A Prospective Study of Pregravid Physical Activity and Sedentary Behaviors in Relation to the Risk for Gestational Diabetes Mellitus

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Background: Although gestational diabetes mellitus (GDM) has been associated with substantial adverse health outcomes for both mothers and offspring, few modifiable risk factors for GDM have been identified.

Methods: We conducted 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 behaviors are associated with GDM risk. The analysis included 21 765 women who reported at least 1 singleton pregnancy between 1990 and 1998. Physical activity and sedentary behaviors were assessed through validated questionnaire.

Results: We documented 1428 incident GDM cases. After controlling for body mass index, dietary factors, and other covariates, there was a significant inverse association between vigorous activity and the risk of GDM. The multivariate relative risk (RR) comparing the highest with the lowest quintile of vigorous activity was 0.77 (95% confidence interval [CI], 0.69-0.94) ($P=.002$ for trend). Among women who did not perform vigorous activity, brisk walking pace was associated with significantly lower GDM risk (RR, 0.66; 95% CI, 0.46-0.95) compared with an easy pace. Women who spent 20 h/wk or more watching television but did not perform vigorous activity had a significantly higher GDM risk than women who spent less than 2 h/wk watching television and were physically active (multivariate RR, 2.30; 95% CI, 1.06-4.97).

Conclusion: Our prospective study provides strong evidence that regular physical activity before pregnancy is associated with lower GDM risk.

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GESTATIONAL DIABETES mellitus (GDM), affecting approximately 4% to 7% of pregnancies, is among the most common complications of pregnancy in the United States.[1] Recent data have shown a substantial rise in the incidence of GDM from 1991 to 2000,[2] in parallel with the increase in the incidence of type 2 diabetes mellitus.[3,4] Women with GDM have increased risk for prenatal morbidity and a considerably elevated risk for impaired glucose tolerance and type 2 diabetes mellitus in the years following pregnancy.[1] Moreover, offspring of women with GDM are more likely to become obese and develop impaired glucose tolerance and diabetes in early adulthood,[5] which may lead to further increases in GDM.

Few modifiable risk factors for this complication have been identified. Obesity is the major recognized modifiable risk factor thus far. High prepregnancy body mass index (BMI) (calculated as weight in kilograms divided by the square of height in meters) has been consistently associated with an increased risk of GDM.[6,7] Recent data suggest that pregravid physical activity may reduce GDM risk.[7,8] While results from these studies are encouraging, inferences are limited by their relatively small sample size and/or cross-sectional design. Moreover, pregravid physical inactivity and sedentary behaviors were not examined in these studies.

Women in the Nurses' Health Study II who reported higher physical activity levels prior to pregnancy were found to be less likely to develop GDM, but these associations were not statistically significant.[9] The present report extends this analysis with more years of follow-up and more detailed measures of physical activity status. In addition, we examine sedentary behaviors, especially prolonged time for television (TV) watching, in relation to GDM risk.

METHODS

STUDY POPULATION

The Nurses' Health Study II, established in 1989, is a prospective cohort study of 116 671 female

nurses in the United States who were 24 to 44 years old at study initiation.[9] This cohort has been and continues to be observed with the use of biennial mailed questionnaires to update information on health-related behavior and characteristics and to determine incident disease outcome. The follow-up rate exceeds 90% for every 2-year period. Between 1990 and 1998, among women who completed the 1989 questionnaire, 31 180 reported having at least 1 singleton pregnancy lasting 6 months or longer. For the analysis presented here, we excluded women who had history of GDM (n=3181), diabetes (n=797), cancer (except nonmelanoma skin cancer), and cardiovascular disease (n=193) reported on the 1989 questionnaire, who were pregnant when completing the 1989 questionnaire (n=4865), who had no data on physical activity in 1989 (n=57), and who reported a multiple gestation (eg, twins or triplets) (n=322) between 1990 and 1998. The final sample for the current analysis consisted of 21 765 women.

