Postpartum Physical Activity and Related Psychosocial Factors Among Women With Recent Gestational Diabetes Mellitus

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OBJECTIVE — In this study, we examined patterns of postpartum physical activity among women with recent gestational diabetes mellitus (GDM) and psychosocial factors related to this behavior that could be addressed in diabetes prevention interventions.

RESEARCH DESIGN AND METHODS — A random sample of women who had attended diabetes clinics in Sydney, Australia, in the past 6–24 months for treatment of GDM were surveyed by telephone. Variables measured included physical activity behaviors, self-efficacy, social support, and barriers to participation.

RESULTS — Of 226 women who completed the survey (mean age 33.4 years), 26.5% were classified as sedentary, and only 33.6% reported sufficient physical activity as recommended by health authorities. Walking was the most popular physical activity, and most women reported no other moderate- or vigorous-intensity activity. Lack of assistance with child care (49.1%) and insufficient time (37.6%) were the most common barriers to physical activity. The type of social support most often reported was verbal encouragement (39.1%), with more than half of the women never receiving assistance with housework or others exercising with them. Self-efficacy for physical activity was lowest when women were under time pressure or tired. Multivariate analyses showed that sufficient physical activity was associated with high social support (odds ratio 2.5 [95% CI 1.21–3.79]) and high self-efficacy (2.09 [1.06–3.20]).

CONCLUSIONS — The prevalence of sufficient physical activity was found to be low and strongly related to social support and self-efficacy. This is an important group to whom diabetes prevention strategies can be targeted.

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Gestational diabetes mellitus (GDM), which is defined as carbohydrate intolerance first diagnosed during pregnancy (1), has been estimated to occur in 2.2–8.8% of pregnancies (2). Longitudinal studies have found that GDM substantially increases the risk of developing type 2 diabetes in later life (3), with the largest cohort showing that 36% of women with GDM developed diabetes after 28 years (4). On the basis of this and other cohort studies, it has been estimated that women who have had GDM have six times the risk of developing type 2 diabetes compared with other women and that in countries such as Australia, 20–30% of women who develop type 2 diabetes would have had prior GDM (2).

Although lifestyle interventions have been found to significantly reduce the risk of diabetes among adults with impaired glucose tolerance (5–7), so far little attention has been given to the potential benefits of behavioral interventions for women with past GDM. One study compared the effect of intensive versus routine dietary advice upon the development of diabetes in this risk group (8). The intensive group received three monthly diet reviews by telephone, but this was not found to reduce diabetes. Because of the potential to identify women at risk of future diabetes through routine antenatal screening for GDM, there is a strong rationale to try comprehensive preventive interventions for this group.

Investigation of the nature and prevalence of postpartum risk behaviors among women with a history of GDM is an important step in the design of diabetes prevention strategies for this group, but this has only been undertaken in a small number of studies (9,10). In this article data are presented about patterns of physical activity participation among women with past GDM in Sydney, Australia. Regular physical activity, at moderate intensity or higher, has been found to be associated with reduced risk of diabetes, even after adjustment for BMI (11,12).

The data here add to the limited research in this area by using established measures of physical activity and examining social and cognitive factors that may be associated with risk behaviors. This contributes to evidence that can assist in the development and targeting of diabetes prevention strategies for this risk group.

RESEARCH DESIGN AND METHODS — Study participants were a random sample of women who had attended the diabetes in pregnancy clinics of one of four public hospitals in Western Sydney for management of GDM. They had been referred after diagnosis on the basis of a 75-g glucose tolerance test, for which the fasting blood glucose level was ≥5.5mmol/l or a 2-h level ≥8.0 mmol/l. Following the Australian Diabetes in Pregnancy Society Guidelines (13), these women were routinely given advice regarding diet and physical activity. Women were eligible for the study if they had given birth 6–24 months earlier and were able to speak English. Those giving birth within 6 months of the study were excluded because the limitations caused by the postpartum recovery, particularly for those undergoing cesarean deliveries, and early adjustment to parenthood.

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Abbreviation: GDM, gestational diabetes mellitus.
A table elsewhere in this issue shows conventional and Système International (SI) units and conversion factors for many substances.
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ing would have created additional temporary barriers to physical activity.

The estimated number of eligible women who had attended diabetes clinics in the previous 2 years was 720. Using a finite population correction factor, we calculated that a sample of 244 would provide 95% CIs of ±5% for an estimated prevalence of sufficient physical activity of 40%.

The study was approved by the ethics committees at the Western Sydney and Wentworth Area Health Services. Women were recruited by mailed invitation and a follow-up telephone call. Two trained research assistants contacted the women, making up to 10 call attempts. The surveys were completed by telephone, taking ~20 min.

