Understanding Exercise Beliefs and Behaviors in Women With Gestational Diabetes Mellitus

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OBJECTIVE — The purpose of this study was to examine the exercise beliefs and behaviors of postpartum women who had gestational diabetes mellitus (GDM) during a recent pregnancy.

RESEARCH DESIGN AND METHODS — Postpartum women with GDM (n = 28) completed a mail survey assessing their self-reported exercise beliefs (advantages, barriers, and important social influences) and behaviors.

RESULTS — We found that *1*) the strongest perceived advantage of exercise during pregnancy was controlling blood glucose and postpartum it was controlling weight, *2*) the most common barrier to exercise during pregnancy was fatigue and postpartum it was a lack of time, *3*) women's husband/partner most strongly influenced their exercise during pregnancy and postpartum, *4*) women exercised more during the postpartum period than before or during pregnancy, and *5*) the number of exercise advantages was positively associated with women's pregnancy and postpartum exercise behavior.

CONCLUSIONS — To increase exercise behavior and reduce the risk of type 2 diabetes in women with GDM, researchers and health care professionals are encouraged to use women's exercise beliefs, that is, advantages, social influences, and perceived barriers to exercise, as a framework for designing effective diabetes treatment and prevention programs.

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Gestational diabetes mellitus (GDM) is one of the most common complications of pregnancy, and it is associated with significant maternal and fetal morbidity (1). In addition, women with a diagnosis of GDM have a 35–50% chance of reoccurrence in future pregnancies and a 40–60% increased risk of developing type 2 diabetes within 10 years (2,3), whereas the children of these women also have an elevated risk of developing obesity and diabetes in their lifetime. Thus, there is an important need for excellent treatment and preferably prevention strategies for GDM in women. Moreover, maternal metabolic control during pregnancy may positively impact women's risk of later onset of type 2 diabetes and the risk of obesity and type 2 diabetes in their children (4), making prevention or treatment of GDM additionally important.

One approach that may be effective for both treating and preventing GDM is engaging in regular exercise (5,6). Exercise is recommended during pregnancy (7,8), and it provides physiological benefits to women with GDM such as lowering blood glucose and controlling excessive gestational weight gain (6,9–11). In addition, exercise may be less stressful and more acceptable to women than insulin injections (11). However, little is known about the psychological determinants of exercise in women with GDM. Because people's exercise behaviors are associated with their exercise beliefs (12,13), it is relevant to study how women with GDM feel about exercise and, more broadly, to understand why these women do and do not exercise. Only through such understanding will it be possible to develop effective intervention strategies to promote exercise.

Most large-scale exercise intervention studies generally exclude pregnant women, so there are only a few studies examining the exercise beliefs and behaviors of pregnant women (13–15). These studies document the fact that women believe exercise has many benefits; however, the unique physical changes of pregnancy coupled with inaccurate perceptions (e.g., exercise may be harmful to the fetus and recommendations are not appropriate or feasible) may keep many pregnant women from being active. For example, Symons Downs and Hausenblas (15) examined the exercise beliefs and behaviors of 74 women and found that physical limitations (e.g., nausea and vomiting) and a lack of time were the strongest barriers to exercise behavior during pregnancy and postpartum behavior. The women in this study, however, did not have GDM. We have found no studies examining the specific advantages, barriers, and social influences for exercise among women with or at risk for GDM. Because women at risk for GDM are likely to be less physically fit than women in general and are known to be more overweight and obese than pregnant women in general, the determinants of their exercise behavior may in fact be different from findings of previous research in women without GDM. Thus, this research is needed to design realistic and acceptable exercise interventions to treat and prevent GDM and perhaps delay or prevent the onset of type 2 diabetes in high-risk women and their children.