ASSESSMENT OF PHYSICAL ACTIVITY AND SEDENTARY BEHAVIORS

Physical activity and sedentary behaviors were assessed through mailed questionnaires in 1989, 1991, and 1997. Participants were asked to report the average amount of time they spent per week on each of the following recreational activities: jogging, running, bicycling, calisthenics or use of a rowing machine, lap swimming, squash or racquetball, and tennis. These activities requiring exertions of 6 metabolic equivalent (MET) hours or greater (a 6-fold or greater increase above resting metabolic rate) were defined as *vigorous*. Women were also asked to report the amount of time they spent per week walking (ie, walking or hiking outdoors, including walking to work) and to categorize their usual walking pace outdoors as easy or casual (slower than 2.0 mph), normal (2.0-2.9 mph), brisk (3.0-3.9 mph), or very brisk or striding (faster than 4.0 mph). Additionally, participants were asked how many flights of stairs they climbed daily. Weekly total energy expenditure in MET-hours was calculated as the sum of the MET-hours spent in each of the aforementioned activities.

In addition, participants were asked about their average weekly time spent sitting at home watching TV or video cassette recordings, sitting at work or away from home or while driving, other sitting at home (eg, reading, meal times, or at a desk), and time spent standing or walking around at home or at work.

Validity and reproducibility for the questionnaire were evaluated and reported previously.[10,11] Briefly, the correlation between physical activity as reported in 1-week recalls and that reported on the questionnaires was 0.79. The correlation between moderate to vigorous activity reported in diaries and that reported on the questionnaires was 0.62.

ASSESSMENT OF COVARIATES

Information on age, weight, and smoking status has been collected on biennial questionnaires since 1989. Information on dietary consumption was assessed using a 133-item semiquantitative food frequency questionnaire completed in 1991, 1995, and every 4 years thereafter. The reproducibility and validity of food-frequency questionnaires similar to those used in the Nurses' Health Study II have been described elsewhere.[12]

ASCERTAINMENT OF GDM

Diagnosis of GDM was based on self-reported information in the biennial questionnaire. A previous validation study of GDM based on medical record review in this cohort demonstrated a high validity of self-reported diagnosis of GDM.[9,13] In brief, we reviewed medical records among a sample of 114 women in the cohort who corroborated on a supplementary questionnaire that they had a first diagnosis of GDM in a singleton pregnancy between 1989 and 1991. Of these women, 94% were confirmed to have a physician diagnosis of GDM on medical record review. We also sent supplementary questionnaires to 100 women reporting a pregnancy uncomplicated by GDM during the same interval. Of 93 responders, 83% reported undergoing a glucose loading test, and all (100%) reported frequent urine screening during pregnancy, consistent with a high degree of surveillance in this cohort.

STATISTICAL ANALYSIS

Each participant contributed follow-up time from the date of returning the 1989 questionnaire to the date of the first event of GDM, death, or June 1, 1999.

Our primary analysis used updated physical activity and sedentary behavior assessments reported in available questionnaires administered before GDM was reported. In the secondary analysis, we created measures of cumulative average METs for total physical activity or vigorous activity to present long-term physical activity levels of individual participants before GDM was reported. For instance, the 1989 physical activity level was used for the follow-up between 1989 and 1991, and the average of the 1989 and 1991 physical activity levels was used for the follow-up between 1991 and 1995.

Relative risks (RRs) of GDM for each category of physical activity level compared with the lowest category were estimated using Cox proportional hazards analysis[14] stratified by 5-year age categories. Because women with previous GDM were excluded from this study and women with a previous pregnancy uncomplicated by GDM were less likely than nulliparous women (ie, women whose index pregnancy is their first termed pregnancy) to develop GDM, nulliparous women were overrepresented in the GDM group. To account for this effect, we adjusted for parity in multivariate analysis. We also restricted our analysis to nulliparous women in secondary analysis. In multivariate analyses, we additionally adjusted for age, smoking status (never, past, or current), race or ethnicity (white, African American, Hispanic, or Asian), family history of diabetes, parity (0, 1, 2, or $\geq$3), and dietary variables (quintile) including total fat (as percentage of energy), cereal fiber (in grams per day), alcohol consumption (in grams per day), glycemic load, and total energy intake (quintile). Because BMI might represent an intermediate variable in the relationship between physical activity and GDM, we adjusted for BMI in separate models. Because further adjustment for weight change between baseline and prepregnancy did not alter the results materially, we did not include weight change in the final model.

