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ORIGINAL ARTICLE

Physical activity questionnaire (PPAQ) scores during pregnancy in a Turkish population with and without gestational diabetes mellitus: A prospective cohort study

[1]Nazan USAL TARHAN
[2]Gültekin AYDIN ADANAŞ
[3]Handan ANKARALI
[1]Habibe AYVACI TAŞAN

[1]Department of Obstetrics and Gynecology, University of Health Sciences, Turkey. Istanbul Zeynep Kamil Maternity and Children's Diseases Health Training and Research Center, Istanbul, Turkey

[2]Department of Obstetrics and Gynecology, Bursa City Hospital, Bursa, Turkey

[3]Department of Biostatistics, Istanbul Medeniyet University Faculty of Medicine, Istanbul, Turkey

ORCID ID
NUT : 0000-0002-7571-4505
GAA : 0000-0002-9113-9846
HA : 0000-0002-3613-0523
HAT : 0000-0002-8517-0556

ABSTRACT

Objective: The risk of gestational diabetes mellitus increases in women with obesity and a sedentary lifestyle. Assessing quantitative physical activity in pregnant women with diabetes can help us better understand disease management. We report the characteristics of pregnant women who were screened and diagnosed with gestational diabetes, as well as the results of the Turkish version of the Pregnancy Physical Activity Questionnaire.

Material and Methods: A total of 292 pregnant women who completed the Pregnancy Physical Activity Questionnaire and underwent gestational diabetes screening were included in the study. Demographic characteristics, total and subscale scores of the Pregnancy Physical Activity Questionnaire were compared between women with positive and negative gestational diabetes mellitus screening and diagnostic test results.

Results: Total activity and subscale scores of the Pregnancy Physical Activity Questionnaire were similar between groups with positive and negative gestational diabetes mellitus screening and diagnostic test results. Age, weight, and body mass index differed significantly between groups (p=0.001, p=0.006, and p=0.001, respectively). Logistic multivariate binary analysis revealed no statistically significant differences between total activity and subscale scores.

Conclusion: Physical activity scores obtained from the Pregnancy Physical Activity Questionnaire, reflecting a 3-month period, were similar in cases with positive and negative gestational diabetes mellitus screening and diagnostic test results. Pregnant women should be encouraged to engage in more physical activity, as the frequency of gestational diabetes mellitus increases with age, body weight, body mass index, and number of pregnancies.

Keywords: Exercise, gestational diabetes mellitus, glucose tolerance test, obesity, physical activity questionnaire.

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Correspondence: Habibe AYVACI TAŞAN, MD. Sağlık Bilimleri Üniversitesi, İstanbul Zeynep Kamil Kadın ve Çocuk Hastalıkları Sağlık Uygulama ve Araştırma Merkezi, Kadın Hastalıkları ve Doğum Kliniği, İstanbul, Türkiye.
Tel: +90 542 531 00 18 **e-mail:** habibayvaci@hotmail.com
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INTRODUCTION

Gestational diabetes mellitus (GDM) is defined as carbohydrate intolerance of varying levels that begins or is first diagnosed during pregnancy.[1] A greater prevalence of obesity and a sedentary lifestyle increases the prevalence of GDM in reproductive-aged women.[2] The aim of GDM management is to control blood glucose levels and improve pregnancy outcomes.[3] First-line treatment consists of dietary modification and exercise planning. Exercise plays an important role in the regulation of blood glucose levels, which in turn prevents or delays insulin treatment.[4] The American College of Obstetricians and Gynecologists (ACOG) recommends 20–30 minutes of moderate-intensity exercise on most or all days of the week.[5] Strong evidence demonstrates that moderate-intensity physical activity decreases the risk of excessive prenatal weight gain and gestational diabetes.[6] It has been reported that maternal epigenetic biomarkers are positively affected in physically active pregnant patients.[7]