The purpose of this study was to examine the exercise beliefs and behaviors of postpartum women who had GDM during a recent pregnancy. Based on previous research (13–15) and to maintain an unbiased assessment, no a priori hypotheses about the type of women's exercise beliefs were generated. Based on the theory of planned behavior (TPB) (16)

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Abbreviations: GDM, gestational diabetes mellitus; LTEQ, Leisure-Time Exercise Questionnaire; TPB, theory of planned behavior.

A table elsewhere in this issue shows conventional and Système International (SI) units and conversion factors for many substances.

[see Symons Downs and Hausenblas (17) for an extensive meta-analytic review], which posits that people's salient behavioral (advantages), control (barriers), and normative (social influences) beliefs provide the underlying framework for the determinants of their intention or motivation, which, in turn, influences whether they will choose to adopt a specific behavior, we hypothesized that the number of behavioral, normative, and control beliefs reported would be associated with women's exercise behavior. In addition, we hypothesized that women's pregnancy exercise behavior would be greater than their prepregnancy and postpartum exercise behavior.

RESEARCH DESIGN AND METHODS

— Approval to conduct this study was obtained from the university's institutional review board. Within 6 months of having a baby, postpartum women who had had GDM were sent a survey packet via mail from a nurse in a gestational diabetes program jointly run by the Departments of Obstetrics/Gynecology and Medicine, section of Diabetes and Endocrinology, at a local medical practice. They were asked to return the survey within 1 week, using the stamped return envelope provided for them. Survey packets contained an informed consent form and two questionnaires and were collected from June through September 2004. Consistent with the TPB guidelines (16,18), the Exercise Beliefs Questionnaire uses an open-ended format to retrospectively elicit the following beliefs: *1*) behavioral (exercise advantages), *2*) normative (important others with a strong influence), and *3*) control (factors preventing exercise). Retrospective accounts of people's beliefs are recommended because there has been time for people's beliefs to form (K.S. Courneya, personal communication, 2002). An example statement for the behavioral beliefs was "List the main advantages of exercising [during your pregnancy] or [following the birth of your child]." Thus, questions about beliefs "during your pregnancy" were retrospective, whereas questions about "following the birth of your child" were related more or less to the present. Participants were asked to list as many beliefs that applied to them.

The participants also completed the Leisure-Time Exercise Questionnaire (LTEQ), assessing mild, moderate, and strenuous exercise done for at least 15 min (19). A total exercise index in weekly METs was calculated by weighing the frequency of each intensity and summing them for a total score (3 [mild] + 5 [moderate] + 9 [strenuous]). The LTEQ is a valid and reliable measure of exercise behavior. Participants were also asked to report the number of days and minutes they currently engaged in moderate to strenuous exercise.

A total of 60 packets were mailed to potential participants with 28 returned, representing a 47% response rate. This sample size is consistent with the TPB guidelines for conducting studies to elicit people's exercise beliefs (i.e., due to the open-ended format used to elicit the beliefs, most elicitation studies are conducted with small samples) (16,18), and this response rate is consistent with that in previous research with pregnant women (15). The women were not given any incentives for their participation.

RESULTS

— The baseline characteristics of the participants in this study are similar to those of the general population in Central Pennsylvania. The postpartum participants (mean age 32 years [range 25–39]) were 100% married, 92% Caucasian, 8% Asian, 75% with a family history of diabetes, 73% at least college educated, and 77% with a family income of at least $40,000. Also, 75% of the women were working (54% full-time and 21% part-time) in professional (71%; e.g., nurse, manager, or marketing), educational (19%; e.g., professor or teacher), and service (10%; e.g., customer service) jobs, and 68% were on maternity leave. Most of the women (97%) gave birth to their first child via vaginal delivery (72%) and were breast-feeding (37%), formula feeding (19%), or both (44%). The women's BMIs ranged from 20 to 51 (mean 32), classifying the average participant as obese (20). Participants gained an average of 28 pounds (range 4–60 lb) during pregnancy. Because weight gain/loss was not a focus of this study, we did not assess women's rate of weight loss postpartum. Based on the number of days and minutes of exercise, only 39% of the women in this study were currently meeting exercise recommendations. Because of insufficient data, we could not examine the influence of moderator variables known to influence women's exercise beliefs and behaviors (e.g., age, ethnicity, family income, job status, feeding method [breast-feeding or formula], parity, delivery method [vaginal or cesarean], and number of months postpartum); thus, the following analyses were conducted on the sample in full.