We evaluated whether the association between physical activity and risk of GDM was modified by BMI or family history of diabetes in stratified analyses. Tests of trend were conducted using the median value for each category of physical activity analyzed as a continuous variable in multivariate models. In addition, we used restricted cubic spline regressions with 4 knots to flexibly model the association of total physical activity and vigorous activity (as continuous variables) with the risk of GDM.[15] All tests of statistical significance were 2 sided, and statistical significance was defined at the α=.05 level. All statistical analyses were performed by using SAS statistical software (version, 8.2; SAS Institute Inc, Cary, NC).

RESULTS

During 10 years of follow-up, 1428 women reported a first diagnosis of GDM among the 21 765 study participants. Women who were more physically active tended

Table 1. Baseline Characteristics According to Quintile of Total Physical Activity Score*

Characteristic	MET-Hours per Week Quintile, Range (Median)				
	0.2-4.8 (2.3)	4.9-11.3 (7.8)	11.4-21.3 (15.9)	21.4-40.3 (29.0)	≥40.4 (63.2)
Women, No.	4377	4382	4336	4326	4344
Age, y	30.6 (3.5)	30.3 (3.5)	30.3 (3.4)	30.3 (3.4)	29.7 (3.3)
BMI†	23.5 (4.6)	23.0 (4.1)	22.7 (3.7)	22.4 (3.4)	22.0 (3.2)
Current smoker, %	12.4	11.6	9.9	10.0	9.6
Nulliparous, %	33.6	39.1	43.9	49.3	59.4
Race/ethnicity, %					
White	92.6	93.7	93.8	94.3	93.2
African American	1.4	1.1	0.9	0.9	1.1
Hispanic	1.9	1.4	1.7	1.5	1.8
Asian	2.4	2.0	1.9	1.9	1.9
Other	1.8	1.9	1.8	1.4	2.1
Family history of diabetes, %	14.2	13.0	12.8	12.8	11.4
Alcohol consumption, g/d	2.3 (5.0)	2.6 (5.0)	2.6 (4.5)	3.1 (5.0)	3.5 (5.5)
Glycemic load‡	174.5 (29.4)	175.0 (28.5)	175.6 (28.7)	175.8 (28.4)	178.4 (30.3)
Total calories, kcal/d	1831 (549)	1866 (553)	1875 (553)	1879 (556)	1877 (569)
Total fat, % of energy	32.3 (5.3)	31.6 (5.1)	31.0 (5.2)	30.5 (5.2)	29.6 (5.6)
Cereal fiber, g/d	5.3 (2.6)	5.5 (2.7)	5.5 (2.7)	5.9 (3.0)	6.0 (3.1)

Abbreviations: BMI, body mass index; MET, metabolic equivalent.
*Data are presented as mean (SD) unless otherwise indicated.
†Calculated as weight in kilograms divided by the square of height in meters.
‡Glycemic load was calculated by multiplying the carbohydrate content of each food by its glycemic index value and then multiplying this value by the frequency of consumption and summing the values from all foods. Each unit of glycemic load represents the equivalent of 1 g of carbohydrate from white bread.

Table 2. Relative Risks of GDM According to Quintiles of Prepregnancy Activity Score (MET-Hours per Week)