Evaluation of quantitative physical activity (PA) in diabetic pregnant women may help to acquire a better understanding of the role of physical activity during treatment and may be useful in more effectively comparing the results of different studies conducted in different locations. There are subjective (questionnaires, interviews, diaries, direct observation) and objective techniques (pedometers, accelerometers, heart rate monitors, multicensors, indirect calorimetry, doubly labelled water method) to measure PA.[8] In assessing the intensity, duration, and frequency of activities, questionnaires are non-invasive, practical, and economical. Chasan-Taber et al.[9] established the Pregnancy Physical Activity Questionnaire (PPAQ), which is a simple and brief tool that measures the frequency, duration, and intensity of PA in pregnant women. The PPAQ evaluates 32 activities based on the time spent in each category. These activities are grouped into the following five categories: household/caregiving (13 activities), occupational (5 activities), sports/exercise (8 activities), transportation (3 activities), and inactivity (3 activities). The compendium-based metabolic equivalent (MET) values were used to estimate intensity. Each activity is classified as sedentary (<1.5 METs), light (1.5–3.0 METs), moderate (3.0–6.0 METs), or vigorous (≥6.0 METs) according to its intensity. Average weekly MET-hour values are calculated for each activity based on its intensity.

A Polish study analyzed the relationships between PA and quality of life using the PPAQ-PL and WHOQOL-BREF questionnaires in the second and third trimesters. Their study made an important contribution to understanding the correlations between PA and quality of life during pregnancy, and the results suggest the need for improvements in prenatal care and the promotion of PA programs for pregnant women.[10]

The Pregnancy Physical Activity Questionnaire provides a score based on a subjective assessment according to the activity type and intensity during the previous 3 months. GDM screening tests are applied at ≥24 weeks of gestation in standard practice. We hypothesized that pregnant women with positive GDM screening and diagnostic tests would have significantly lower PPAQ scores for the last 3 months than pregnant women with negative GDM screening and diagnostic test results. The validity and reliability of the Turkish version of the PPAQ (PPAQ-Tr) in GDM cases have been reported.[11] We aimed to evaluate characteristics and PA levels measured quantitatively with the PPAQ-Tr in cases with and without a diabetes diagnosis, as determined by gestational diabetes screening and diagnostic procedures performed during pregnancy.

MATERIAL AND METHODS

The Turkish reliability and validity version of the PPAQ was studied in the pregnant population of Zeynep Kamil Women's and Children's Diseases Training and Research Hospital between April 2015 and April 2017. The sample size calculation was made by predicting that the PPAQ "total activity of light-intensity and above" score in pregnant women without GDM would be 20% higher than in pregnant women with GDM. It was calculated that at least 256 cases were needed for 80% power and 95% CI. A total of 292 pregnant women over the age of 18 gave their consent for the study. Pregnant women who were referred for GDM screening at ≥24 gestational weeks were included in the study. Patients who had already been diagnosed with diabetes, had mobility issues, had multiple pregnancies, or were not Turkish literate were excluded from the study. Pregnant women who were diagnosed with a psychiatric disorder and receiving treatment were also excluded.

At the first follow-up, the age information of the pregnant women was verified using official identification. Height and weight measurements were taken by the outpatient clinic nurse before the examination. Body mass index values were calculated using the measurements taken at the patient's first visit. Obstetric history was obtained by the study team. Gestational age was determined using the last menstrual period and confirmed by first-trimester ultrasound measurements. A first-trimester ultrasound was used to establish gestational age in pregnant women whose last menstrual period was unclear. The patients were informed about the study and gave their consent prior to undergoing the 50-g glucose challenge test (GCT) for GDM screening. Gestational diabetes screening and diagnostic tests were performed with a two-step approach.[12]

At this first follow-up, the pregnant women were given the PPAQ-Tr and were asked to complete and bring it to the second follow-up. Those who did not fill out the PPAQ-Tr at the second follow-up were given it again and returned it the same day. The GCT results were assessed at the second follow-up. Pregnant women whose 50-g GCT result was ≥180 mg/dL were diagnosed with GDM. Cases with results between 140–180 mg/dL were referred for the 100-g oral glucose tolerance test (OGTT) for diagnosis.[12] The PPAQ-Tr scale's total and sub-dimension scores were calculated. The scores were compared between cases with positive and negative GDM screening results and between cases with positive and negative GDM diagnostic test results. After excluding primiparous cases, comparisons were also made for pregnant women who had and had not been diagnosed with GDM in their previous pregnancies.