Exercise beliefs

A content analysis (based on procedures reported elsewhere) (15) was conducted to rank order the exercise beliefs (16). Content validity was established by having two TPB experts examine the participants' responses, and 100% content validity agreement was established. Because some participants reported multiple beliefs, the categories exceeded 100%. The salient behavioral advantages of exercise during pregnancy and postpartum for GDM women are listed in Table 1. During pregnancy, the most frequent advantage of exercise was that it helped to control blood glucose (43%), the strongest barrier was fatigue (39%), and the husband/partner had the strongest social influence (57%). Postpartum, the greatest advantage of exercise was that it helped the woman to lose weight (61%), the strongest barrier was no time (50%), and the husband/partner still had the strongest social influence (71%). Table 2 displays means ± SD and ranges for the total number of beliefs. Mean comparisons using *t* tests were used to determine whether there were differences in the total number of beliefs reported during pregnancy compared with postpartum; these findings were not statistically different.

Exercise behavior

Walking was the most frequently reported type of exercise during women's first (58%), second (61%), and third (62%) trimesters and postpartum (75%), followed by a combination of activities such as yoga, aerobic activity (e.g., StairMaster, elliptical trainer, and low-impact aerobics), and swimming. Women's total LTEQ scores for exercise behavior were compared using *t* tests (see Table 2 for score means ± SD and ranges). Women exercised more postpartum than during their pregnancy: $t(25) = 2.29$, $P = 0.03$. Women's prepregnancy exercise was slightly greater than their pregnancy exercise, but it was not statistically different from their pregnancy and postpartum exercise ($P > 0.05$). Thus, we noted a trend to reduce exercise during pregnancy and a statistically significant increase after pregnancy.

Associations between exercise beliefs and behavior

Pearson correlations were used to examine the associations between women's be-

Table 1—*Exercise beliefs reported during pregnancy and postpartum*

Belief themes	Percent*
Pregnancy	
Behavioral beliefs (advantages)	
Control blood glucose	43
Feel better/have more energy	39
Control weight gain	30
Help with labor/delivery	11
Help with recovery	7
Normative beliefs (social influences)	
Husband/partner	57
Other family members (parents, siblings)	50
Doctor/nurse	14
Friends	11
Coworkers	11
Children	11
Control beliefs (barriers or obstructing factors)	
Fatigue	39
Pain/discomfort	32
Sickness (nausea, vomiting)	18
No time	18
Afraid to exercise	14
Taking care of children	14
Complications (torn placenta, bed rest)	14
Size (too big)	7
Postpartum	
Behavioral beliefs (advantages)	
Lose weight	61
Get fit (endurance/muscle tone)	29
Have time for self	21
Increase energy	11
Decrease risk of type 2 diabetes	7
Lower cholesterol	7
Normative beliefs (social influences)	
Husband/partner	71
Other family members (parents, siblings)	54
Children	47
Friends	11
Coworkers	11
Control beliefs (barriers or obstructing factors)	
No time	50
Taking care of children	46
Fatigue	20
Other priorities	14
Breast-feeding	7
No access to exercise equipment	7
Work	7

*Because some participants reported multiple beliefs, the total percentage exceeds 100.

havioral, normative, and control beliefs and total prepregnancy, pregnancy, and postpartum LTEQ exercise scores. The number of behavioral beliefs reported during pregnancy was positively associated with women's pregnancy ($r = 0.68$, $P < 0.001$) and postpartum ($r = 0.43$, $P < 0.05$) exercise behavior. Although not significant, we noted a positive trend for the number of behavioral beliefs reported postpartum and during pregnancy and postpartum exercise behavior. No significant associations were found for the number of normative and control beliefs reported and women's exercise behavior.

