. Given these limitations and in order to gain a broader picture of women’s incidental and volitional activity, women were also asked to complete a seven-day physical activity recall diary. Forty-seven women in this study completed the diary and recorded type, duration and intensity of physical activity across each trimester of pregnancy and in the postpartum period. Whilst 150 diaries were sent out, few women completed the diaries, possibly reflecting the burdensome nature of completing a diary (Washburn & Montoye, 1986). More women completed the survey during trimester 3 (43.8%) compared to the other stages (trimester 1, 8.3%; trimester 2, 20.8%; postpartum 27%). It was not possible to compare any differences between those who completed the diary and those who chose not to complete it.

Overall, the most common household activities recorded related to housework (38%) followed by childcare (15%). Walking comprised 27% of reported activities, followed by swimming (6%), yoga/pilates (5%), and ‘other’ (9%). Although the actual metabolic energy equivalent (MET) intensity was not calculated for each type of activity, women were asked to estimate the intensity of the activity. Almost two-thirds of overall activities were undertaken at the gentle level (63%), one-third at the moderate intensity level (33%), and only 4% of activities were at a vigorous level of intensity.

**Volitional activity: Data from PPAS**

The most common volitional physical activities at either a moderate or gentle level of intensity reported by women in this study were walking and, to a lesser extent, swimming; this was similar to the most common activities during pregnancy identified in other studies (Da Costa et al., 2003; Evenson et
Walking quickly

Women were asked about walking quickly as a measure of moderate physical activity intensity. Compared to before pregnancy where 77% of women reported that they walked quickly, time spent walking quickly was lowest during pregnancy (63%) and after the baby was born (69%). Women (those with and without GDM) did not resume their pre-pregnancy levels of walking quickly.

The findings are comparable to other studies that showed walking is generally the most common activity undertaken during pregnancy, physical activity levels decrease during pregnancy compared to before pregnancy (Da Costa et al., 2003), and women do minimal levels of exercise postpartum (Gennero & Fehder, 2000). Owe et al. (2007) were interested in capturing walking at a moderate intensity only and excluded strolling due to its very low intensity in order to establish the exercise levels of women. The most common activity reported before and during pregnancy by Owe et al. (2007) was brisk walking, followed by bicycling. Evenson et al. (2004) also found that the most common LTPA during pregnancy was walking, followed by swimming laps, weight lifting, gardening and aerobics. A study by Da Costa et al. (2003) which explored LTPA during pregnancy found that during trimesters 1 and 2, the most common activities were low-impact aerobics followed by walking and swimming; whereas in trimester 3, swimming was the most common activity followed by walking and low-impact aerobics. Only in the present study was walking not the most commonly reported activity. An earlier study (Zhang & Savitz, 1996) reported the most common physical activity during pregnancy as walking (42%) followed by swimming and aerobics (~12% each). All the above studies reported a decrease in physical activity as pregnancy progressed.

Walking slowly

The pattern of declining levels of moderate physical activity during pregnancy in this study in relation to walking quickly, is similarly reported in the literature (Ning et al., 2003; Owe et al., 2007). This pattern is in contrast to walking at a slower pace. More women in this study reported walking at a slower pace during and after pregnancy compared to before pregnancy. For women who had GDM, walking at a slower pace increased from 3% (of women who walked at a slow pace before pregnancy) to 65% in trimester 3, to 67.5% postpartum; this was similar to women without GDM (pre-pregnancy 13%, during pregnancy 42%, and postpartum 47%). Studies that indicate walking as the most common activity during pregnancy usually refer to moderate intensity or brisk walking (Evenson et al., 2004; Ning et al., 2003). Owe et al (2007) excluded strolling or walking slowly in order to determine women who ‘exercised’ as they were interested in capturing walking at a
moderate intensity only. Walking at a moderate pace is classified as a moderate-intensity level of exercise according to the Compendium of Physical Activity (Ainsworth et al., 2000) and walking at a slower pace has less health benefits (National Public Health Partnership, 2005).

In the present study, women who reported a low prevalence of walking at a slow pace before they were pregnant did more walking during their pregnancy which was sustained after the baby was born, especially for women who had experienced GDM.

Low-intensity exercise has benefits associated with a less depressed mood, anxiety and stress during pregnancy (Da Costa et al., 2003; Hammer et al., 2000). Although it is well recognised that physical activity undertaken at the moderate level of intensity or vigorous intensity (for non-pregnant women) confers the most health benefits, there is an opportunity for targeted health promotion towards women who are walking slowly to increase this to a moderate intensity of activity, since walking is the most common activity reported during pregnancy. According to Owe et al. (2007), walking and swimming may be the most beneficial exercises and should be targeted activities, especially for sedentary women.

Pregnancy as a motivating factor

During pregnancy, women may be motivated to increase their physical activity, especially following a diagnosis of GDM. In terms of walking slowly, women in this study substantially increased this activity during pregnancy. From a review of the literature on exercise during the childbearing years, Hammer et al. (2000) comments that many women “wish to pursue an active lifestyle during pregnancy … [and the] … pregnancy itself may provide the motivation for other more sedentary women to begin an exercise program for the sake of improved health/fitness” (p. 1).

Perhaps one of the reasons women increase their walking at a slow pace after the baby was born is because of the flexibility and ease of going for a walk. Going for a walk is not so restricted by childcare issues since the mother can push the baby in the pram. Childcare issues and lack of time were identified as factors that influenced participation in physical activity in this study as a result of the factor analysis and have been documented in the broader literature (Albright et al., 2005; Evenson et al., 2009). It is also easier to push a pram walking slowly than walking quickly. If women do not enjoy exercise but believe it to be beneficial they may be more likely to engage in a slow walk. These findings require further exploration.

Reasons for motivation or lack of motivation to engage in physical activity during pregnancy were not explored with all women in this study but a diagnosis of GDM had an impact on women’s motivation to make recommended lifestyle changes.

Women who experienced GDM were asked to indicate whether their concerns about GDM motivated behavioural change during pregnancy. Over 70%
reported that concerns about GDM motivated them to engage in physical activity. Women with GDM reported concerns about the possibility of developing future Type 2 diabetes. These concerns reportedly motivated 77.5% of women to eat healthier food, 65% to lose/manage weight, and 50% to engage in more physical activity. Nonetheless, this reported motivation of GDM women to engage in physical activity during pregnancy and in the postpartum period was only reflected in behavioural change to walking slowly in this study.

In terms of reasons for behavioural change, a study conducted to examine whether physical activity during pregnancy reduced the risk of gestational diabetes among women who were previously inactive before they were pregnant found that almost 12% became active during pregnancy (Liu et al., 2008). The reasons for becoming active were not explored with the women. Data from the 1988 National Maternal and Infant Health Survey on 4,813 women were analysed. Women who did become active during pregnancy were less likely to develop GDM compared to those who remained inactive and longer periods of physical activity and brisk walking contributed to a significantly lower risk of developing GDM (Liu et al., 2008). An interesting finding was that physical activity can help to reduce the risk of developing GDM, irrespective of pre-pregnancy weight (Liu et al., 2008).

Advice to walk

Interestingly, the most common advice about physical activity provided by health professionals as reported by women who had experienced GDM was to walk (reported by 77% of women in the GDM survey). Just over half the women reported they were advised to be active for 30 minutes per day, although advice about the level of intensity of physical activity was not reported. There is an obvious opportunity for health professionals to encourage pregnant women to shift the intensity of walking from a slow pace towards walking for 30 minutes a day at a moderate intensity which would be in line with the general current Australian guidelines for physical activity (Australian Government Department of Health and Ageing, 2005).

Positive attitudes towards gentle and moderate intensity activity during pregnancy

In this study, women’s attitudes towards gentle and moderate intensity physical activity during pregnancy were positive. All women (n=108) believed gentle physical activity was helpful during pregnancy; most believing it was very helpful (81.5%). Similarly, when women were asked their beliefs about moderate physical activity during pregnancy, nearly all believed moderate physical activity was beneficial during pregnancy. Favourable attitudes towards physical activity (in general) have been similarly reported by Symons Downs & Hausenblas (2004).

Even though a change in attitude is not always necessary for lifestyle change (Egger et al., 2005) and that motivation is also required (Stage et al., 2004), it
seems logical that if pregnant women were advised/encouraged and supported to engage in physical activity, behavioural change would more likely follow if attitudes were already favourable.

Women’s reported physical activity behaviour in this study did not seem to match the favourable attitudes towards moderate physical activity during pregnancy, at least in relation to walking quickly. Even though over 57% of all women reported that for six months before pregnancy they participated in regular physical activity and intended to continue during their pregnancy, their intentions did not match their behaviour in relation to walking quickly compared to walking slowly during pregnancy in this study. Walking quickly declined as pregnancy progressed. This may have been as a result of intrinsic and extrinsic barriers identified in the factor analysis. Specific reasons for changes to specific physical activity require further exploration.

Mixed attitudes towards vigorous intensity physical activity during pregnancy

Just over 50% of all women in this study believed vigorous activity during pregnancy was harmful and just fewer than 50% believed it was helpful to some extent. Other studies have noted that women view gentle to moderate physical activity as safe during pregnancy and vigorous and high impact activities as unsafe (Duncombe et al., 2007).

Current guidelines for vigorous activity during pregnancy advocate a very individualised approach (ACOG, 2001; National Public Health Partnership, 2005). Some women do wish to engage in regular aerobic exercise during pregnancy to improve or maintain fitness (Kramer & McDonald, 2006). However, a literature review to assess the advice for aerobic exercise for women during pregnancy on pregnancy outcomes led the authors to conclude that available data are insufficient to infer important benefits or risks to the mother or child (Kramer & McDonald, 2006).

There is clear evidence of the positive role of vigorous activity in lowering the risk of developing GDM. Evidence that women who engage in vigorous activity before pregnancy and light-to-moderate or vigorous activity during pregnancy have a lower risk of both GDM and abnormal glucose compared with women not reporting any activity in either time periods (Oken et al., 2006). However, as discussed in the literature review, further research is needed in order to inform clear recommendations for type, intensity and duration of physical activity during pregnancy.

Overall, women do reduce the intensity of their physical activity as their pregnancy progresses and tend to replace strenuous activities with lighter-intensity activities, without reaching recommended levels of activity during pregnancy (Borodulin et al., 2008; Duncombe et al., 2007; Evenson et al., 2004). Yet, in this study, over 80% of women did not engage in vigorous levels of physical activity at before, during or after pregnancy even though 70% of women reported that they enjoyed vigorous levels of activity before
pregnancy. Overall, the attitudes did not seem to reflect participation in vigorous activity for most women in this study.

Swimming

After walking, swimming was the next most commonly reported activity in the study even though >54% of women did not swim at any stage. Women swam more in trimester 3 (45.6%) compared to before pregnancy (41%) but this decreased after the baby was born (35.1%). Da Costa et al. (2003) also found that swimming in trimester 3 was the most common activity, followed by low-impact aerobics. Similarly, Owe et al. (2007) found that participation in swimming increased from pre-pregnancy (7.3%) to trimester 3 (week 30, 8.2%) and the authors state that, to their knowledge, it is the first study to report an increase in swimming from pre-pregnancy to gestational week 30. Results from this study add to the relatively few findings about swimming as the activity that actually increases during pregnancy. However, swimming participation in the present study was not very high which is surprising given the warm climate of northern NSW (the location of most of the participants) and the safety and ease of exercising in water during pregnancy (Katz, 2003).