Physical Activity	Quintile of Activity Score					*P* Value for Trend
	1	2	3	4	5	
Total						
MET-hours per week, range (median)	0.2-4.8 (2.3)	4.9-11.3 (7.8)	11.4-21.3 (15.9)	21.4-40.3 (29.0)	≥40.4 (63.2)	
Cases, No.	312	313	265	287	251	
Person-years	39 312	40 594	40 049	40 080	40 076	
RR1* (95% CI)	1.00	0.94 (0.83-1.14)	0.83 (0.70-0.97)	0.86 (0.73-1.02)	0.71 (0.60-0.84)	<.001
RR2† (95% CI)	1.00	0.97 (0.87-1.20)	0.88 (0.75-1.04)	0.90 (0.80-1.11)	0.81 (0.68-1.01)	.01
Vigorous						
MET-hours per week, range (median)	0	0.2-2.8 (1.4)	2.9-8.7 (6.0)	8.8-22.0 (15.0)	≥22.1 (38.8)	
Cases, No.	397	262	270	275	224	
Person-years	49 041	31 374	37 897	41 732	40 066	
RR1* (95% CI)	1.00	0.94 (0.71-1.26)	0.81 (0.67-1.16)	0.70 (0.60-0.82)	0.72 (0.62-0.84)	<.001
RR2† (95% CI)	1.00	0.95 (0.71-1.28)	0.84 (0.71-1.20)	0.75 (0.64-0.87)	0.77 (0.69-0.94)	.002

Abbreviations: BMI, body mass index; CI, confidence interval; GDM, gestational diabetes mellitus; MET, metabolic equivalent; RR, relative risk.
*Adjusted for age (5-year categories), race/ethnicity, cigarette smoking status (never, past, or current), family history of diabetes in a first-degree relative (yes, no), parity (0, 1, 2, ≥3), alcohol intake (0.0, 0.1-5.0, 5.1-15.0, or >15.0 g/d) and dietary factors (quintiles of total energy, cereal fiber, glycemic load, and total fat).
†Adjusted for variables in model 2 and BMI (calculated as weight in kilograms divided by the square of height in meters) before the index pregnancy (<20.0, 20.0-21.9, 22.0-24.9, 25.0-29.9, and ≥30.0).

to be leaner, were more likely to be nulliparous, and were less likely to be current smokers. These women also had lower intake of total fat and higher consumption of cereal fiber and alcohol (**Table 1**).

Both total and vigorous activity scores were significantly and inversely associated with GDM risk (**Table 2**). The inverse associations remained statistically significant after controlling for BMI and other covariates. In stratified analyses, these inverse associations persisted in subgroup strata defined by BMI (<25.0, 25.0-29.9, or ≥30.0) or family history of diabetes (yes or no) (data not shown). In addition, we restricted our analysis to nulliparous women (n=9799; 508 GDM cases) and obtained similar results. After adjustment for multiple covariates including prepregnancy BMI, RRs of GDM across increasing quintiles of vigorous activity were 1.00, 0.93 (95% CI, 0.62-1.63), 0.82 (95% CI, 0.72-1.18), 0.67 (95% CI, 0.51-0.86), and 0.74 (95% CI, 0.58-0.95); *P*=.03 for trend.

The regression splines demonstrated linear relationships between both total (*P*=.41 for curvature) and vigorous activity (*P*=.10 for curvature) and the risk for GDM (**Figure**). Similar results were obtained when cumulative average or baseline activity variables were used in