The study protocol was approved by the Ethics Committee of Bursa Yüksek İhtisas Training and Research Hospital (2011-KAEK-25 2015/19-04). The study was conducted in accordance with the principles of the Declaration of Helsinki.

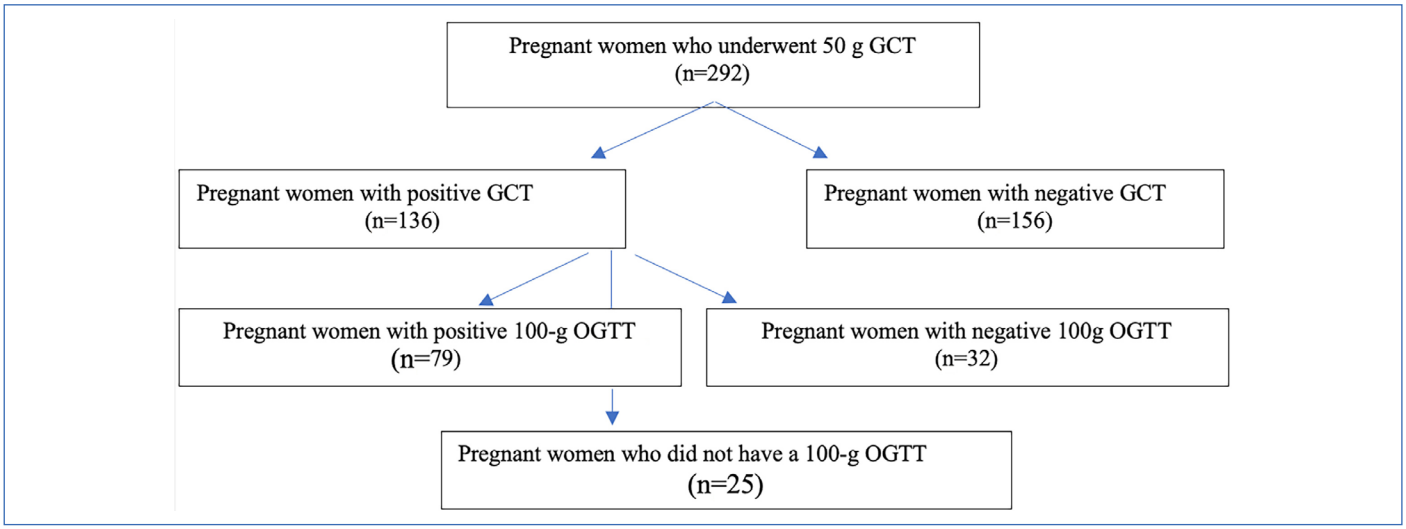

Figure 1: Flow diagram of case distribution according to GDM screening and diagnostic test results.

Statistical Analysis

Statistical analysis was performed using SPSS version 23.0 software (IBM Corp., Armonk, NY, USA). Descriptive statistics were expressed as mean±standard deviation (SD), percentiles (25th, median, 75th), and frequencies (number and percent). The compatibility of numerical variables with the normal distribution was examined using the Shapiro–Wilks test. Positive and negative OGTT results in terms of numerical characteristics were compared with the independent samples t-test or Mann–Whitney U test. A multiple binary logistic regression model was used to account for confounding variables. A p value of<0.05 was considered statistically significant.