Lack of advice about physical activity – a diagnosis of GDM makes a difference

Of the 107 women who completed the PPAS, almost 80% reported they had never been advised by a health professional (doctor, midwife, diabetes educator) either during or after pregnancy to engage in more regular, levels of physical activity. These findings are higher than those reported in a study which explored advice for exercise with 123 pregnant women (were recruited through antenatal clinics, community health centres and a private gynaecologist’s practice) who completed a questionnaire (Kirkby & Symons, 2000). Even though it was a small sample size with volunteer women, the findings indicate that over a third of women reported they received no advice from health professionals during pregnancy (Kirkby & Symons, 2000). Similarly Clarke et al. (2004) found that less than 20% of women interviewed about beliefs, behaviours and information sources regarding physical exercise participation reported receiving activity advice from the health professionals involved in their pregnancy care (Clarke et al., 2004).

Advice following a diagnosis of GDM

In this study, when advice received about physical activity was compared between the GDM and non-GDM groups of women (in the PPAS), women in the GDM group received significantly more advice about physical activity (at the p<.05 level). When the GDM survey alone was analysed, 30% of women reported being given no advice about physical activity during pregnancy but this increased to 77.5% after a diagnosis of GDM. However, only half the women who completed the GDM survey reported being given any advice that physical activity could help prevent the progression of Type 2 diabetes.
The advice following a diagnosis of GDM and the general advice to walk reported by women in this study were reflected in findings from a study which explored the management of GDM and Type 1 diabetes with 569 obstetricians and gynaecologists in a mailed survey (Gabbe et al., 2004). That study found that almost 74% of the O&G used exercise in addition to medical nutrition therapy and, of these, most (80%) recommended walking (Gabbe et al., 2004).

In general women take notice of the advice

Interestingly, results of the GDM survey indicated that as a result of their concerns about GDM, 97% of women took notice of the advice of the doctor or the diabetes educator. Similarly, from the qualitative interviews with Australian and Tongan women who had had GDM, all women reported taking seriously the advice given by the health professionals. There is a clear role for primary care interventions by health care providers for physical activity. As a result of a systematic review of the literature into primary care interventions to promote physical activity with adult patients (albeit not specific to pregnancy), the authors concluded that brief interventions for physical activity alone can achieve improvements but they need to be incorporated within multi-faceted, community strategies (Smith et al., Prepared for The National Institute of Clinical Studies, 2002).

The authors of another study which explored physical activity promotion in general practice suggested that long-term adherence to primary care physical activity is poor and needs to be linked to multi-sector response (Elley et al., 2007). A nested qualitative study was undertaken with 15 sedentary adults from general practices in New Zealand who took part in semi-structured phone interviews. These qualitative interviews were part of a larger cluster random control trial from 2000 to 2003 that assessed a physical activity intervention with 878 sedentary patients. Four themes emerged that influenced participation in physical activity: the need to tailor advice, to take note of barriers to physical activity, the importance of internal motivators, and the role of significant others. As well as a personalised approach, the study highlighted the need for continued structured external support and the need to focus on barriers and facilitators (Elley et al., 2007).

Lack of advice – room for improvement

Not all women in this research were happy with the advice received from health professionals about physical activity. The advice to engage in physical activity after a diagnosis of GDM was highlighted in qualitative in-depth interviews. The lack of follow-up advice, concerns about developing Type 2 diabetes, and the uncertainty about whose responsibility follow up is (the woman’s or the health professionals’) were also identified as problems in these interviews. Women in the focus groups also reported dissatisfaction with the lack of attention to physical activity during pregnancy.
Advice can correct misconceptions about physical activity

For a variety of reasons, women may not be aware of the health benefits associated with engaging in moderate levels of physical activity during pregnancy which may negatively influence participation in physical activity during pregnancy (Kirkby & Symons, 2000). Perhaps the present education by health care providers is “failing to correct inaccurate perceptions of the risks associated with physical activity in pregnancy” (Clarke et al., 2004, p. 138) and women are taking a “pregnant pause” (Dempsey et al., 2005) unnecessarily. As Clarke et al. (2004) suggests there is considerable scope for improving the quantity and quality of advice in this area. One such way is through the development of information packages for pregnant women, ensuring that health promotion is a significant part of the primary consultation and attention to physical activity is a serious component of the antenatal care, particularly for women who are diagnosed with GDM. Another way is for women to be advised, supported and encouraged to engage in recommended levels of physical activity irrespective of pregnancy status.

Follow up and postpartum screening

Postpartum screening is another area where physical activity (and other modifiable risk factors) can be addressed. However, follow-up screening is poorly attended (Hunt & Conway, 2008) and problematic (McElduff, 2003). Systematic approaches for detecting new diabetics among women with a history of diabetes are needed, as well as detecting GDM in the first place (Simmons, 2008). Results of an extensive literature review on Type 2 diabetes risk for women with GDM, including recommendations from leading organisations on follow up of GDM postpartum, found that the recommendations are conflicting and compliance is poor (England et al., 2009). The need for studies into prevention interventions for these women that explore how to maximise compliance were identified in this population (England et al., 2009).

Of the women who had GDM who participated in the present study, seven out of 37 women (18%) who had GDM reported they had undertaken the recommended six to eight week follow-up OGTT screening test. However, ADIPS recommends that all women with previous GDM are offered testing for diabetes with a 75 g OGTT six to eight weeks after delivery and repeat testing should be performed every one to two years among women with normal glucose tolerance and the potential for further pregnancies (Hoffman et al., 2003). Responsibility for follow-up care emerged as an issue from the qualitative interviews with Australian women who experienced GDM, particularly in relation to whose responsibility it is to initiate the test – the woman’s or the doctor’s. Of the 18% of women who did have their six to eight week recommended screening test in this study, it was not ascertained who initiated the postpartum screening test The ADIPS recommendations are that women are ‘offered’ this follow-up test and subsequent tests. How women are offered this test is not clear. As outlined by ADIPS, future research is needed
on the role of follow-up programs for affected mothers and babies, and possible interventions to reduce the rates of development of permanent diabetes in the mother (Hoffman et al., 2003).

The Australian Longitudinal Women’s Health Study (ALWHS), in collaboration with Diabetes Australia, which involved 1,300 women who had experienced GDM (530 women from NSW), also found that many women with GDM are not meeting lifestyle recommendations postpartum, placing them at risk of developing diabetes later in life (Diabetes Australia New South Wales, 2007). Results of the ALWHS indicated that women reported taking seriously advice received during pregnancy. However, postpartum, their priorities were looking after the baby over looking after their own health. Most received specialist care for GDM management and although 63% were told they were at increased risk, less than half could recall how to reduce their risk (Diabetes Australia New South Wales, 2007). In the ALWHS, only 40% of women had returned for their recommended six to eight week follow-up OGTT.

Lack of attention to follow-up screening

A recent American study which aimed to determine if obstetrician-gynecologists provided postpartum diabetes screening for women with a history of gestational diabetes found that, of the 90 women surveyed, only 20% of these women had documented orders for the ADA screening test (Almario et al., 2008). When the criteria was expanded to include referrals to primary care physicians for postpartum diabetes mellitus screening, only 33.3% met the criteria. This lack of attention to follow-up diabetes screening in this high-risk group of women is in contrast to the findings from the survey of 569 obstetricians and gynaecologists which reported that 75% of these respondents routinely perform a postpartum evaluation of glucose tolerance in the ‘patient’ with GDM (Gabbe et al., 2004).

Public health benefits of screening

The implications for prevention are profound in terms of the potential for preventing Type 2 diabetes. One study estimated that comprehensive health care and lifestyle intervention can prevent up to 58% of people with impaired glucose tolerance from developing Type 2 diabetes, over a three to four year time frame (Tuomilehto et al., 2001).

A recent study by Feig et al. (2008), who used a population-based database to identify all deliveries in Canada over a seven-year period to determine the risk of development of Type 2 diabetes after a diagnosis of GDM, found that the risk of GDM increased over time. At nine months, the probability of developing Type 2 diabetes was 3.7% which increased to 20% at nine years (Feig et al., 2008).

In 2005-2006, GDM affected just over 12-600 (4.6%) of hospital confinements in Australia. The rate was 1.2 times higher for ATSI women and three times higher for Polynesian women (AIHW et al., 2008). If Feig et al.’s (2008) figures
were applied (albeit a crude and conservative measure) to the Australian context, over a nine-month to nine-year period, in between 466 and 2,520 women would develop Type 2 diabetes. Postpartum, almost 3,000 women could be specifically targeted. As indicated above, 12,600 pregnant women in 2005-2006 were identified as being at risk of developing future Type 2 diabetes. These women are a clear target group for lifestyle intervention during and after pregnancy to reduce their risk of developing Type 2 diabetes.

**Conclusion**

This chapter identified factors that support women to engage in physical activity during and after pregnancy. During pregnancy ‘personal/family limitations’ and ‘physical limitations’ were categorised as the main barriers to physical activity and, in the postpartum period, in addition to ‘personal/family limitations’, ‘personal/family responsibilities’ were identified. The factors that supported women’s participation in physical activity during and after pregnancy were similar and were categorised as ‘intrinsic factors’ which related to personal beliefs, and ‘extrinsic factors’ which related to social support. Most of these factors are supported in the broader literature. A distinct factor that emerged for women who had experienced GDM in the postpartum period, which supported participation in physical activity, was the fear of developing future Type 2 diabetes. However, further research needs to be undertaken to determine if, how, and in what ways this ‘fear’ influences positive lifestyle changes in the postpartum period.

Generally, physical activity was low in the postpartum period as well as during pregnancy for all women in this study. A large proportion of women’s activity was taken up with childcare and household responsibilities. Walking slowly was the only activity where women increased their activity levels pre-pregnancy, then during and after pregnancy. Walking quickly declined during pregnancy and swimming and vigorous activity levels were generally very low. Attitudes towards moderate physical activity were generally positive. However, in this study, the behaviour did not match attitudes in relation to moderate physical activity. In terms of health promotion to target specific physical activity during and after pregnancy, walking may be a good starting place for health professionals. Women could be encouraged to increase the intensity of walking to a moderate level, rather than a gentle level.

For women generally, few women reported being advised to engage in regular or more physical activity. However, there was a significant difference between women who developed GDM compared to those without GDM, who were advised to engage in physical activity as part of the management of GDM. Of the advice received, most of the women reported being advised to walk and most women reported taking notice of the advice. In this study, the lack of attention given to physical activity by health professionals for pregnant women was apparent. More attention to physical activity was provided to those women who were diagnosed with GDM. However,
postpartum screening and ongoing lifestyle support in this group of women was virtually absent. Women who develop GDM are at a high risk of developing Type 2 diabetes. Postpartum lifestyle support is lacking but is urgently needed.

Lifestyle interventions that focus on physical activity to promote health and wellness in the general population of pregnant women (with specific attention to women who experience GDM) are needed. Individual change must be supported with broader environmental support in order to balance the focus on individual incentives and motivation for physical activity. Raising awareness, educating women and implementing lifestyle changes are important, but there is also a need for woman friendly environments beyond childcare strategies to promote women’s participation in health care decision-making. In particular, how safe women feel while undertaking physical activity is an important consideration when planning health promotion activities or interventions.