CONCLUSIONS — The purpose of this study was to examine the exercise beliefs and behaviors of women who had GDM during a recent pregnancy. Consistent with previous research, the type and frequency of women's exercise beliefs varied from pregnancy to postpartum (15). Of particular importance, women with GDM believed that controlling blood glucose was the most important advantage of exercising during their pregnancy, and postpartum it was controlling their weight. Interestingly, only 7% of women believed that exercising postpartum would decrease their risk of type 2 diabetes despite the fact that part of the standard care for these women included an emphasis on prevention of diabetes later in life. Further research is therefore needed to clarify whether in the clinical setting one should simply explore the postpartum weight-related beliefs of women with GDM, which appear to be a relevant motivator, or whether and how to develop better strategies for persuading women about the benefits of exercise and being active enough to meet exercise guidelines and prevent diabetes.

Also consistent with previous research (15), a woman's husband/partner had the strongest normative influence on her exercise, both during the pregnancy and postpartum, followed by other members of her family. Future research is needed to examine these family members' beliefs about exercise and diabetes prevention and treatment and to determine how much influence they have on women's own beliefs and behaviors and how family members can be further motivated to encourage these women to exercise. Again it is interesting that only 14% of women reported that a doctor/nurse motivated them to exercise, illustrating the fact that better strategies for encouraging exercise in the health care setting are needed. Further research is also needed to examine the extent to which health care providers are knowledgeable about current exercise recommendations (7,8) and provide adequate exercise prescriptions. That is, only 39% of the women were meeting current exercise recommendations postpartum, despite the fact that part of the standard care of these women is to encourage them to exercise.

The main barrier to exercise during pregnancy was fatigue, and postpartum it was having no time. On a positive note, women reported relatively the same number of control beliefs as they did behavioral beliefs, so that it does not appear that women with GDM encounter a greater number of exercise barriers compared with exercise advantages. Thus, health care professionals aiming to increase ex-

Table 2—*Exercise beliefs and behavior*

Variable	Means ± SD (range)
Total number of exercise beliefs (pregnancy)	
Behavioral (advantages)	2.64 ± 1.62 (0–7)
Normative (social influences)	2.04 ± 1.37 (0–5)
Control (barriers)	1.64 ± 1.31 (0–5)
Total number of exercise beliefs (postpartum)	
Behavioral (advantages)	2.62 ± 1.39 (0–6)
Normative (social influences)	2.14 ± 1.04 (1–4)
Control (barriers)	1.50 ± 1.23 (0–5)
Total LTEQ exercise behavior*	
Prepregnancy	23.94 ± 20.00 (0–67)
Pregnancy	22.04 ± 15.38 (0–53)
Postpartum	28.77 ± 21.28 (0–71)
Number of days exercising (postpartum)	3.07 ± 1.76 (0–7)
Number of minutes exercising (postpartum)	30.93 ± 20.98 (0–90)

*Scores for the LTEQ are composite scores in total metabolic equivalents (METs); 1 MET is equivalent to a metabolic rate of consuming 3.5 ml oxygen · kg body wt^{-1} · min^{-1} and 1 kcal · kg body wt^{-1} · h^{-1}.

ercise among women with GDM must focus on techniques for overcoming these barriers such as tailoring exercise programs to meet the specific needs of women, teaching time management skills, and helping women to restructure their priorities (i.e., their health and well-being should be a top priority and making time for exercise should be encouraged) to increase the likelihood of exercise adoption and maintenance.