RESULTS

The results of 292 pregnant women who completed the PPAQ-Tr before the screening test were evaluated. The test was positive in 136 of the 292 pregnant women who received the 50-g GCT. A 100-g OGTT was indicated for those with positive 50-g GCT findings, and the result was positive in 79 of 111 pregnant women who took the test, while 25 patients did not undergo a 100-g OGTT. Of the 267 pregnant women who obtained OGTT results, 79 (29.6%) were diagnosed with GDM. Among women who had previously given birth (n=179), GDM in a previous pregnancy was found in 14.5% (n=26) (Fig. 1).

Pregnant women with positive GDM screening test results had a statistically significantly lower mean height (p=0.018) and statistically significantly higher mean age (p=0.001), weight (p=0.002), body mass index (BMI) (p=0.001), and median gravida (p=0.005). The PPAQ-Tr scale scores showed no significant difference between pregnant women with positive or negative GDM screening test results (Table 1).

Pregnant women with positive GDM diagnostic test results (100-g OGTT) had statistically significantly higher mean age (p=0.001), mean weight (p=0.036), mean BMI (p=0.002), and median gravida (p=0.005) than pregnant women with negative GDM diagnostic test results. There was no statistically significant difference between pregnant women with positive or negative 100-g OGTT results in terms of PPAQ-Tr scale scores (Table 2).

Pregnant women who were diagnosed with GDM in their previous pregnancy had statistically significantly higher mean age (p=0.003), mean weight (p=0.029), mean BMI (p=0.009), and median gravida (p=0.025) compared with women whose previous pregnancies were not complicated by GDM. Evaluation of the PPAQ-Tr scale scores revealed that only the total score for the transportation activity subdimension was statistically significantly higher (p=0.025) in pregnant women who were diagnosed with GDM in their previous pregnancy (Table 3).

A multiple binary logistic regression model was created for confounding factors (age, BMI, gravidity, parity, and gestational age). The effects of these factors on the OGTT result at the time of diagnosis were eliminated, and the corrected effect of PA was examined. The model created for 'Total activity of light intensity and above' and 'Total activity of all questions' scores showed no significant relationship with GDM at the time of diagnosis after the baseline characteristic effects were eliminated.

DISCUSSION

In this study, no significant difference was found in PPAQ-Tr scale scores between pregnant women with positive and negative GDM screening and diagnostic test results.

Different GDM prevalences have been reported from various regions around the world. A meta-analysis reported the lowest prevalence of GDM in North America, with a rate of 7.1%, while the highest prevalence was reported in the Middle East and North Africa, with a rate of 27.6%.[13] Türkiye is located in the Middle East region. It has been reported that the prevalence of diabetes in the Turkish adult population increased by 90% over 12 years, reaching 13.7%. Diabetes was more common in women than in men (17.2% vs 16.0%).[14] These rates may explain the high prevalence of GDM among women of reproductive age. Lifestyle changes and predisposing conditions that contribute to the rising frequency of diabetes may also play a role in the increased prevalence of GDM in our country. In our study population, the GDM rate was found to be 29.6%.

Table 1: Comparison of pregnant women with positive and negative GDM screening test in terms of demographic characteristics and PPAQ-Tr scale scores