The next chapter

Key issues that have been identified from all stages of this research are presented in the next and final chapter. The conclusion ‘wraps up’ the themes that emerged from each stage of the research. The research aims are revisited and constraints on the research are discussed. PHC and health promotion philosophy and strategies frame the conclusions, implications, proposed recommendations, and model of care. The proposed model of care is informed by a fusion of key concepts that have emerged in the research, including gaps in care, in terms of lack of attention to physical activity for all women during pregnancy and lack of follow up and support for lifestyle changes in the postpartum period for women who have experienced GDM. This model of care is a gendered approach to health promotion and is informed by an understanding of the social determinants of health, identified by women in this research, particularly those factors that facilitate and are barriers to participation in physical activity.
Chapter 8: Conclusion, implications and recommendations
Introduction

In this final chapter, conclusions of the research are drawn and recommendations are made. The conclusion and recommendations have been framed by a consideration of strategies to achieve health promotion as outlined in the Ottawa Charter for Health Promotion, particularly developing personal skills, reorienting health care towards health, and developing partnerships between women and their health care providers (WHO, 1986). Education for health is one way health professionals can contribute to enabling women to take control of their health (Northern Territory Government, 2007) and their lives. Empowerment is a fundamental consideration within a PHC approach (Keleher, 2007b; McMurray, 2007). Empowering partnerships between health professionals and women to develop strategies to support healthy levels of physical activity are suggested with a model of care proposed in this final chapter. This model of care is a gendered approach to health promotion and is informed by an understanding of the social determinants of health, identified by women in this research.

This chapter summarises what the research set out to do and what was found. Recommendations for what needs to be done including implications for health promotion and health education are made.

What did this research set out to do?

Through a combination of mixed methods, the research set out to comprehensively meet the following research objectives:

1. Explore physical activity levels of pregnant women before, during and after pregnancy, especially for women at high risk of developing GDM;
2. Explore factors that influence levels of physical activity during pregnancy and in the postpartum period; and
3. Explore the impact of GDM on a woman’s life in terms of lifestyle changes, especially physical activity during pregnancy, after a diagnosis of GDM, and postpartum.

Interpretive constructivist health promotion research was the methodological framework, and mixed methods were utilised in order to investigate the research questions. Feminist research principles framed the research processes. The discussion of the findings was informed by a commitment to health promotion, PHC, notions of empowerment, and partnership. Women’s health was viewed within a social context and at the forefront was an explicit consideration of the gendered social determinants which influence health, illness and lifestyle.
Some of the constraining influences on the research

There were several factors that influenced the sample size. The surveys were placed at the antenatal clinic at a local base hospital. Several clinics were run each week: one was a high-risk clinic where women with GDM were advised to attend. The Health Service Ethics Committee stipulated that the researcher was not allowed to directly approach pregnant women at the clinics. Even though the researcher informed the clinic staff of the study and placed information posters in the waiting room notice board, the inability to personally inform women of the study was a constraint on the number of women who may have participated in the study. If women had been more informed and more aware of the study, the number of participants may have increased.

Secondly, in order to specifically target women who had GDM, survey packages were posted out from two health clinics to women who had accessed the services for GDM management in the previous 18 months. Follow up was only possible from one of these centres as a woman whose baby had died received the survey package and notified the centre that she did not want to participate but did not leave her name. It was not ethical to follow up with any of the women who accessed that health centre. This again was a constraining influence on the sample size. However, since the purpose of the research was exploratory, it was not the intention to make inferences or generalisations to the larger population. The eventual number of participants still enabled meaningful findings to be revealed. Further, the findings from the quantitative stage were consistent with the themes identified in the qualitative stages thus adding a level of confirmation (Guba & Lincoln, 2005).

Another constraining influence related to the interviews with the Tongan women. Prior to the researcher’s arrival in Tonga, close liaison had occurred with the Tongan counterpart, as well as with the WHO Western Pacific Regional Officer in Tonga, both of whom had advised on the written survey design, and had commented positively on the final survey. However, when the researcher arrived in Tonga, the counterpart suggested that the women may not be able to understand the survey and recommended that the survey be conducted verbally as an interview. It then became necessary to re-visit the written survey and review the essential questions to ask in a face-to-face interview. The interviews went well and key themes were covered. However, funding to enable the survey be translated into the Tongan language would have been very beneficial.

In relation to the data collection about types, intensity and duration of physical activity, a validated survey (Chasan-Taber et al., 2002) was used which mainly examined unintentional and household activity. The authors of this survey reported the level of intensity for every activity as metabolic equivalents (METs). (Chasan-Taber et al., 2007). It is common to report the metabolic energy expenditure of activity as multiples of resting metabolic rate termed METs. However, since the purpose of the research was exploratory,
the MET hours were not calculated; rather, the level of intensity (or energy expended) in this research was classified as gentle or moderate. Basically, the validated survey was useful in terms of survey design but the results of the validated survey compared to the results of this research were presented and calculated differently.

**What this research found and what are the implications**

**What was found when research Objective 1 was explored?**

*Physical activity levels before, during and after pregnancy, especially for women at high risk of developing GDM*

*Types of activities undertaken*

The results provided insight into women's attitudes toward pregnancy and physical activity and the experience and impact of a diagnosis of GDM, particularly in relation to physical activity. Walking, yoga and swimming were mentioned as the safest and most beneficial exercise to do. These activities that women believed to be beneficial parallel the general recommendations and evidence for moderate exercise during pregnancy (Artal, 1996; NSW Health, 2000; VICFIT, 2004).

Results of the surveys indicated that 99% of women had positive attitudes towards moderate-intensity physical activity during pregnancy and believed it was beneficial. Similarly, 95% of women reported that they enjoyed moderate-intensity physical activity before they were pregnant. Women in this study reported very low rates of participation in vigorous activity and almost all believed vigorous activity was particularly applicable to a woman’s experience and level of fitness. There were no differences between women who had or had not experienced GDM and all women believed gentle physical activity was helpful during pregnancy.

*Walking, swimming, yoga*

Results from the focus groups, interviews with women, data from the surveys and exercise diary indicated that the most common type of volitional and incidental activity at both a moderate and gentle level of intensity, undertaken before, during and after pregnancy, was walking. Swimming and yoga were also common activities but nowhere near as high as walking.

Walking at a moderate pace did decrease during pregnancy compared to before pregnancy and after pregnancy but, overall, almost two-thirds of the women in this study reported walking at a moderate level at every stage (before, during and after pregnancy). In terms of walking slowly, women in this study substantially increased this activity from 3% before pregnancy to over 60% during and after pregnancy, which was similar for women who did and did not experience GDM. The findings parallel other findings in the literature that indicate that walking is the most common activity, followed by swimming (Da Costa et al., 2003; Evenson et al., 2004; Oken et al., 2006).
However, the results of this study add to the body of knowledge in this area in terms of identifying a high prevalence of walking slowly during and after pregnancy compared to before pregnancy, for women with and without GDM. Most other studies focus on moderate intensity activity (Avery & Walker, 2001; Dempsey et al., 2005; Oken et al., 2006; Schmidt et al., 2006) because this is the level of intensity that is recommended for health benefits. Even though it is clear that most health benefits are derived from participation in physical activity at a moderate level of intensity (Australian Government Department of Health and Ageing, 2005), low-intensity exercise has benefits associated with a less depressed mood, anxiety and stress during pregnancy (Da Costa et al., 2003; Hammer et al., 2000). Other studies also report a decline in activity during pregnancy compared to before pregnancy (Clarke et al., 2004; Evenson et al., 2009) but in relation to walking slowly, this activity increased substantially during pregnancy, which, unlike other studies that have reported declining activity in the postpartum period, did not decrease after the baby was born. Walking has been explored as a gendered activity, and of note was the influence of childcare and external support which enabled/hindered participation in activity (Kavanagh & Bentley, 2008). The results of this research have filled a gap in knowledge in two areas:

1. Walking slowly was an activity that substantially increased during and after pregnancy compared to before pregnancy.

2. Walking at a gentle level was the intensity of activity most commonly engaged in by women.

Although the intent of this research is not to generalise the findings beyond the study participants to the broader population, there are certainly health promotion implications for paying attention to walking slowly for all pregnant and postpartum women, both with and without GDM.

Implications

1. There is an opportunity for targeted health promotion towards women who are walking slowly to increase this to a moderate intensity of activity.

2. There is an opportunity to target women who are not doing any physical activity. Walking and swimming may be the most beneficial exercises and should be targeted activities, especially for sedentary women (Owe et al., 2007).

Caring and housework responsibilities

This research also explored women’s responsibilities related to caring and housework as these are often overlooked as measures of women’s physical activity. If gender is considered as a determinant of health (Keleher, 2004), then the social context of women’s experiences during pregnancy and caring for a newborn also inform an understanding of the factors that influence health. Results from the PPAS indicated that almost half the women reportedly spent up to two hours every day on household and childcare activities and women became busier after their babies were born. These
results were supported by the results of the physical activity diary which revealed the most common activities undertaken during the previous week were housework, walking, childcare, and, to a lesser extent, swimming and yoga/pilates. Almost two-thirds of overall activities were undertaken at the gentle level. Furthermore, walking may actually be underestimated since walking could also comprise a substantial component of housework (Kavanagh & Bentley, 2008).

Women continue to have most of the responsibility for caregiving and domestic work in the home (Doyal, 1995; Smith et al., 2005) which in this study translated into barriers to participation in physical activity (discussed in the next section). The results from this research indicate that women, especially those with new babies, are busy and active people, for whom most activity is undertaken at a gentle level of intensity. Three questions emerge that warrant further investigation:

1. How much time is ‘left over’ for women to participate in more moderate levels of activity?
2. In what ways could women be encouraged/supported to increase their current gentle intensity activity to a moderate or vigorous level of intensity?
3. What proportion of childcare and housework is spent walking?

**What was found when research Objective 2 was explored?**

**Factors that influenced levels of physical activity during pregnancy and in the postpartum period.**

Specific factors that the women reported as positively or negatively influencing their engagement in physical activity were mentioned at every stage of the research. While this is so, factor analysis pointed to clusters of specific factors.

**Factors that facilitated participation in physical activity**

Factor analysis highlighted factors that women viewed as helpful to participation in physical activity during and after pregnancy. These factors were identified as ‘intrinsic’ factors (related to personal benefits) where women reported that physical activity was beneficial for weight and stress management, women felt/looked better when they exercised, and women enjoyed exercise. ‘Extrinsic’ factors were identified as other factors that facilitated participation in physical activity and included having someone to exercise with, support from friends/family/doctor/diabetes educators, and having a place to exercise.

Whilst most of these factors are reflected in the broader literature (Dutton et al., 2005; Evenson et al., 2009; Smith et al., 2005; Symons Downs & Ulbrecht, 2006), this research also identified that, for postpartum women who developed GDM, ‘being scared of developing diabetes’ was a factor that facilitated participation in physical activity. Similarly, during pregnancy,
women reported that their participation in physical activity was helped by their desire to prevent later health problems. These are key themes and warrant further exploration in terms of establishing links between concerns about future health problems and how this translates into specific lifestyle changes. Possible areas for further exploration could be:

- Is there a relationship between a desire to change and specific change in the postpartum period?
- Following a GDM pregnancy, for how long are lifestyle changes sustained, especially those related to physical activity that are made during pregnancy?
- What are the factors that are associated with supporting women to sustain long-term lifestyle changes?