From this study based in one clinic, it is not possible to determine to what extent these exercise beliefs apply more generally to pregnant women with GDM and to what extent these beliefs were imparted by this particular GDM program. Nevertheless, because people's underlying beliefs are strong determinants for behavior adoption and maintenance (12,16), these data begin to provide some insight for health care professionals as to why women with GDM are motivated to exercise and conversely what the barriers to exercise are, so that positive beliefs and support can be encouraged and exercise increased. Of interest, previous researchers (15) have documented that the most important positive exercise belief of healthy pregnant women was that exercise improves mood and a husband/partner and doctor had the strongest social influence on their exercise behaviors. Our findings here with respect to pregnant women with GDM are similar, but not identical, emphasizing the need for more research in this area. Specifically, prospective studies in multiple clinics are now needed to confirm our findings.

In contrast to our hypothesis and previous research (15), women exercised more postpartum than before and during their pregnancy. This finding is interesting in that it suggests that women with GDM may be more active postpartum than women without GDM, a finding that is consistent with these women being sensitized by the GDM experience to improve their overall health and obesity risk. However, this apparent sensitization to exercise more after pregnancy did not translate into exercising more during their pregnancy.

As predicted, the total number of behavioral advantages reported during pregnancy was associated with women's pregnancy and postpartum exercise behavior. We did not find an association between the number of barriers or social influences reported and exercise behavior. Thus, the more advantages a woman had for exercise, the more she actually exercised during her pregnancy and postpartum. This observation validates to some extent the relevance of the reported beliefs to exercise behavior, although a prospective study will be required for full validation. This observation also suggests that encouraging women to identify multiple perceived benefits of exercise may help to increase their actual amount of activity during this time. The fact that the number of normative beliefs was not associated with women's pregnancy and postpartum exercise behavior is not surprising considering the fact that most of the women only reported one or two social influences. To this end, the actual number of people providing a woman with encouragement may not be as important as having the most important person in her life (in this case, her husband/partner) encouraging her to exercise. Moreover, although it is encouraging that the number of barriers reported was not associated with women's pregnancy or postpartum exercise, more research is needed to determine whether and how women's control beliefs are associated with their GDM diagnosis and their ability to actually meet current exercise recommendations.

Lastly, although this study is the first to document exercise beliefs and behaviors among women with GDM and it provides some insights, there are study limitations. First, because of insufficient data, we could not examine the moderating influence of particular demographic variables (e.g., ethnicity, parity, or type of delivery) across exercise beliefs and behaviors. Because most of the participants were middle- to upper-class Caucasian women, there is limited generalizability of the findings to low socioeconomic and ethnic minority populations. Second, although exercise behavior was assessed with a valid and reliable instrument, there are inherent biases in self-reported data. In addition, because of recall bias, we only examined whether women were currently meeting the exercise recommendations and did not ask women to report the number of days and minutes they were active before and during their pregnancy. Future research to prospectively track whether women are meeting exercise recommendations across their pregnancy and postpartum with more objective assessments (e.g., pedometer or accelerometers) is needed to have a more accurate picture of their exercise behavior and to better understand whether women are sufficiently active to reduce their diabetes risk. Third, the retrospective and cross-sectional nature of this study precludes us from making firm conclusions about cause and effect.

In summary, pregnancy induces significant stress and anxiety for women and adding a diagnosis of GDM makes the emotional and physical load even greater. Regular exercise, however, is one strategy that can help high-risk women prevent GDM and help women with GDM manage their GDM better, and it may help all high-risk women prevent the later onset of type 2 diabetes. Our study findings demonstrate that women with GDM believe that exercise has many benefits including controlling their blood glucose and weight and that the number of re-

ported advantages of exercise were positively associated with women's exercise behavior. Nonetheless, most of the women were not sufficiently active during their pregnancy and were not meeting the current exercise recommendations postpartum. Thus, we recommend that researchers and health care professionals use women's exercise beliefs, that is, their advantages, social influences, and perceived barriers to exercise, as a framework for designing effective diabetes treatment and prevention programs in an attempt to increase women's pregnancy and postpartum exercise behavior and therefore improve their overall health.

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