	GDM screening test negative (n=156)		GDM screening test positive (n=136)		p
	Mean	±SD	Mean	±SD	
Age (year)[a]	28.7	4.9	31.5	5.3	0.001
Height (cm)[a]	162.1	5.8	160.4	5.6	0.018
Weight (kg)[a]	71.2	11.9	76.4	12.4	0.002
BMI (kg/m²)[a]	27.2	4.2	29.8	4.7	0.001
Gestational age (weeks)[a]	26.7	3.0	27.0	4.1	0.494
	Median	IQR (25–75%)	Median	IQR (25–75%)	
Gravidity[b]	2	1–3	2	1–4	0.005
Parity[b]	1	0–1	1	0–2	0.103
Total activity of all questions[b]	139.8	101.3–188.0	139.4	97.3–212.8	0.883
Total activity of light intensity and above[b]	111.1	64.6–161.0	105.4	63.1–182.0	0.948
Sedentary activity[b]	29.4	14.0–44.8	29.4	7.6–44.8	0.870
Light-intensity activity[b]	95.1	58.0–129.5	90.6	55.7–141.8	0.879
Moderate-intensity activity[b]	10.6	3.5–33.0	13.7	1.9–45.7	0.851
Vigorous-intensity activity[b]	0.1	0.0.6	0.1	0–0.6	0.556
Household/caregiving activity[b]	71.4	41.9–126.4	70.2	35.4–116.5	0.526
Occupational activity[b]	0	0–0	0	0–11.5	0.342
Sports/exercise activity[b]	0.6	0.2–1.5	0.7	0.2–1.8	0.320
Transportation activity[b]	8.8	3.4–17.0	10.0	2.1–20.6	0.476
Inactivity[b]	30.4	15.0–56.5	31.0	14.0–46.8	0.979

a: Independent Samples t-Test. b: Mann-Whitney U test; GDM: Gestational diabetes mellitus; BMI: Body mass index; IQR: Intequartile range; SD: Standard deviation.

Advanced maternal age and pre-pregnancy BMI have been shown to be associated with an increased risk of GDM.[15] It has been reported that exercise interventions are effective in reducing the likelihood of developing GDM. Pregnant women should perform at least 600 MET-min of moderate-intensity exercise per week to reduce the likelihood of developing GDM by 25%.[16] In our study, pregnant women with positive GDM screening test results had a considerably lower mean height; in contrast, for both GDM screening and diagnostic tests, the mean age, mean weight, mean BMI, and median gravida were significantly higher. Increasing age, body weight, BMI, multiparity, and short stature play a role in the development of diabetes.[17] Height differences may be affected by ethnicity and environmental factors, which were not evaluated in our study. The pre-pregnancy weights of the cases were not recorded. It is noteworthy that the average BMI in our entire patient group was high. Body mass index was calculated as ≥25 kg/m² (overweight) in 90% of pregnant women diagnosed with GDM and 67.6% of pregnant women not diagnosed with GDM. The fact that our study was conducted in a tertiary center and the high rate of high-risk pregnancies may partially explain this result. Therefore, our results should not be interpreted as representative of the general population.

In a randomized trial, it was determined that higher acculturation was associated with a lower likelihood of meeting dietary guidelines but a greater likelihood of meeting PA guidelines during pregnancy.[18] Although immigrants were not included in our study, this approach was insufficient to exclude acculturation differences. Physical activity varies during pregnancy. A study that assessed PA using the visual analogue scale (VAS) for each trimester reported that PA decreased by 31% in the first trimester compared with the pre-pregnancy period, increased in the second trimester, and remained at the same level until birth.[19] In our study, gestational age was similar in all groups, and the gestational weeks at which the PPAQ-Tr was applied were comparable, with the majority being in the second trimester.

The examination of quantitative PA in diabetic pregnant women may help to acquire a better understanding of the role of PA throughout treatment and may be useful in more effectively comparing the results of previous studies. It can be considered that there may be differences between healthy pregnant women and those with GDM in terms of daily activities and caloric expenditure. Previous studies on PA in healthy pregnant women or those with GDM have reported varying

Table 2: Comparison of pregnant women with positive and negative diagnostic OGTT in terms of various demographic characteristics and PPAQ-Tr scale scores