Factors that hindered participation in physical activity

In this study it became clear that women were presented with real barriers to physical activity when caring for a newborn baby even they were aware of the benefits gained from participation in physical activity. One participant’s written comment reflects these issues:

"Many Mums would exercise more if they had support/childcare – lack of time for ourselves is a big problem – but we love our babies!"

The main barriers in the postpartum period women reported were lack of support from their partner, being too busy, not having enough time and lack of childcare, which were categorised as the factor ‘Personal/family limitations’. During pregnancy the main barriers women identified were ‘physical limitations’. The other factor identified as barrier to physical activity during pregnancy was ‘personal/family limitations’.

Whilst barriers are also reported in the broader literature (Smith et al., 2005) the research highlights and affirms the social determinants of women’s lives which directly influence their ability and opportunity to participate in physical activity. Much of women’s time, particularly in the early postpartum period, is spent caring for others and attending to household duties, often with little support. Women reported adjusting their physical activity according to the needs of their children and combining physical activity with mothering by going for a walk with the baby in the stroller or baby carrier – activities that were easier to fit and did not require childcare. Perhaps one of the reasons women increased their walking at a slow pace after the baby was born is because of the flexibility and ease of going for a walk. Going for a walk is not as restricted by childcare issues since the mother can push the baby in the pram. It is also easier to push a pram walking slowly than walking quickly. These areas require further exploration in terms of gender as a social determinant that influences choices made about participation in types of activity (Kavanagh & Bentley, 2008).

The conclusions thus far to be drawn from the research are that women were aware of the personal benefits to be gained from physical activity during
pregnancy and in the postpartum period, attitudes and beliefs towards moderate and gentle levels of physical activity during pregnancy were positive, and in order to engage in some activity women adjusted their schedule to combine parenting and activity. However, women were constrained by issues such as lack of time and lack of childcare.

**Weight**

In terms of lifestyle issues that influenced health, pregnancy and participation in physical activity, ‘worry about weight’ emerged as a theme in all aspects of the qualitative research, particularly in Tonga. The factor analysis indicated that physical activity was positively related to weight management. Although not explored in this research, weight management after the baby was born was perhaps even more difficult, given women’s reported lack of time to engage in physical activity.

‘Laziness’

In Tonga, ‘laziness’ was a distinct theme perceived to preclude participation in physical activity. More culturally specific research with a larger sample of women who have experienced GDM is needed to expand on these themes and develop health promotion strategies appropriate for women in Tonga. The health professionals in Tonga provided insight into GDM and diabetes in their country.

Research with health professionals in Australia would also be useful to gain insight into their views about:

(a) ways to develop partnerships with women during pregnancy and in the postpartum period, especially those who develop GDM and Indigenous women;

(b) further research with Indigenous women to ascertain their particular barriers and

(c) ways to target physical activity as a health promotion strategy.

**Lack of information about physical activity**

Early in the research, in the focus groups, a strong theme emerged as the desire for more information about physical activity during pregnancy, mainly about what to do, at what intensity, and what activities were safe. Some women were not sure what they could safely undertake during pregnancy. As one focus group participant said, “they should give you a handout sort of earlier ... if you are not sure what exercise you can do ... because people don't realise what they can do.”

This theme was consistently identified across all stages of the research. Women were not satisfied with the attention given to physical activity or the information provided. As another focus group participant stated, there was “not a lot out there” and “no-one says too much about it.”
For women who were advised to make lifestyle changes after a diagnosis of GDM, the view was that most of the attention was on diet with less serious recommendations for physical activity. This was reflected in the survey data in that just over one in four women reported never receiving advice from their health professionals to engage in more regular, moderate levels of exercise. There was a significant difference in the advice received between the GDM and non-GDM groups, after a diagnosis of GDM, the advice for physical activity did increase. However, in the written comments and qualitative interviews with women who had experienced GDM, there was a perceived lack of attention to physical activity advice for GDM management. A comment from one of the women who had experienced GDM reflects the focus on diet as the standard management of GDM:

“I think exercise is part of the answer to help with GDM but I think the main issue is food. No matter how much exercise you do, if you don’t eat the right foods than exercise isn’t going to do much – sticking to the diet is the answer.”

Yet even if diet is used as the main strategy to help women monitor and control their BSL as part of the main strategy for GDM management, the diagnosis of GDM affords a prime opportunity to direct attention towards physical activity so that recommendations for physical activity are made in conjunction with dietary changes. As a modifiable risk for GDM prevention and management, and prevention of future Type 2 diabetes, the evidence of the beneficial role of physical activity is clear (Special Communications; Roundtable Consensus Statement, 2006).

Although the research did not specifically ask all women if their participation in physical activity was directly influenced by the advice provided by their health professionals, of women who did develop GDM, 97% reported that they did take notice of the advice of a doctor or diabetic educator. Of the advice received, most was to walk.

Health professionals have a role in influencing lifestyle changes (Australian General Practitioner Network, 2008; Kirkby & Symons, 2000). The implications of this role are further discussed in the next section: what needs to be done. Despite the positive link established between physical activity and a reduction in GDM (Dawes, 2006; Dempsey et al., 2005; Lee et al., 2007; Oken et al., 2006; Yun et al., 2007; Zhang et al., 2006), there are still no clear guidelines based on evidence for frequency, intensity, duration, and type of activity to prevent the incidence of GDM in sedentary, at-risk populations (Mottola, 2007). However, substantial evidence now points out that the benefits of moderate levels of physical activity undertaken at recommended levels (30 minutes every day) far outweigh the risks in women with uncomplicated pregnancies (ACOG, 2003; Brown, 2002; Special Communications; Roundtable Consensus Statement, 2006).

At the minimum, there is an opportunity for health professionals to encourage pregnant women to shift the intensity of walking from a slow pace towards walking for 30 minutes a day at a moderate intensity which would be
in line with the general current Australian guidelines for physical activity (Australian Government Department of Health and Ageing, 2005) and in line with the American guidelines for physical activity during pregnancy (ACOG, 2003). Women in this study were not provided with advice based on these recommendations. Women in this study did suggest some ways information about physical activity could be provided to them during pregnancy which included pamphlets they could be given early in their pregnancy. Other strategies could include talks at diabetes clinics, information sessions at the antenatal clinics, videos in the waiting rooms of the antenatal clinics, as well as information about physical activity during pregnancy on websites women could be advised to peruse.

“Do a bit of exercise” – implications for individual support within the primary care setting

In this study, physical activity was not perceived to be a serious component of antenatal care; it needs to be more than “do a bit of exercise.” As Egger & Climstein (2008, p. 74) point out:

Physical activity has typically been regarded in a ‘motherhood’ light, with a clinician’s exhortation to ‘do some exercise’ thought to require no further elaboration. With the rapidly changing ambient exercise environment of the twenty-first century, however, this is no longer sufficient.

With the increase in chronic diseases, generic prescriptions for physical activity (mainly for use by doctors) are emerging as a strategy to assist people to reduce modifiable lifestyle risk factors for these diseases. Yet there is little research on attention health professions give to physical activity performed by pregnant women.

This research revealed that physical activity is still viewed in this ‘motherhood light’. Not only is more attention to physical activity required during pregnancy but a gendered approach to health promotion needs to be taken which seriously considers women’s experiences surrounding pregnancy and caring for a baby. The social determinants of women’s lives as reported in this study are related to the factors that both enable and hinder women’s participation in physical activity.

Supporting a woman to adopt healthier behavioural patterns during pregnancy can positively affect her for the rest of her life (Gavard & Artal, 2008), particularly in relation to reducing modifiable risk factors for Type 2 diabetes (Hu et al., 2001).

An unexpected finding of this research was that health professionals paid little attention to physical activity during pregnancy. Even though health education was not the focus of the research, the results in terms of the lack of attention to physical activity have implications for health education and health promotion.
‘Education for health’ is a term more reflective of a health promotion focus and “aims to empower people so they can exercise more control over the factors that determine their health – especially social determinants” (Northern Territory Government, 2007, p. 27). Health education has traditionally been associated with health promotion (Egger et al., 2005) yet health education and health promotion are not interchangeable terms (Northern Territory Government, 2007; Whitehead, 2003). “Health promotion is about assisting people to take control of the factors that influence their health; and for that to be possible practitioners need a solid understanding of people’s experiences of everyday life, of the social factors that contribute to those experiences, including the systemic influences” (Keleher, 2007b, p. 16).

A consideration of social determinants draws attention to the barriers women reported in this study that negatively influence participation in physical activity during pregnancy and in the postpartum period; this consideration is necessary in any form of ‘health education’ about the role and benefits to be gained from physical activity. Without a commitment to understanding the broader social determinants which influence a woman’s ability to engage in physical activity, education may in fact be a disempowering experience.

**Factor analysis – useful for a checklist at an individual level**

The factors that have been revealed as a result of factor analysis could be used as a checklist to identify factors in women’s lives that possibly help or hinder women’s participation in physical activity during pregnancy (see Table 8.1) and then in the postpartum period (see Table 8.2). Health professionals could use this checklist in several ways: first, to identify factors that enable or, are barriers to, participation in physical activity, in partnership with the woman; and secondly, to consider strategies to overcome some or all of the barriers in order to develop achievable goals that would enable her to increase participation in physical activity both during pregnancy and in the postpartum period.
<table>
<thead>
<tr>
<th>Enabling factors</th>
<th>Tick if applies</th>
<th>Barriers</th>
<th>Tick if applies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Look better/healthier when exercise</td>
<td>√</td>
<td>Feeling unwell</td>
<td></td>
</tr>
<tr>
<td>Help manage weight</td>
<td></td>
<td>Feeling uncomfortable</td>
<td></td>
</tr>
<tr>
<td>Enjoy exercising</td>
<td></td>
<td>No time</td>
<td></td>
</tr>
<tr>
<td>Help manage stress</td>
<td></td>
<td>Caring for others</td>
<td></td>
</tr>
<tr>
<td>To prevent later health problems</td>
<td></td>
<td>Don't enjoy physical activity</td>
<td></td>
</tr>
<tr>
<td>Support from friends</td>
<td></td>
<td>Too hard</td>
<td></td>
</tr>
<tr>
<td>Have someone to exercise with</td>
<td></td>
<td>Don't know what to do</td>
<td></td>
</tr>
<tr>
<td>Support from family</td>
<td></td>
<td>Not that important</td>
<td></td>
</tr>
<tr>
<td>Support from doctor/diabetes educator</td>
<td></td>
<td>Being overweight</td>
<td></td>
</tr>
<tr>
<td>Having a place to exercise</td>
<td></td>
<td>Lack of money</td>
<td></td>
</tr>
<tr>
<td>Support from friends</td>
<td></td>
<td>Nowhere to exercise/lack of facilities</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Family not supportive</td>
<td></td>
</tr>
</tbody>
</table>
Table 8.2: Checklist for enabling factors and barriers to participation in physical activity after pregnancy