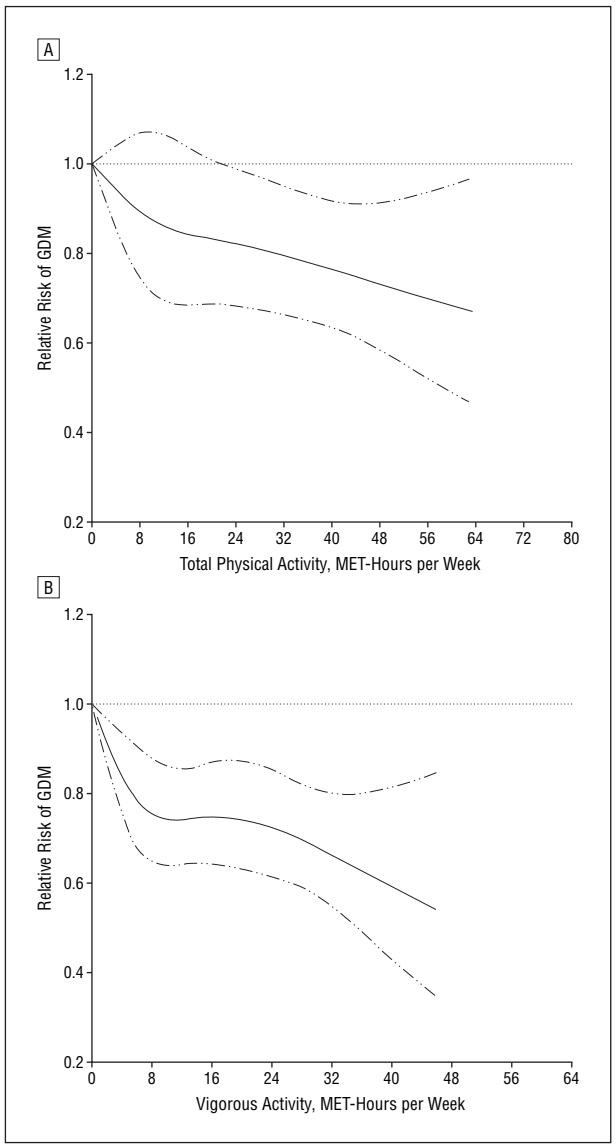

Figure. Relative risks of gestational diabetes mellitus (GDM) according to total physical activity (A) and vigorous activity (B) scores measured in metabolic equivalent (MET)-hours per week, continuous. Relative risks are adjusted for age, race/ethnicity, cigarette smoking status (never, past, or current), family history of diabetes in a first-degree relative (yes, no), parity (0, 1, 2, ≥3), alcohol intake (0.0, 0.1-5.0, 5.1-15.0, or >15.0 g/d), dietary factors (in quintiles of total energy, cereal fiber, glycemic load, and total fat), and body mass index (calculated as weight in kilograms divided by the square of height in meters) before the index pregnancy. The solid black lines represent point estimates; dashed lines illustrate 95% confidence intervals.

the analyses. To avoid potential bias due to undiagnosed nongestational diabetes mellitus before GDM developed, we eliminated women with GDM who reported the occurrence of nongestational diabetes mellitus in the next-round questionnaire (n=25); the results did not change materially.

We next examined whether walking (ie, walking and hiking outdoors) and stair climbing were related to risk of GDM. To avoid obscuring a benefit by vigorous forms of activity, we restricted these analyses to participants who did not report performing vigorous exercise (395 GDM cases). Faster walking pace was strongly associated with a reduction in GDM risk (**Table 3**). Walking time alone was not significantly associated with GDM risk. When examining the joint effect of walking pace and walking time, we observed that women who walked 4 hours or more per week (approximately 30 min/d, which is recommended by current guidelines[16]) at a brisk or very brisk pace had the lowest risk (multivariate adjusted RR, 0.56; 95% CI, 0.31-1.00) compared with those who walked less than 4 hours a week at a casual pace. Greater stair climbing was significantly associated with lower GDM risk as well (**Table 4**).

After adjustment for age and time spent on other sedentary behaviors, greater time spent watching TV was associated with higher GDM risk. The RRs across categories of time for TV watching (0-1, 2-5, 6-20, ≥20 h/wk) were 1.00, 1.12, 1.19, and 1.74 (95% CI, 1.29-2.34), respectively (P=.001 for trend). This association was attenuated after further adjustment for total physical activity score and dietary factors (RR comparing extreme categories, 1.47; 95% CI, 1.09-1.99; P=.03 for trend). This association was no longer significant after additional control for BMI. Notably, in joint analyses of TV watching and vigorous exercise (controlling for BMI and other covariates), women who spent at least 20 hours per week watching TV but did not perform vigorous activity had more than 2-fold increased risk for GDM (multivariate adjusted RR, 2.30; 95% CI, 1.06-4.97) compared with women who spent less than 2 hours watching TV and were in the highest quintile of vigorous activity (P=.71 for the interaction).

COMMENT

In this large prospective cohort study of women, prepregnancy physical activity, in particular increasing vigorous physical activity, was associated with significantly lower risk of GDM. Among women who did not engage in vigorous activities, brisk or striding walking pace and increasing daily flights of stair climbing were associated with substantially reduced risk for GDM, independent of total physical activity levels and prepregnancy BMI.