	GDM diagnosis test negative (n=188)		GDM diagnosis test positive (n=79)		p
	Mean	±SD	Mean	±SD	
Age (year)[a]	28.9	5.0	32.4	5.5	0.001
Height (cm)[a]	161.9	5.8	160.8	5.2	0.058
Weight (kg)[a]	72.1	12.0	76.7	12.2	0.006
BMI (kg/m²)[a]	27.4	4.3	29.9	4.3	<0.001
Gestational age (weeks)[a]	26.8	3.127.6	4.0		0.103
	Median	IQR (25–75%)	Median	IQR (25–75%)	
Gravidity[b]	2	1–3	3	2–4	0.005
Parity[b]	1	0–1	1	0–2	0.287
Total activity of all questions[b]	146.2	102.5–204.0	136.3	93.9–187.6	0.265
Total activity of light intensity and above[b]	111.2	67.5–179.4	100.2	59.7–161.6	0.282
Sedentary activity[b]	29.4	14.0–44.8	28.2	7.4–43.4	0.263
Light-intensity activity[b]	97.2	60.0–136.5	85.2	53.6–128.8	0.191
Moderate-intensity activity[b]	11.9	3.5–38.2	15.4	1.6–39.2	0.857
Vigorous-intensity activity[b]	0.1	0.0.6	0.1	0–0.7	0.628
Household/caregiving activity[b]	78.1	42.0–128.0	64.0	32.6–110.2	0.096
Occupational activity[b]	0	0–0	0	0–0	0.769
Sports/exercise activity[b]	0.7	0.2–1.6	0.7	0.2–1.8	0.832
Transportation activity[b]	8.8	3.4–17.4	12.1	3.4–22.6	0.220
Inactivity[b]	30.9	14.9–56.7	28.7	7.4–45.9	0.161

a: Independent Samples t-Test. b: Mann-Whitney U test; GDM: Gestational diabetes mellitus; BMI: Body mass index; IQR: Interquartile range; SD: Standard deviation.

effects across different countries. In a study evaluating different types of PA using the PPAQ in 909 pregnant women in the first trimester, it was reported that sports/exercise and household/caregiving activities in early pregnancy significantly prevented the development of GDM, whereas other PPAQ subgroup dimension scores did not show significant differences.[20] Since the PPAQ evaluates the PA status of the last three months, first-trimester PA was not evaluated in our study. In the subgroup analyses of the groups diagnosed with and without GDM, no difference was found in the PA subgroup scores.

Another study conducted with 653 postpartum women reported that the overall means of PPAQ total and sub-scores were below average, and only the PPAQ sub-score "Vigorous Intensity Activity" was significantly higher among women without GDM than those with GDM. Additionally, PPAQ mean scores showed a significant positive correlation with women's pre-pregnancy BMI and birth weight, and a significant negative association with gestational systolic and diastolic blood pressure.[21]

Increased PA has been reported to improve insulin sensitivity through mechanisms such as anti-inflammatory changes, increased lipolysis, and enhanced fat oxidation.[22] However, it has also been reported that many women do not engage in PA at the currently recommended levels during pregnancy.[23] In a study conducted in Poland, the median PPAQ total activity score in the second trimester was reported as 166.8 MET-hour/week, and the median total activity of light intensity and above score was 143.3 MET-hour/week. A Greek version of the PPAQ translation and cross-cultural adaptation study reported the total activity score as 139.9 MET-hour/week, and the median score of total activity of light intensity and above as 78.4 MET-hour/week. A review including 18 systematic reviews and meta-analyses reported that PA is protective against GDM and that the risk of GDM is 24–38% lower in physically active women. The importance of starting and maintaining aerobic and strength exercises in early pregnancy was also emphasized.[24]

A prospective study conducted with women who had excessive gestational weight gain compared a group of pregnant women with low levels of PA with another group characterized by high levels of PA and high sedentary behavior. As a result, they reported that PA alone is not sufficient if sedentary behaviors accompany it. In fact, it was

Table 3: Comparison of demographic characteristics and PPAQ-Tr scale scores of pregnant women with and without GDM in their previous pregnancy