<table>
<thead>
<tr>
<th>Enabling factors</th>
<th>Tick if applies</th>
<th>Barriers</th>
<th>Tick if applies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feel better when I exercise</td>
<td>√</td>
<td>Feeling uncomfortable</td>
<td></td>
</tr>
<tr>
<td>Helps manage weight</td>
<td></td>
<td>Feeling unwell</td>
<td></td>
</tr>
<tr>
<td>Look better/healthier when exercise</td>
<td></td>
<td>Too har</td>
<td></td>
</tr>
<tr>
<td>Enjoy exercising</td>
<td></td>
<td>Don't enjoy physical activity</td>
<td></td>
</tr>
<tr>
<td>To prevent later health problems</td>
<td></td>
<td>Don't know what to do</td>
<td></td>
</tr>
<tr>
<td>Helps manage stress</td>
<td></td>
<td>Family not supportive</td>
<td></td>
</tr>
<tr>
<td>Scared of getting Type 2*</td>
<td></td>
<td>Being overweight</td>
<td></td>
</tr>
<tr>
<td>Have someone to exercise with</td>
<td></td>
<td>Nowhere to exercise/lack of facilities</td>
<td></td>
</tr>
<tr>
<td>Support from friends</td>
<td></td>
<td>Lack of money</td>
<td></td>
</tr>
<tr>
<td>Having a place to exercise</td>
<td></td>
<td>Caring for others</td>
<td></td>
</tr>
<tr>
<td>Support from family</td>
<td></td>
<td>No time</td>
<td></td>
</tr>
<tr>
<td>Support from doctors /diabetes educator*</td>
<td></td>
<td>Lack of/no childcare</td>
<td></td>
</tr>
</tbody>
</table>

* For women who developed GDM in a previous or any pregnancy
Broader level strategies for health promotion

On a broader level, strategies for health promotion need more than individual responses and must include inter-sectoral approaches to health. A health care system based on comprehensive PHC reflects an understanding of the broad nature of health promotion, the need to work with other sectors, and a need to work with individuals and communities in partnership to increase control over issues that affect health (Talbot & Verrinder, 2009). Also, a social determinants approach to health recognises the primacy of people’s physical and social environment and the need to work for broader changes rather than a sole focus at the individual level (Keleher & MacDougall, 2009b). Key issues that influence women’s health that were identified in this research and reflect themes in the broader literature were especially related to lack of affordable, available, accessible and appropriate childcare, together with problems of time constraints (Chasan-Taber et al., 2007; Dutton et al., 2005; Smith et al., 2005). Although during an individual consultation at a primary care level, more attention to physical activity is needed, “health promotion is everybody’s business and inter-sectoral collaboration is the key” (Talbot & Verrinder, 2009, p. 7).

What was found when research Objective 3 was explored?

The impact of GDM on a woman’s life in terms of lifestyle changes, especially physical activity during pregnancy, after a diagnosis of GDM during pregnancy and in the postpartum period

GDM has been indentified as a ‘warning signal’ for the development of future Type 2 diabetes and is viewed as an `excellent marker’ (McElduff, 2003) for targeted preventive strategies, both during pregnancy and postpartum. Some of the Australian women interviewed commented positively on a diagnosis of GDM and one woman considered it to be a `blessing’ in terms of a ‘warning signal’ for the possibility of developing Type 2 diabetes in the future. This finding of a diagnosis of GDM as an indicator for the woman to address modifiable risk factors has been similarly reported in one other study (Evans & O’Brien, 2005).

However, GDM was not viewed by the Tongan health professionals interviewed as a warning signal for women’s increased risk of developing future Type 2 diabetes because diabetes was already considered by these health professionals to be a prevalent and significant health issue in Tonga. Diabetes was viewed by the health professionals interviewed as the most significant chronic health issue in Tonga. Preventing chronic diseases including Type 2 diabetes and obesity has been on the political, economic and health agenda of the Tongan Ministry of Health (WHO Regional Office for the Western Pacific, 1998) and more recently Tonga has recently developed a national chronic disease plan (Epping-Jordan et al., 2005).
Preventing chronic diseases is a global concern. In 2002, a WHO global strategy on diet, physical activity and health to curb the burden of non-communicable diseases, including diabetes, was released (WHO, 2002). Comprehensive strategies for the prevention and control of GDM and diabetes requires strong government commitment, supportive public policies and the development of national programs (WHO Regional Office for the Western Pacific, 1998).

In this study, it was evident that GDM had an impact on women’s lives and that, during pregnancy, women’s main concern was the health of the baby. After a diagnosis of GDM, all women reported being advised to make lifestyle changes and during pregnancy women reportedly took notice of the advice. Changes to diet were made more often than changes to physical activity. Even though women were aware of the risk factors for developing Type 2 diabetes, changes made during pregnancy were not always maintained postpartum, mainly because of lifestyle management factors; some of these factors that hindered participation in physical activity after the baby was born have already been discussed. As one woman who had GDM commented:

“There is a recovery phase after having the baby; it is hard for women to manage their lives after the baby.”

Women in the interviews expressed conflict. Even though they were aware of their increased risk of Type 2 diabetes, the disease was perceived to be a long way off. Some felt confident they could cope if they did develop Type 2 diabetes since they had already managed diabetes in pregnancy. Women also noted the lack of public health information about the dire consequences of diabetes.

Key points that emerged from this research which negatively influenced lifestyle changes postpartum were:

1. women’s perceived ability to cope if they were diagnosed with diabetes;
2. developing Type 2 diabetes was perceived to be a long way off so it was not women’s immediate priority; and
3. lack of public health information about the dire consequences of diabetes contributed to complacency about the need to reduce risk factors for Type 2 diabetes.

Lack of postpartum lifestyle changes to prevent Type 2 diabetes for women who had experienced GDM emerged as an issue for women in this study, despite their awareness of the increased risk of developing future Type 2 diabetes and their knowledge of the beneficial role of physical activity to ameliorate this risk. These issues have been similarly reported in the few studies that have explored lifestyle changes with women postpartum GDM (Evans & O’Brien, 2005; Fehler et al., 2007; Smith et al., 2005; Stage et al., 2004). There is a gap in the literature as well as in practice in this area. Although women often receive intense antenatal education during pregnancy, it often ends with the delivery, even though the associated risks of GDM go beyond
pregnancy. Women in this situation fall through the gaps in health services. As one participant who had GDM commented in the interview:

“The antenatal clinic managed me when I was pregnant but I don’t belong to them anymore.”

Women who experience GDM report being worried about developing diabetes but make minimal lifestyle changes to ameliorate this risk (as cited in Glass, in press). Stage et al. (2004) suggests that “[i]nformation and advice has to be given repeatedly by a team of nurses, doctor, dieticians and exercise physiologists to obtain sustained success. Change of lifestyle is difficult” (p. 71).

Given the difficulty identified by Stage et al. (2004), an interprofessional team may be the best group carry to out this educative role. Glass (in press) has differentiated multi-disciplinary, interdisciplinary and interprofessional teams. She has suggested that, in multidisciplinary teams, individuals have separate and distinctive roles and although interdisciplinary teams are similar, they offer more flexibility and shared goals. Health Canada (2006, n.p) has defined interprofessional teams as “[m]edical and health professionals from at least three different disciplines or professions, who share a common purpose and work together collaboratively and interdependently to serve a specific patient/client population and achieve the team’s and organization’s goals and objectives” (as cited in Glass, in press).

The lack of follow-up education and support for sustained behavioural change emerged as a gap in care for the women interviewed. Women in this study suggested that they were more motivated to make recommended lifestyle changes during their pregnancy but these changes were difficult to sustain after the baby was born. As stated previously, areas for future exploration relate to:

- the duration of postpartum lifestyle changes; and
- the factors to support motivation to continue with healthy lifestyle changes in the postpartum period.

As encapsulated by England et al. (2009), health care providers and public health workers face numerous challenges in developing and implementing interventions for this population. It is likely that meaningful reductions in risk will require multi-level approaches that include patient and provider education, development of efficient mechanisms for the transfer of medical information, establishment of readily available interventions, and environmental changes that support lifestyle changes including physical activity and healthy eating.

Postpartum screening was inadequate for women in this study and in general is problematic (Kim et al., 2002). However, for women with GDM who have an increased risk of developing Type 2 diabetes, postpartum follow up and monitoring is essential (Feig et al., 2008). Women who develop GDM are a known high risk group for diabetes (Albright et al., 2005). It is an obvious
group for health promotion attention and interventions to help minimise the risk of developing Type 2 diabetes. Initiatives that support positive lifestyle changes are needed because postpartum women in general are an at-risk group for inactivity (Kapustin, 2008).

**Follow up: both inactive women and GDM inactive women who are at an increased risk of developing Type 2 diabetes**

Fragmentation of care postpartum is also an issue that contributes to low adherence to screening (Kapustin, 2008). After pregnancy, women may return to primary care settings and their GPs may not be aware that they developed GDM in their pregnancy. Women may have been managed solely by their specialists or at a high-risk antenatal clinic during their pregnancies. Practitioners are likely to follow guidelines or to ‘offer’ women a screening test when features are in place to facilitate their use. These include electronic medical records, computerised reminder systems, and file alerts (Crowther et al., 2005). Pilot study recall projects have been shown to be successful in encouraging women post-GDM to have follow-up screening and as a means to support women with behavioural change (Chittleborough et al., 2005). There is no recall system implemented in Australia for GDM.

Screening both during pregnancy (Dornhorst & Rossi, 1998; Kapustin, 2008; Lee et al., 2007; Löbner et al., 2006; Smirnakis et al., 2005) and in the postpartum period offers health care providers a unique opportunity to identify women at high risk for Type 2 diabetes who would greatly benefit from lifestyle interventions to ameliorate this risk (Feig et al., 2008). This is becoming more urgent as the risk of developing Type 2 diabetes following GDM is increasing (Gennero & Fehder, 2000).

**Recommendations**

The recommendations outlined in the following section apply to professionals who support women during pregnancy and in the postpartum period. Mostly the recommendations relate to primary care practitioners including midwives, general practitioners, specialist obstetricians and gynaecologists, Indigenous primary health care workers and dieticians. A more collaborative approach to supporting women during their pregnancies is proposed as part of the recommendations and may be incorporated within the practice of a health promotion practitioner or practice nurse. Specialised training within the emerging area of lifestyle medicine is also discussed and may suit health promotion practitioners or practice nurses who are keen to take up the role of lifestyle practitioner to support and promote women’s participation in physical activity.
Ways to target women postpartum GDM for screening and lifestyle support

Women with little babies are busy people (Ratner, 2007). Follow-up screening rates are low (McElduff, 2003). Postpartum, new mothers may access the health system for their babies and this has been suggested as an opportune time to target these women. As discussed by McElduff (2003), a strategy adopted at the Royal North Shore Hospital, NSW to rapidly identify mothers with a past history of GDM was to highlight this within the child’s health record (McElduff, 2003). This alerts the doctor to opportunistically assess the woman’s need for screening, weight loss advice and postpartum education to help prevent or detect Type 2 diabetes (WHO, 1986).

Lack of information about physical activity during pregnancy

Pregnancy is a life-changing event that can initiate an adverse change in physical activity. A partnership approach, where an individual is empowered through the development of personal skills and the provision of information, has been identified as key action areas for effective health promotion (Kirkby & Symons, 2000). A diagnosis of GDM and pregnancy in general can offer a prime time for opportunistic health education and support to engage in physical activity. Adopting healthier behavioural patterns during pregnancy can positively affect a woman for the rest of her life (Gavard & Artal, 2008). As such, every opportunity needs to be made by health professionals to support women’s lifestyle changes during pregnancy as a way to manage GDM, and in the postpartum period, to prevent Type 2 diabetes.