Invitation letters were sent to 625 clinic attendees who had given birth in the past 6–24 months, and 392 were successfully contacted. Of these, 327 were eligible (60 could not speak English, and 5 were found not to have had GDM) and 244 completed the survey (72.9%).

Medical records were searched to determine whether survey participants differed from those who refused or were not contacted. An equal proportion of women among the contacted and noncontacted groups were non–English speaking (35%). As only English-speaking women were included in the survey, respondents were compared with women identified as English speaking in the medical records who refused or were not contacted. There was no difference in age, gravidity, parity, and insulin use during pregnancy between these groups but a slightly longer (2 months) time since delivery among respondents (P < 0.01).

**Measurements**

Physical activity was measured using the Active Australia Questionnaire, which has been found to have reliability and validity comparable with other widely used measures of physical activity (14). Respondents were asked to recall the number of times that they engaged in walking (for 10 min or more) and moderate- and vigorous-intensity leisure activities in the past week and the total time in the past week that they spent doing each of these types of activity.

Self-efficacy for physical activity was measured using a modified version of a five-item scale developed by Marcus et al. (15) and reported to have good retest reliability. Respondents were asked to rate their level of confidence (very confident to not at all confident) to undertake physical activity in five situations: feeling tired, being in a bad mood, having limited time, being on holidays, and feeling like it takes too much effort. Principal components factor analysis revealed that omitting the item concerning physical activity when on holidays produced a scale with moderate internal reliability (Cronbach's α = 0.64).

The measure of social support for physical activity was a revised version of subscales developed by Sallis et al. (16), with items added to examine assistance with child care and home duties because these have been reported by women to have an important influence on their physical activity participation (17). Women were asked to report how often family or friends supported them by exercising with them, giving encouragement to keep exercising, looking after the children so they could exercise, and doing household chores so they could exercise. A single social support scale derived by summing responses to these questions was found to have acceptable internal reliability in this sample (Cronbach's α = 0.73).

The barriers to physical activity measured in the survey were identified from previous studies in Australia and North America (18,19). Respondents were asked to rate their level of agreement (strongly agree to strongly disagree) with five statements concerning physical activity: regular exercise would take too much of my time; I would find it difficult to find an exercise activity that I enjoy; I would be too tired for my daily tasks if I exercised; I don't exercise as much as I would like because of poor public facilities around where I live; and I don't exercise as much as I would like because I can't get enough help with child care. In addition to these, they were asked to rate their agreement with the statement: I do not know what type of exercise will reduce my risk of type 2 diabetes.

The descriptive information collected about respondents included number of children, living arrangements (with spouse, parents, or others), hours per week of paid work, educational attainment, language spoken at home, self-reported height and weight, and completion of postpartum glucose testing.

**Statistical analysis**

The duration of walking and moderate- and vigorous-intensity activity was converted to MET minutes by multiplying the reported minutes by MET values representing energy expenditure relative to the resting state: 3.3 MET for walking, 4 MET for moderate-intensity activity, and 8 MET for vigorous-intensity activity. Physical activity was classified into three levels: sufficient, ≥600 MET min and ≥5 sessions of activity or reporting the recommended minimum or five 30-min sessions of moderate-intensity activity or three 20-min sessions of vigorous-intensity activity; low, ≥100 MET min but not meeting the criteria for sufficient activity; or sedentary, <100 MET min of activity. The proportions of women in each category were calculated with 95% CIs, applying a finite population correction factor to take into account the limited size of the study population.

To explore the relative amount of time spent in walking and moderate- and vigorous-intensity activity median MET minutes were calculated, because the physical activity data were not normally distributed. The median test was used to test the differences in medians between subgroups of respondents.

Multiple logistic regression modeling, using the enter method, was used to identify variables that were independently associated with sedentariness and sufficient activity. The independent variables in the models included age (<35 or ≥35 years), language spoken at home (English or other), educational attainment (university level or lower), number of children (≥2 or 1), and BMI (<25 or ≥25 kg/m²). The scales for self-efficacy and social support were dichotomized using a median split and included in the models, together with perceived barriers, categorized as ≥3 or <3 reported barriers.

**RESULTS** — There were 226 eligible women who completed the survey (age 33.4 ± 5.2 years [mean ± SD]). A language other than English was spoken by 38.5% of respondents, with Middle Eastern (e.g., Arabic or Turkish), South Asian (e.g., Hindi or Tamil), and Chinese languages being the most commonly reported. Most women (58.4%) had two or more children, and 35.4% had attained a college level education. Based on self-reported height and weight, 22.2% of women were overweight (BMI 25–29 kg/m²) and 29.1% were obese (BMI ≥30 kg/m²). Of 147 women who had undergone glucose testing since pregnancy, 8.8% reported that they had borderline diabetes and 4.8% reported overt diabetes.