Data relating pregravid physical activity to the risk for GDM are sparse. Our findings are largely in agreement with those among pregnant women provided by other investigators. Dempsey and colleagues[8] in a cross-sectional case-control study found that women who reported any physical activity during the year before pregnancy experienced a 55% reduction in risk compared with sedentary women. Similar results were observed in a subsequent prospective study of 909 pregnant women.[7] These studies and our findings are generally consistent with a relatively large body of literature documenting the benefits of physical activity in the prevention of type 2 diabetes mellitus and/or insulin resistance in nonpregnant individuals[17] and extend these findings to pregnant women.

The protective effects of pregravid physical activity against GDM are biologically plausible. During normal pregnancy, the third trimester is characterized by profound metabolic stresses on maternal lipid and glucose homeostasis, including marked insulin resistance and hyperinsulinemia, favoring the transfer of nutrients to the fetus.[18] Glucose tolerance, however, stays within the normal range in most pregnant women. Women who develop GDM are thought to have a compromised capacity

Table 3. Relative Risks of GDM According to Usual Walking Pace Among Women Without Vigorous Activity

Characteristic	Usual Walking Pace			*P* Value for Trend
	Casual	Normal	Brisk/Very Brisk	
Cases, No.	50	191	94	
Person-years	5142	23 662	14 336	
RR1* (95% CI)	1.00	0.79 (0.57-1.08)	0.60 (0.42-0.86)	.004
RR2† (95% CI)	1.00	0.81 (0.59-1.12)	0.66 (0.46-0.95)	.02

Abbreviations: BMI, body mass index; CI, confidence interval; GDM, gestational diabetes mellitus; RR, relative risk.
*Adjusted for age (5-year categories), race/ethnicity, cigarette smoking status (never, past, or current), family history of diabetes in a first-degree relative (yes, no), parity (0, 1, 2, ≥3), alcohol intake (0.0, 0.1-5.0, 5.1-15.0, or >15.0 g/d) and dietary factors (quintiles of total energy, cereal fiber, glycemic load, and total fat).
†Adjusted for variables in model 2 and BMI (calculated as weight in kilograms divided by the square of height in meters) before the index pregnancy (<20.0, 20.0-21.9, 22.0-24.9, 25.0-29.9, and ≥30.0).

Table 4. Relative Risks of GDM According to Stair Climbing Among Women Without Vigorous Activity

Characteristic	Stair Climbing, Flights per Day					*P* Value for Trend
	≤2	3-4	5-9	10-14	≥15	
Cases, No.	163	93	93	37	12	
Person-years	74 043	32 136	37 746	30 787	11 501	
RR1* (95% CI)	1.00	1.03 (0.80-1.33)	0.97 (0.75-1.26)	0.73 (0.51-1.05)	0.44 (0.24-0.79)	.003
RR2† (95% CI)	1.00	1.03 (0.80-1.33)	1.00 (0.77-1.30)	0.77 (0.54-1.11)	0.50 (0.27-0.90)	.02

Abbreviations: BMI, body mass index; CI, confidence interval; GDM, gestational diabetes mellitus; RR, relative risk.
*Adjusted for age (5-year categories), race/ethnicity, cigarette smoking status (never, past, or current), family history of diabetes in a first-degree relative (yes, no), parity (0, 1, 2, ≥3), alcohol intake (0.0, 0.1-5.0, 5.1-15.0, or >15.0 g/d) and dietary factors (quintiles of total energy, cereal fiber, glycemic load, and total fat).
†Adjusted for variables in model 2 and BMI (calculated as weight in kilograms divided by the square of height in meters) before the index pregnancy (<20.0, 20.0-21.9, 22.0-24.9, 25.0-29.9, and ≥30.0).