“Consistent recommendations, together with a professional and public health campaign to raise awareness of GDM as a diabetes predictor, will be necessary to improve postpartum care of women at highest risk” (Ratner, 2007, S244). Changes made to lifestyle during pregnancy can potentially have long-term benefits. Pregnancy and even thinking about pregnancy can create a prime chance for intervention, health promotion and lifestyle planning and management.

Recommendations for increased attention to physical activity: future directions for practice

For a variety of reasons, women may not be aware of the health benefits associated with engaging in moderate levels of physical activity during pregnancy. In turn, this may negatively influence their participation (Clarke et al., 2004). Perhaps the present education by health care providers is “failing to correct inaccurate perceptions of the risks associated with physical activity in pregnancy” (Dempsey et al., 2005) and women are taking a ‘pregnant pause’ (Clarke et al., 2004) unnecessarily. As Clarke (2004) suggests, there is considerable scope for “improving the quantity and quality of advice in this area” (Keleher, 2007b). One such way is through the development of information packages for pregnant women, ensuring that health promotion is a significant part of the primary consultation, and attention to physical
activity is a serious component of the antenatal care, particularly for women who are diagnosed with GDM. Another way is for women to be advised, supported and encouraged to engage in recommended levels of physical activity irrespective of pregnancy status.

Health promotion is based on the principle of empowerment and is linked to the concept of ‘enabling’ (Keleher, 2007b). As stated by Keleher (2007b, p. 16):

> health promotion is about assisting people to take control of the factors influencing their health; and for that to be possible practitioners need a solid understanding or people’s experiences of everyday life, of the social factors that contribute to those experiences, including the systemic influences.

Clearly, there is a role for health professionals to support women with lifestyle changes, especially to encourage moderate levels of physical activity during pregnancy. Women who develop GDM need ongoing support to reduce their modifiable risk factors for Type 2 diabetes. This research has identified gaps in both these areas. Medical Practitioners, Midwives and Aboriginal Health Workers who care for pregnant women are often very busy and do not always have the time to support lifestyle changes. Diabetic educators may likewise not have the time or background knowledge to pay attention to physical activity. Exercise physiologists could provide information about exercise but may not be as informed about nutrition. Often attention to health promotion and physical activity is not ideal within the current primary care setting for a variety of reasons including lack of time, lack of expertise in the area and lack of awareness of the social determinants which influence health.

**A collaborative health promotion approach to promote physical activity**

A more collaborative approach to supporting women during their pregnancies and in the postpartum period for women who have GDM is proposed in line with the emerging role of the health promotion practitioner and lifestyle medicine. The advent of specialist training in the field of health promotion will help to define the role of the health promotion practitioner. There will no doubt be possibilities for a health promotion practitioner to link to specialist training in lifestyle medicine, another emerging clinical discipline which aims to form a bridge with health promotion at an individual primary care level (Egger et al., 2008, p. 1).

Lifestyle medicine has arisen in response to the increasing contribution of unhealthy behaviours (including physical inactivity) to disease. It is the “application of environmental, behavioural, medical and motivational principles to the management of lifestyle-related health problems in a clinical setting” (Egger et al., 2008, p. 1) and involves the therapeutic use of lifestyle interventions. The individual is the focus of the intervention rather than population and environmental interventions. Whilst it is a clinical discipline, the proponents of lifestyle medicine suggest that it is different from conventional medicine in that the focus is on modifying the behavioural and
lifestyle bases of disease and not simply treating the disease (Egger et al., 2008). However, the language used to describe the application of lifestyle medicine reflects a medical model of care, not a social model of health. For example, lifestyle interventions are usually ‘administered’ within a primary care setting with a ‘patient’ who although is active in care, may require a ‘prescription’ for exercise and diet that is ‘administered’. These prescriptions are described as the “penicillin” of lifestyle medicine where psychology is described as the “surgery” (Egger et al., 2008, p. 4). The authors do recognise that the term ‘patient’ is not the ideal term and is no longer appropriate in this setting (Egger et al., 2008) but suggest that there is no other fully acceptable term to use. Nevertheless, lifestyle medicine is an emerging discipline which does move away from the notion of care being provided by one expert, towards practice carried out by a team of health professionals, with the medical doctor (most likely a GP) proposed to co-ordinate the team (Egger et al., 2008).

Notwithstanding some of these reservations about how lifestyle medicine is framed within a medical model of health, the approach does reflect a move towards incorporating some of the action areas of health promotion as identified in the Ottawa Charter for Health Promotion (WHO, 1986) and the Jakarta Declaration (WHO, 1997) as indicated in Table 8.3.

Table 8.3: Health promotion charters and links to lifestyle medicine

<table>
<thead>
<tr>
<th>Ottawa Charter Action Area (1986)</th>
<th>Approach of lifestyle medicine (Egger et al., 2008)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Re-orientating health services.</td>
<td>Treats lifestyle causes. Involves allied health professionals. Goal is primary/secondary/tertiary prevention. Emphasis is on lifestyle change. Treatment is always long term.</td>
</tr>
<tr>
<td>Create supportive environments.</td>
<td>Considers the person’s environment. Attention given to side effects that impact on lifestyle.</td>
</tr>
<tr>
<td>Developing personal skills.</td>
<td>Patient is active in care. Responsibility is on the patient. Emphasises motivation and compliance.</td>
</tr>
<tr>
<td>Jakarta Declaration (1997)</td>
<td>Involves allied health professionals.</td>
</tr>
<tr>
<td>Consolidating and expanding partnerships for health.</td>
<td></td>
</tr>
<tr>
<td>Increasing community capacity and empowering the individual.</td>
<td></td>
</tr>
<tr>
<td>Patient is active in care.</td>
<td></td>
</tr>
</tbody>
</table>

What should be noted about the above is that gender as a social determinant of health is not overtly considered. For example, ‘patient is active in care’ does not consider the factors that constrain women in relation to their social role and influence their participation in physical activity. Yet, as the authors note,
“as lifestyle medicine is a developing area, there is still much to be learned” (Egger et al, 2008, p. 6). Two specific goals of lifestyle medicine are proposed:

1. To learn how to comprehensively incorporate gender as a social determinant of health to support lifestyle change.
2. To explore how a ‘lifestyle practitioner’ can best practice within a PHC framework.

Practice nurses – to take up the role of ‘lifestyle practitioners’?

Specialised training in lifestyle medicine may suit health promotion practitioners or practice nurses who are keen to take up this role. As suggested by Egger et al (2008, p. 5), the “emerging areas of practice nurses may be able to fill this gap.” As stated previously, an unintended finding of the research was the lack of attention paid to physical activity by health professionals. The practice nurse may be the practitioner to take a leading role in directing attention to physical activity during pregnancy and in the postpartum period, to direct attention to primary prevention strategies to minimise modifiable risk factors for GDM for all women of child-bearing age (Evans & O’Brien, 2005), and to promote healthy lifestyles with younger adults/school students. Furthermore, wherever possible the practice nurses need to work with Aboriginal Health Workers to address issues for Indigenous women who experience GDM.

Health education is one health promotion strategy that can empower women to improve their health (McMurray, 2007). However, as Annells (2007, p. 21) suggests, practice nurses, for a variety of reasons including their own education, have traditionally not incorporated health promotion as part of a PHC approach within their practices. Furthermore, it is not clear what the emerging role of practice nurses will evolve into, which raises broader issues and opportunities about the organisation of PHC (Annells, 2007). However, practice nursing is an increasing part of PHC globally and within the Australian health care system (Annells, 2007). In Australia over the past decade, there has been substantial attention given to the role of practice nurses in relation to PHC (Patterson, 2000); the development of the role of the practice nurse (Halcomb et al., 2007; Halcomb et al., 2006; Patterson, 2000); the role of the practice nurse in co-ordinating care of people with chronic and complex conditions (Patterson et al., 2007) and ways to promote leadership and management of practice nurses in general practice (Halcomb et al., 2008). These discussions provide a foundation platform to further explore the expanding role of the practice nurse, particularly in relation to lifestyle medicine.

The emerging role of the lifestyle practitioner may synthesise with the emerging role of the practice nurse (Annells, 2007) to reflect a practitioner responsible for directing attention to physical activity (and other lifestyle factors such as diet and weight) both during pregnancy and in the postpartum period.
A social model of care that encompasses a gendered approach to health promotion

Drawing on the literature, the previous discussion can be conceptualised as a possible model of care. In this model, attention is directed to ways practice nurses (or lifestyle practitioners) can incorporate a social model of health within the medical model of health as a way to meet a comprehensive PHC agenda (Annells, 2007). The practitioner’s work is underpinned by an understanding of the social determinants of health – the factors that positively and negatively influence physical activity during pregnancy and in the postpartum period which have been identified in this research to construct a checklist. The model would reflect an approach that is empowering and individualised; that enables women to develop personal skills so that they are well informed, motivated and supported to make informed decisions about their lifestyle practices; and a commitment to social justice that recognises that health is influenced by a myriad of factors.

This model is a gendered approach to health promotion. It is a model of care based on comprehensive PHC that is situated within the individual primary care level, offered by a health promotion lifestyle practitioner, possibly a practice nurse who also recognises the need for multi-sector collaboration, or an interprofessional team to optimise support for individual lifestyle change. The interprofessional and participatory approaches are in line with the principles outlined in the Ottawa Charter for Health Promotion, confirmed in subsequent conferences on health promotion, which recognise the “complex interactions between personal choices, social norms and economic and environmental factors” (WHO, 2002, p. 4).

This model is not definitive. Rather, it is a work in progress as it is recognised that broad public health initiatives are also needed to increase people’s awareness of diabetes, encourage the sedentary to become active, encourage a shift from gentle intensity to moderate intensity physical activity, and create supportive environments (such as access to affordable childcare) conducive to women’s participation in physical activity. However, clear and practical implications are proposed (that could be implemented to some degree by those professionals who already support women during pregnancy and in the postpartum period) to shift care towards a social model that encompasses a gendered approach to health promotion.

Concluding comments

In conclusion, pregnancy can afford a prime opportunity for ‘education for health’, intervention and health promotion. In order to maximise healthy lifestyle change and institutionalise appropriate norms of physical activity, this research has identified a need for strategies to be delivered to pregnant women and in the postpartum period for women who have experienced GDM and who have an increased risk of developing Type 2 diabetes. Results of this study indicated that attention to physical activity as a component of
antenatal care is lacking. Walking was the most common activity undertaken by women in this study, and walking at a slow pace was the only activity that increased during and after pregnancy compared to before pregnancy. As such, pregnant women may be missing out on the benefits of physical activity, especially moderate intensity activity. There is an opportunity for health professionals to develop empowering partnerships with women and to develop strategies that enable women to participate in physical activity. A shift towards encouraging healthy lifestyle practices must be undertaken with a consideration of the factors that support and hinder women’s participation in physical activity. Directing serious and sustained attention to walking may be a good first step towards a gendered approach to health promotion for all pregnant women, especially those who experience GDM.
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during pregnancy reduce the risk of gestational diabetes among previously

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Appendix 4.1: SCU Ethics Approval for focus groups

SOUTHERN CROSS UNIVERSITY

~ MEMORANDUM ~

To: A. O’Brien/F. Doran
Nursing and Health Care Practices
aobrien@scu.edu.au
fdoran@scu.edu.au

From: Secretary, Human Research Ethics Committee

Date: 14.3.05

Project: A cross-cultural exploration of exercise, pregnancy and gestational diabetes mellitus (GDM) with implications for preventive interventions and health promotion initiatives.