Table 1 shows that 26.1% of women...
Physical activity after GDM

<table>
<thead>
<tr>
<th>Table 1—Prevalence of sedentariness, low physical activity, and sufficient physical activity</th>
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<td>All</td>
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<td>Age</td>
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<td>&lt;35 years</td>
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<td>≥35 years</td>
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<td>Language spoken</td>
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<td>English</td>
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<td>Children</td>
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<td>1 child</td>
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<td>≥2 children</td>
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<tr>
<td>Educational attainment</td>
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<td>Senior high school or lower</td>
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<td>University</td>
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<td>BMI</td>
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<td>Healthy weight</td>
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<td>Overweight/obese</td>
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Data are % (95% CI).

were classified as sedentary, with the prevalence of sedentariness being highest among women of non–English-speaking background and those educated up to a high school level. The prevalence of low activity was 39.4% and was highest among women with a university level of education. Only 33.2% of the respondents were classified as sufficiently active, with English-speaking women more likely than women of non–English-speaking background to report this level of activity. Overall, the levels of physical activity participation did not differ significantly by age-group, number of children, or BMI.

Walking was the most common type of physical activity undertaken, with a median of 208 MET min reported (equivalent to 63 min/wk) (Table 2). Time spent walking tended to be higher in several subgroups of the sample but only reached significantly higher levels among the overweight or obese. The median time spent in moderate- and vigorous-intensity activity was 0 MET min across all subgroups of the sample. Moderate-intensity activity was found to be significantly higher among English-speaking women, indicating that a lower proportion of this group reported 0 MET min than those who were non-English speaking.

The median duration of all types of activity combined was 396 MET min (Table 2). Women <35 years of age and those who spoke English as a first language reported significantly higher total physical activity than other subgroups. The situations in which women most often reported feeling “very confident” or “confident” to undertake physical activity, measuring self-efficacy, was when they were on holidays (67.8%), followed by when they were in a bad mood (45.9%), felt that it required a lot of effort (35.9%), felt tired (22.6%), or lacked time (16.6%). The type of social support that the highest proportion of women reported receiving “often” was verbal encouragement (39.1%) followed by assistance with child care (32%), help with household chores (21.3%), and being accompanied during physical activity (20.5%). More than half of the women reported never receiving support through assistance with housework or others exercising with them.

The barriers to physical activity that were most often reported were lack of child care (49.1%) and lack of time (37.6%). About one-fourth of the women reported an unsuitable local neighborhood (25.4%), lack of enjoyment of physical activity (25.3%), and feeling tired (24.9%) to be barriers. Just less than half (48.9%) of the women did not know the type of physical activity that would be beneficial for diabetes prevention.

Table 3 shows the results of multiple logistic regression analyses to identify factors independently related to sedentariness and sufficient physical activity. This shows that women with a significantly lower likelihood of reporting sedentary behavior had a university education (odds ratio 0.43 [95% CI 0.26–0.71]) and high self-efficacy for physical activity (0.32 [0.21–0.71]). Sufficient physical activity was independently associated with high self-efficacy (2.09 [1.06–3.20]) and high social support (2.5 [1.21–3.79]).

**CONCLUSIONS** — The findings here demonstrate a clear need to promote physical activity in the postpartum period...
among women who have had recent GDM. Just over one-fourth of the women reported the equivalent of <30 min of walking per week, whereas more than two-thirds did not attain the recommended amount of total activity that would reduce their risk of developing type 2 diabetes. Population data for women of the same age in the regions of Sydney from which the sample was drawn show that ~40.7% are sufficiently active (New South Wales Health Department, unpublished data, 2002), indicating that those with a history of GDM are a relatively inactive group. Taking into account the fact that physical activity was measured by self-report interview, a method known to be susceptible to over-reporting (20), it is likely that this was an underestimation of the actual prevalence of inactivity among women with past GDM. In addition to this, more than half of the women were overweight or obese, which is also likely to be a conservative estimate (21).

Despite the well-known risk of development of diabetes after GDM, there is limited literature examining lifestyle in this population. The current study is the first detailed investigation of physical activity patterns. The results support previous research showing that as a group, women with a history of GDM do not take adequate measures to reduce their risk of diabetes. A recent survey in Denmark found that 39% of women performed no exercise at all 4–11 months after pregnancy with GDM (9). The number of women who gained weight exceeded the number who lost weight after pregnancy. Similarly, an earlier Australian study reported that almost three-fourths of women with GDM showed weight gain after pregnancy (10).

It was notable that about half of the women in the present study did not know the type of physical activity that would lower their future risk of developing diabetes. This finding suggests that efforts to communicate with women who had GDM about physical activity during the antenatal period have had limited success and that the strategies that health care workers use for this task may need to be addressed. Research showing that women who have had GDM are concerned about their health and perceive themselves to be at risk of diabetes (22) indicates that there are opportunities for lifestyle interventions in this group that could be better used.