to adapt to the metabolic challenges of pregnancy.[18,19] Pregnancy serves to unmask a predisposition to glucose metabolic disorders in some women. Factors that affect insulin resistance or relative insulin deficiency before pregnancy may thus affect the risk of GDM. Several possible biological effects for physical activity have been proposed and are relevant to the pathophysiologic characteristics of GDM. For instance, physical activity has independent effects on glucose disposal by increasing both insulin-mediated and non–insulin-mediated glucose disposal.[20,21] Physical activity can also exert a long-term effect on improvement in insulin sensitivity through increased fat-free mass.[22]

Previous data have suggested that moderate physical activity results in benefits for type 2 diabetes mellitus comparable to those associated with vigorous activity.[23] Moderate activity such as daily walking combined with dietary therapy not only reduced body weight but also improved insulin sensitivity among patients with type 2 diabetes mellitus.[24] Faster walking pace has also been associated with a reduced risk for type 2 diabetes mellitus compared with slower pace, perhaps because of a greater impact in improving insulin sensitivity.[23] Stair-climbing exercise may also substantially improve whole-body insulin sensitivity and nonoxidative glucose metabolism, and result in an increase in insulin-stimulated muscle glycogen synthesis.[22]

Thus far, the role of sedentary behaviors in the development of GDM has not been well studied. Our results are in general accord with emerging evidence showing a positive association between prolonged TV watching and type 2 diabetes mellitus in men and nonpregnant women.[25,26] Television watching has been associated with obesity.[27,28] Obesity is an important cause of insulin resistance and glucose intolerance and is a strong risk factor for GDM.[9] Our findings suggest that the association between TV watching and GDM is primarily mediated through obesity.

Physical activity status during pregnancy was not specifically measured in the current study. However, available, though sparse, literature[8,29] indicates that physical activity status during the year before pregnancy and during the adolescent years are the strongest predictors of physical activity status in pregnancy. More than 75% of women who were physically active before pregnancy continued to exercise in pregnancy, although they generally decreased the average intensity and duration of their activity, and only 6% of women who were physically inactive in the year before pregnancy became active in the first 20 weeks of pregnancy. Therefore, it is plausible that much of the benefit that we observed for pregravid physical activity also reflects continued activity during pregnancy. Future studies are warranted to examine the effect of changes in physical activity patterns before and after pregnancy on GDM risk.

The physical activity questionnaire used in the present study has been validated against a physical activity diary,[10] and similar questionnaires have correlated well with measured oxygen consumption.[11] Although some misclassification of physical activity was inevitable, because of the prospective design of this study, misclassification would be nondifferential and would be expected to bias the risk estimate toward the null. Conceivably, women with classic GDM risk factors such as obesity and advanced age might be screened more carefully for GDM than women without such risk factors, artifactually increasing the ob-

served risks associated with such characteristics. However, a previous study that evaluated GDM self-reports[13] found a high level of surveillance for GDM regardless of risk factor status and noted no significant bias in screening based on risk-factor profile. A validation study also indicated a high degree of accuracy of self-reported GDM compared with medical record review.[9,13] Misclassification of noncases as cases would be expected only to attenuate observed associations between risk factors and outcome and so would not explain positive results.[30]

Because of the observational nature of the current study, we cannot rule out residual confounding by unmeasured factors. However, we carefully controlled for well-documented risk factors for GDM. The present study includes, to our knowledge, the largest cohort for whom data on physical activity, sedentary behaviors, and GDM were collected prospectively, and it is the largest study of women at reproductive age in which physical activity, diet, and other lifestyle factors were reevaluated regularly after the initial assessment, with detailed examination of moderate and vigorous activity and sedentary behaviors.

In conclusion, our prospective study found that increased physical activity before pregnancy was associated with a reduction in the risk for GDM, independent of conventional risk factors for diabetes. This is particularly true for vigorous physical activity. Among women who did not engage in vigorous activities, women who briskly walked more than 30 minutes or climbed more than 15 flights of stairs daily also had lower risk of developing GDM. Part of this benefit, but not all, was mediated by lower body weight. Television watching was associated with greater risk of GDM, and this appeared to be largely meditated by greater body weight. These findings suggest a potential benefit of the adoption and continuation of an active lifestyle for women of reproductive age.

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