Status: Approved subject to standard conditions of approval and some special conditions

Approval Number: ECN-05-18

HUMAN RESEARCH ETHICS COMMITTEE (HREC)

Thank you for your application to the Human Research Ethics Committee.

At the meeting of the HREC on the 7 March 2005, this application was considered by the full Committee. This project has been approved subject to the usual standard conditions of approval and the following special conditions.

Compliance to the special conditions is mandatory to the approval and the compliance is required within one month of the approval. Please send all correspondence to the Secretary. Please contact the Secretary if the compliance cannot be provided within one month.

Please return the signed certification (attached) with appropriate signatures any specific documentation to the Secretary when you have complied.
Appendix 4.2: Focus group questions

Welcome & Introduction
Please state your name and one thing you enjoy doing or one thing you enjoy about being pregnant/caring for pregnant women

Pregnancy generally
In general, what kinds of things can influence pregnancy?

Lifestyle influences
What kinds of lifestyle factors can influence a healthy pregnancy?
Can you think of any ways your lifestyle has changed since you became pregnant?

Exercise
What do you think about exercise when pregnant?
Knowledge of exercise – what is good to do? What is not good to do? And why?
Would there be any reasons that would stop you exercising when you are pregnant?
What do you think about resistance exercises? Eg. Aerobic exercises?
What is your understanding of gestational diabetes mellitus?
What are the reasons women may get this during their pregnancy? What are the things people can do to keep their diabetes under control? What about exercising if women have gestational diabetes? Any benefits? Which types of exercise? What have they done? or their friends? (If applicable)

For pregnant women specifically – not health carers
Think back to what you did before you were pregnant. What type of exercise did you mostly do before becoming pregnant, if any?
What type of exercise (if any) do you mostly do since becoming pregnant?
Have there been any changes?
What have been some of the reasons for these changes?
Are there any particular things in your culture you think influence exercise when you are pregnant?
Where have you have gained your information about exercise during pregnancy?

Diabetes – and gestational diabetes
How would a pregnancy be different if a woman developed diabetes during pregnancy?
Would there be any lifestyle changes that could help the woman to manage the diabetes during her pregnancy?

Summarise the main points with the group

Thank participants
Appendix 4.3: SCU Ethics Change of Protocol approval for individual interviews

SOUTHERN CROSS UNIVERSITY

~ MEMORANDUM ~

To: A. O’Brien/F. Doran
Nursing and Health Care Practices
aobrien@scu.edu.au
fdoran@scu.edu.au

From: Secretary, Human Research Ethics Committee

Date: 6.7.05

Project: A cross-cultural exploration of exercise, pregnancy and gestational diabetes mellitus (GDM) with implications for preventive interventions and health promotion initiatives.

Status: Change of protocol approved subject to standard conditions of approval.

Approval Number ECN-05-18

HUMAN RESEARCH ETHICS COMMITTEE (HREC)

At the meeting of the HREC on the 27 June 2005, the change of protocol to include individual women with gestational diabetes has been noted by the HREC. This change is approved subject to the usual standard conditions.

Please note that Point 6 of the Standard Conditions has been modified and this updated version should be included in any relevant documentation provided to participants of your research.

Standard Conditions (in accordance with National Health and Medical Research Council Act 1992 and the National Statement on Ethical Conduct in Research Involving Humans):
Appendix 4.4: GDM interview question guide

Interview guide for individual women who had developed GDM

1. Can you describe the experience of a diagnosis of GDM?
   How many pregnancies have you had with GDM?
   How old were you when you were 1st diagnosed with GDM?
   How old is the baby now?

2. Can you tell me about the ways in which GDM may have influenced your life and lifestyle?

3. How were you advised to manage your GDM and blood sugar levels?

4. Can you recall being advised to continue with lifestyle changes after the baby was born? What were the recommendations? What helped and what were the barriers?

5. Since the birth of the baby, have you had a follow-up BSL test?
   Yes/no
   If yes/how many weeks after the birth?
   Do you recall any lifestyle recommendations offered at this time?

6. Do you recall being advised that a diagnosis of GDM places some women at a higher risk of developing Type 2 diabetes later on in life?

7. Do you recall being advised of any specific lifestyle recommendations to reduce your risk of developing Type 2 diabetes (or to prevent another GDM pregnancy) and what the advice was?

8. I’m interested in your suggestions about what could be done to prevent GDM.
   Before women become pregnant?
   During pregnancy before it is picked up around 28 weeks?

9. Once the baby is born, how could health care professionals support/assist women in reducing their risk of developing Type 2 diabetes?
10. What would be the main thing that would help you to do 30 minutes of moderate physical activity each day (or most days) [where you breathe harder like during a fast walk or riding a bike or swimming laps?]

11. What would be the main thing that makes it difficult for you to do 30 minutes of mod physical activity each day? (or most days?)

12. Upon reflection of the experience of GDM, can you describe any “positives” that have arisen for you as a result of a diagnosis of GDM?

13. Are there any comments, thoughts, suggestions, insights you would like to add?

Thank you for agreeing to be interviewed and for your insights.
Appendix 4.5: A brief report of attitudes towards physical activity during pregnancy

Appendix 4.6a: Ethics approval from SCU for Tongan research

SOUTHERN CROSS UNIVERSITY

~ MEMORANDUM ~

To: A. O’Brien/F. Doran  
Nursing and Health Care Practices  
aobrien@scu.edu.au, fdoran@scu.edu.au

From: Secretary, Human Research Ethics Committee

Date: 7.9.05

Project: A cross-cultural exploration of exercise, pregnancy and gestational diabetes mellitus (GDM) with implications for preventive interventions and health promotion initiatives.

Status: Change of protocol approved subject to standard conditions of approval and one special condition.  
Approval Number ECN-05-18

HUMAN RESEARCH ETHICS COMMITTEE (HREC)

The change of protocol to continue data collection with women from Pacific Island backgrounds, specifically pregnant women who live in Tonga and some of the health care professionals who care for the women during their pregnancy. This will involve overseas travel by the researcher and it is noted that an IRG has been approved for this purpose. The protocol changes have been approved by the Chair and the Chair’s nominee.

Special Condition  
Please include the name and contact details of a ‘counsellor’ or doctor in Tonga, to whom the women could refer if they had any difficulties during the interviews. This information should be included in the Consent information to the participants.

Please note that you must comply with the special condition/s within one month of this approval, otherwise the approval will be revoked. Please send your responses and the signed certification to the Secretary by the 7 September 2005.
Please return the attached **signed certification** with any specific documentation to the Secretary when you have complied. This will be included in the next appropriate HREC Agenda for noting by the Committee.

Please note that Point 6 of the Standard Conditions has been modified and this updated version should be included in any relevant documentation provided to participants of your research.

**Standard Conditions** (in accordance with *National Health and Medical Research Council Act 1992* and the National Statement on Ethical Conduct in Research Involving Humans)
Appendix 4.6b: Ethics approval from the Tongan Ministry of Health
Appendix 4.7: Tonga women interview guide
(questions with a tick were actually asked)

Questionnaire guide for interview with non health professionals (interviewer to fill in answers)

Example
Please place a tick in the empty box that applies to you with a tick or a number, which ever is applicable:

<table>
<thead>
<tr>
<th>About you:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Your age in years: ✓</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Background:</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Tonga</td>
</tr>
<tr>
<td>---</td>
</tr>
<tr>
<td>3. Number of previous pregnancies:</td>
</tr>
<tr>
<td>4. Number of previous pregnancies with GDM: ✓</td>
</tr>
<tr>
<td>5. Are you currently pregnant?</td>
</tr>
<tr>
<td>6. Have you been diagnosed with GDM this pregnancy?</td>
</tr>
<tr>
<td>7. Were you diagnosed with GDM during your last pregnancy? ✓</td>
</tr>
<tr>
<td>8. If diagnosed, how many weeks were you when you were diagnosed with GDM in the most recent pregnancy?</td>
</tr>
<tr>
<td>9. If a positive GDM last pregnancy, did you have a follow up screening test (glucose tolerance test) for</td>
</tr>
</tbody>
</table>
12. Have you since been diagnosed with type 2 diabetes?

13. How old is your youngest baby? ✓

14. Do you have a family history of diabetes? ✓

15. Do you have a family history of GDM? ✓

**During Gestational Diabetes Mellitus**

16. Your last pregnancy (and before you were diagnosed with GDM) were you aware of GDM? Yes | No | Can’t Remember

   What did you know about GDM?

17. During your last pregnancy (but before you were diagnosed with GDM) what information were you given about GDM? Information

   By whom?

   How often?

18. What was your reaction when you found out you had GDM? not that concerned | a little concerned | very concerned
19. If you were concerned, what were you mainly concerned about? ✓

- a. the health of the baby
  - not concerned
  - moderately concerned
  - very concerned

- b. having a big baby
  - not concerned
  - moderately concerned
  - very concerned

- c. the birth
  - not concerned
  - moderately concerned
  - very concerned

- d. developing type 2 diabetes
  - not concerned
  - moderately concerned
  - very concerned

- e. not knowing what was going to happen
  - not concerned
  - moderately concerned
  - very concerned

- f. worried about how to manage blood sugar levels
  - not concerned
  - moderately concerned
  - very concerned

- g. worried about going on insulin
  - not concerned
  - moderately concerned
  - very concerned

- h. other concerns
  - not concerned
  - moderately concerned
  - very concerned

20. Out of the above concerns from a diagnosis of GDM which were the main two?

1
2

21. After a diagnosis of GDM do you think your concerns motivated you to:

- a. take the management of your GDM seriously?
  - No
  - Not much
  - Yes
  - Very much

- b. engage in more physical activity?
  - No
  - Not much
  - Yes
  - Very much

- c. eat healthier food?
  - No
  - Not much
  - Yes
  - Very much

- d. lose / manage weight
  - No
  - Not much
  - Yes
  - Very much

- e. manage your blood sugar levels
  - No
  - Not much
  - Yes
  - Very much

- f. take notice of the advice given by the doctor/ diabetes educators
  - No
  - Not much
  - Yes
  - Very much
<table>
<thead>
<tr>
<th>g. other</th>
<th>No</th>
<th>Not much</th>
<th>Yes</th>
<th>Very much</th>
</tr>
</thead>
</table>

22. After the diagnosis of GDM what information were you given about GDM? ✓

I was advised to....

By whom?

How often?

THE NEXT QUESTIONS ARE ABOUT PHYSICAL ACTIVITY

23. Were you given any information about physical activity in relation to GDM? ✓

<table>
<thead>
<tr>
<th>None</th>
<th>A little</th>
<th>Quit a lot</th>
<th>Don’t remember</th>
</tr>
</thead>
</table>

24. If you were given any information about physical activity what were you advised? ✓

<table>
<thead>
<tr>
<th>a. that it was important?</th>
<th>Yes</th>
<th>No</th>
<th>Yes</th>
</tr>
</thead>
<tbody>
<tr>
<td>b. beneficial?</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>c. that I must do more?</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>d. what types to do?</td>
<td>Yes</td>
<td>No</td>
<td>No - examples</td>
</tr>
<tr>
<td>e. how much time to spend each day?</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>f. what intensity? (e.g. moderate, make you sweat, breathe harder, increase your heart rate)</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>what types to avoid?</td>
<td>Yes</td>
<td>No</td>
<td>No - examples</td>
</tr>
</tbody>
</table>
25. Did the diagnosis of GDM influence you to change your physical activity levels at all?  