	No GDM diagnosis in previous pregnancy (n=153)		With GDM diagnosis in previous pregnancy (n=26)		p
	Mean	±SD	Mean	±SD	
Age (year)[a]	30.8	5.3	34.4	4.0	0.003
Height (cm)[a]	161.0	6.2	160.0	5.5	0.442
Weight (kg)[a]	72.9	11.5	78.3	12.2	0.029
BMI (kg/m^2)[a]	28.1	4.4	30.7	4.8	0.009
Gestational age (weeks)[a]	27.0	3.6	25.8	4.6	0.140
	Median	IQR (25–75%)	Median	IQR (25–75%)	
Gravidity[b]	2	2–3	3	2–5	0.025
Parity[b]	1	1–2	1	1–2	0.063
Total activity of all questions[b]	152.2	99.5–222.6	180.0	121.7–250.4	0.182
Total activity of light intensity and above[b]	115.8	71.2–192.3	138.6	93.5–241.4	0.170
Sedentary activity[b]	28.0	14.0–43.8	23.6	4.2–33.0	0.380
Light-intensity activity[b]	98.0	58.7–149.6	122.9	67.6–158.1	0.209
Moderate-intensity activity[b]	16.5	3.9–48.6	30.6	6.1–81.1	0.214
Vigorous-intensity activity[b]	0.1	0.0.6	0.2	0–1.8	0.317
Household/caregiving activity[b]	85.1	45.5–140.1	94.4	53.4–171.8	0.530
Occupational activity[b]	0	0–0.7	0	0–27.6	0.352
Sports/exercise activity[b]	0.6	0.2–1.4	0.6	0.2–2.6	0.389
Transportation activity[b]	8.8	2.1–17.4	15.0	6.4–27.5	0.025
Inactivity[b]	28.0	14.0–46.0	29.4	12.5–42.7	0.697

a: Independent Samples t-Test. b: Mann-Whitney U test; GDM: Gestational diabetes mellitus; BMI: Body mass index; IQR: Intequartile range; SD: Standard deviation.

reported that the risk of GDM increased despite increased PA in the second group. They concluded that reducing sedentary behavior is more effective than increasing PA in women with excessive gestational weight gain.[2] In our study, in a healthy pregnant population without a diagnosis of GDM, the median total activity score was found to be 139.8 MET-hour/week, and the median total activity of light intensity and above score was 111.1 MET-hour/week. PPAQ scores were similar between groups diagnosed with and without GDM. The low activity scores of our entire study population may explain why we could not detect a difference.

This study has several limitations. Although PA was assessed using a questionnaire, the patient's age, educational status, occupation, and socioeconomic level were all substantially related to how the questions were understood and answered—this being the main limitation of questionnaire-based studies. The study was conducted during a specific period of pregnancy, in which physiological changes related to GDM occur, and the diagnosis is determined by objective screening and diagnostic tests. Different results might have been obtained if PA levels had been evaluated in the first or third trimester.

CONCLUSION

This study did not reveal a significant difference between women with positive and negative GDM diagnostic and screening test results in terms of subjective PA scores reflecting the 3 months before GDM screening performed at 24 weeks and later. Pregnant women with positive GDM screening and diagnostic test findings had significantly higher mean age, weight, BMI, and gestational age than pregnant women with negative test results.

Statement

Ethics Committee Approval: The Bursa Yüksek İhtisas Training and Research Hospital Ethics Committee granted approval for this study (date: 14.10.2015, number: 2011-KAEK-25 2015/19-04).

Informed Consent: Informed consent was obtained from all pregnant women. The patients filled out the questionnaire form with their own consent.

Conflict of Interest: The authors have no conflict of interest to declare.

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Author Contributions: Concept – GAA, HAT, NUT; Design – GAA, HAT, NUT; Resources – GAA, HAT, NUT; Data Collection and/or Processing – HA, NUT; Analysis and/or Interpretation – HA; Literature Search – GAA, HAT, NUT, HA; Writing – GAA, HAT, NUT; Critical Reviews – GAA, HAT, NUT, HA.

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