Self-efficacy and social support were strongly related to physical activity and need to be addressed in diabetes prevention interventions for women with previous GDM. Practical support, through help with child care and undertaking other responsibilities, appears to be particularly important. Emphasis should be given in interventions to the legitimacy of women taking time away from their day-to-day responsibilities to participate in physical activity and offering guidance about ways they could negotiate with partners and other sources of support to enable this to happen.

Important issues in the design of lifestyle interventions for women with past GDM include whether group or individual modes of delivery are used, the number and duration of contacts, and the follow-up strategies used to promote the maintenance of behavior change. Supervised group programs have been used extensively in physical activity promotion (23,24), but only a minority in the population are willing to attend these and retention levels have been observed to fall to ~50% after 6 months (25,26). The time and child-care pressures that women with recent GDM reported as barriers to physical activity mean that the requirement to attend groups at scheduled times and to travel to and from venues will deter many from taking part. Individual methods of intervention will have greater reach to this target group. Contact by telephone, which has been used effectively in physical activity interventions with primary care patients (27,28), is a flexible method of delivery that could be used on its own or in addition to face-to-face contacts. Mailed self-help materials present one option for follow-up after direct contacts with health care providers and have been used successfully in community-based physical activity interventions (29). Internet-based strategies (30) and automated telephone counseling systems (31) have also been recently tried as methods for promoting physical activity and are potential approaches for expanding the reach and intensity of interventions at minimal marginal cost.

As indicated above, one of the limitations of the present study was the use of self-report measures of physical activity; however, self-report continues to be the most practical method of measuring this behavior in large populations. The cross-sectional nature of this study meant that it was not possible to determine the direction of causality between the psychosocial factors measured and physical activity. According to social cognitive theory (32), a relationship of reciprocal determinism is likely to exist between the performance of physical activity and the types of intrapersonal and social processes measured here. Multivariate, cross-sectional analyses are nevertheless useful for identifying factors that are most relevant to physical activity among women with GDM and that could be addressed to improve the salience and impact of interventions.

A further limitation of the present study is that it was carried out in English only and therefore excluded women from ethnic groups who might have an elevated risk of GDM and subsequent development of type 2 diabetes. Language-specific studies to investigate the prevalence of behavioral risk factors and the most relevant issues to address to promote physical activity are warranted. In the present study there were also an insufficient number of women with the diagnosis of impaired glucose tolerance or diabetes since the birth of their child to examine the impact that either of these may have had on physical activity beliefs, attitudes, and behaviors. Studies with larger samples may be able to investigate the impact that such a diagnosis has and

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**Table 3—Multiple logistic regression analysis of factors associated with sedentariness and sufficient physical activity**

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<thead>
<tr>
<th></th>
<th>Sedentariness</th>
<th>Sufficient activity</th>
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<tbody>
<tr>
<td>Age: &lt;35 vs. ≥35 years</td>
<td>0.98 (0.53–1.84)</td>
<td>0.92 (0.53–1.65)</td>
</tr>
<tr>
<td>Language: other vs. English</td>
<td>0.51 (0.29–1.12)</td>
<td>1.35 (0.70–2.36)</td>
</tr>
<tr>
<td>Education: up to year 12 vs. university</td>
<td>0.43 (0.26–0.96)</td>
<td>0.96 (0.54–1.70)</td>
</tr>
<tr>
<td>Children: 1 vs. ≥2</td>
<td>1.28 (0.67–2.24)</td>
<td>0.91 (0.54–1.58)</td>
</tr>
<tr>
<td>BMI: &lt;25 vs. ≥25 kg/m²</td>
<td>0.88 (0.49–1.64)</td>
<td>0.89 (0.53–1.56)</td>
</tr>
<tr>
<td>Self-efficacy: low vs. high</td>
<td>0.32 (0.21–0.71)</td>
<td>2.09 (1.06–3.20)</td>
</tr>
<tr>
<td>Social support: low vs. high</td>
<td>0.70 (0.40–1.33)</td>
<td>2.50 (1.21–3.79)</td>
</tr>
<tr>
<td>Barners: ≤2 vs. ≥3</td>
<td>0.85 (0.43–1.69)</td>
<td>0.87 (0.49–1.63)</td>
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</tbody>
</table>

Data are adjusted odds ratios (95% CI).

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Smith and Associates
whether it represents a significant opportunity for lifestyle interventions.

Women with a history of GDM are a population at elevated risk of development of type 2 diabetes. This study has shown that physical activity levels in this group are low, and there are cognitive and social factors related to this behavior that could be addressed to improve the relevance and success of interventions. Diabetes prevention interventions for women with past GDM need to be informed by formative behavioral research and to be designed with consideration of their future transferability to the health care system.

References
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