If so, what did you do differently?

26. What helped you engage in physical activity during your pregnancy and after the baby was born?

**During preg/ After baby**

<table>
<thead>
<tr>
<th>Reason</th>
<th>Yes</th>
<th>No</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. support/ encouragement from doctor/ diabetes educator</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>b. diabetes clinic</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>c. family</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>d. friends</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>e. having someone to exercise with</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
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</tr>
<tr>
<td>f. having a place to exercise</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>g. feel better when I exercise</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>h. prevent health later health problems</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>i. scared of developing type 2 diabetes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>j. helps with managing weight</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>k. other reason</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
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</table>

27. Which would be the two things that helped you the most?

1

28. What are some of the barriers to you doing physical activity during pregnancy and after the baby was born?
### During preg / After baby

<table>
<thead>
<tr>
<th></th>
<th>a. during preg.</th>
<th>b. after baby born</th>
<th>c. no time</th>
<th>d. caring for others</th>
<th>e. too hard</th>
<th>f. don’t know what to do</th>
<th>g. not that important</th>
<th>h. being weight</th>
<th>i. dogs</th>
<th>j. nowhere to exercise</th>
<th>k. family not supportive</th>
<th>l. other reason</th>
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<td>No</td>
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</tbody>
</table>

29. **Which would be the main two barriers?**

1

2

30. **How would you rate the importance of physical activity in relation to**

<table>
<thead>
<tr>
<th></th>
<th>a. preventing the onset of type 2 diabetes?</th>
<th>b. for general health and well-being?</th>
<th>c. managing GDM?</th>
<th>d. avoiding heart disease</th>
<th>e. losing weight</th>
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<tbody>
<tr>
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<td>Very important</td>
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<td>Not Important</td>
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31. Think back to what you did before you were pregnant. What type of exercise did you mostly do before becoming pregnant, if any? ✓

32. What type of exercise (if any) did you mostly do during your pregnancy? ✓

33. Have there been any changes? ✓

34. What were some of the reasons for these changes? ✓

35. Are there any particular things for Tongan women that you think influence exercise / physical activity levels during pregnancy? ✓

36. Most recent physical activity? Please tick the number of days you did 30 minutes of moderate physical exercise in the last week. (Moderate exercise means that it is energetic physical activity but it does not leave you out of breath e.g. a fast walk).
37. What type of physical activity did you do in the last week? / During your last pregnancy? and before you became pregnant? ✓

<table>
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<th></th>
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<th>two days</th>
<th>three days</th>
<th>four days</th>
<th>five days</th>
<th>six days</th>
<th>seven days</th>
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<td>during preg</td>
<td>before last pregnancy</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>c.</td>
<td>other outdoor work</td>
<td>last week</td>
<td>during preg</td>
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<td>last week</td>
<td>during preg</td>
<td>before last pregnancy</td>
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<td>e.</td>
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<td>f.</td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>g.</td>
<td>other</td>
<td>last week</td>
<td>during preg</td>
<td>before last pregnancy</td>
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<td></td>
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</table>

38. What would be the best way for you to increase your physical activity levels?

39. What are the things that could help you become more active?

40. Do you think GDM is a significant health issue for Tongan women? ✓

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<thead>
<tr>
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<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>
41. Do you think type 2 diabetes are a significant health issue for Tongan people generally? ✓
   | Yes | No |

42. What do you think is needed to prevent diabetes / GDM? ✓ (from the governments, doctors, health care professionals generally, people’s attitudes/ lifestyle)

| Weight |

43. Do you know how much weight you put on during your last pregnancy? Yes | No |

44. How much did you weigh at the end of that pregnancy? Weight

45. If you did put on a lot of weight during your pregnancy have you tried to lose this weight since the birth? Yes | No
46. If so, how have you been attempting to lose weight?  

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
</table>

Further comments?

Thank you so much for your time and assisting with this questionnaire.
Appendix 4.8: The consent form: The Savea Suka Feitama
Appendix 4.9: Tonga – health professional’s interview guide

Thank you so much for your time and assisting with this questionnaire.

<table>
<thead>
<tr>
<th>Interview schedule</th>
</tr>
</thead>
<tbody>
<tr>
<td>Guided semi-structured interview with Health Carers re: Gestational Diabetes</td>
</tr>
</tbody>
</table>

1. What is your understanding of a woman's risk of developing gestational diabetes mellitus?

2. Can you tell me about the general screening and diagnostic tools that are used?

3. What is your usual treatment/management of gestational diabetes?

4. What are your views about exercise/physical activity in terms of the management/prevention of gestational diabetes?

5. What recommendations (if any) would you make to women with a recent diagnosis of GDM?

6. In what ways do you think culture may influence women during pregnancy in terms of general lifestyle and behaviour factors?

7. What are the factors in your culture that would encourage women to engage more in physical activity? (both during pregnancy and generally)

8. What do you consider to be the barriers to pregnant women and women generally engaging in physical activity?

9. What are your thoughts on the significance of GDM for Tongan women?

Further comments:
Appendix 4.10: Pregnancy and Physical Activity Survey
Appendix 4.11: GDM Survey
Appendix 4.12: Physical Activity Diary
Appendix 4.13a: Ethics approval from NCAHS for Surveys and Diary

19 February 2007

Frances Doran
Lecturer
School of Health & Applied Sciences
Faculty of Health & Applied Sciences
Southern Cross University
PO Box 157
LISMORE NSW 2480

Dear Frances

RE: NCAHS HREC NO. 380N

Pregnancy, gestational diabetes mellitus and physical activity

Thank you for your correspondence dated 21 December 2006 to the North Coast Area Health Service (NCAHS) Human Research Ethics Committee (HREC).

Documentation received:
• Letter of explanation
• Amended Appendix A ‘Are you pregnant?’
• Amended Appendix C Permission letter
• Amended Appendix D Permission letter
• Amended Appendix E ‘Letter to GDM Group’
• Amended Appendix F ‘GDM Survey’
• Appendix G with management approval

The above documentation was reviewed at the Population Health & Health Services HREC meeting on 25 January 2007, and the Committee resolved to approve this study subject to the following clarifications:

• That the researcher be advised that recruiting 40 women with gestational diabetes will be a challenge and there may be a need to recruit over a longer period of time
• It is redundant to tick the last two options in Appendix C and D, remove these options from forms
• In relation to the researcher sitting in the waiting room (dot point 3 on page 3), the researcher to be as inconspicuous as possible to avoid putting pressure on women to participate.

Please ensure that all of the requested changes are done using tracked changes.

In order to facilitate the Chair’s final consideration of the above project, please provide one copy of the requested information as soon as possible. Please note that if no reply is received within 6 months of this letter a full resubmission will be required. Your response/s should be sent to:

Human Research Ethics Committee  
North Coast Area Health Service  
PO Box 126  
PORT MACQUARIE NSW 2444

Please quote 380N, short and full study name in all correspondence.

Yours sincerely

Val Johnstone  
Research Ethics Officer  
Human Research Ethics Committee
Appendix 4.13b: Ethics approval from SCU for Surveys and Diary
Appendix 4.14: Gestational Diabetes Mellitus: Perspectives on Lifestyle Changes during Pregnancy and Post-partum, Physical Activity and the Prevention of Future Type 2 Diabetes

Appendix 4.15: Stage 3 – GDM interview guide

Interview guide for individual women who had developed GDM

1. Can you describe the experience of a diagnosis of GDM?
   How many pregnancies have you had with GDM?
   How old were you when you were 1st diagnosed with GDM?
   How old is the baby now?

2. Can you tell me about the ways in which GDM may have influenced your life and lifestyle?

3. How were you advised to manage your GDM and blood sugar levels?

4. Can you tell me if you took the advice seriously during your pregnancy and if you were able to adopt any particular lifestyle recommendations? What helped and what were the barriers?

5. Can you recall being advised to continue with lifestyle changes after the baby was born? What were the recommendations? What helped and what were the barriers?

6. Since the birth of the baby, have you had a follow-up BSL test?
   Yes/no
   If yes/how many weeks after the birth?
   Do you recall any lifestyle recommendations offered at this time?

7. Do you recall being advised that a diagnosis of GDM places some women at a higher risk of developing Type 2 diabetes later on in life?

8. Do you recall being advised of any specific lifestyle recommendations to reduce your risk of developing Type 2 diabetes (or to prevent another GDM pregnancy) and what the advice was?

9. From your understanding, are you aware of any specific risk factors for developing Type 2 diabetes?

Just recently, there has been a large study on diabetes in Australia, including GDM. * I’d like to quote a few comments made by women which were reported in the study. I’d be interested in your thoughts and comments about these statements and whether or not these statements would describe if these women’s experiences are similar to your own experiences?

10. “I had no problems with gestational diabetes and kept to ..(the Dieticians) advice. It’s after the birth I’ve let my diet and exercise slip”

11. “Once gestational diabetes goes away, you kind of go back to your old lifestyle and eating habits’ .... (things get in the way)
12. I’m interested in your suggestions about what could be done to prevent GDM.

   Before women become pregnant?
   During pregnancy before it is picked up around 28 weeks?

13. Once the baby is born, how could health care professionals support/assist women in reducing their risk of developing Type 2 diabetes?
   The next few questions are about physical activity

14. In the last week, how many times a week would you say you did 30 minutes of moderate physical activity a day?

15. What would be the main thing that would help you to do 30 minutes of moderate physical activity each day (or most days) [where you breathe harder like during a fast walk or riding a bike or swimming laps?]

16. What would be the main thing that makes it difficult for you to do 30 minutes of mod physical activity each day? (or most days?)

17. Upon reflection of the experience of GDM, can you describe any “positives” that have arisen for you as a result of a diagnosis of GDM?

18. Are there any comments, thoughts, suggestions, insights you would like to add?

Thank you for agreeing to be interviewed and for your insights.

Appendix 6.1: Principal components analysis: facilitators to engaging in physical activity during pregnancy

Total Variance Explained unrotated loadings

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Extraction Method: Principal Component Analysis.
Appendix 6.2: Scree Plot: facilitators to engaging in PA during pregnancy
Appendix 6.3: Principal components analysis: facilitators to engaging in PA after birth

(Items that helped women to engage in physical activity after the baby was born)

Total Variance Explained

<table>
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<th>Extraction Sums of Squared Loadings</th>
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Extraction Method: Principal Component Analysis
Appendix 6.4: Scree Plot: facilitators to engaging in PA after birth
Appendix 6.5: Principal Component Analysis: barriers to engaging in PA during pregnancy

Total Variance Explained >.3

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Extraction Method: Principal Component Analysis. Coefficient values >.3
Appendix 6.6: Scree Plot: barriers to engaging in PA during pregnancy
Appendix 6.7: Principal Components Analysis: barriers to engaging in PA after birth

Total Variance Explained

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Extraction Method: Principal Component Analysis.
Appendix 6.8: Scree Plot: barriers to engaging in PA after birth