Development and Validation of a Pregnancy Physical Activity Questionnaire

LISA CHASAN-TABER1, MICHAEL D. SCHMIDT1, DAWN E. ROBERTS2, DAVID HOSMER1, GLENN MARKENSON3, and PATTY S. FREEDSON2

1Department of Biostatistics & Epidemiology, School of Public Health & Health Sciences, University of Massachusetts, Amherst, MA; 2Department of Exercise Science, School of Public Health & Health Sciences, University of Massachusetts, Amherst, MA; 3Baystate Medical Center, Springfield, MA.

ABSTRACT


Purpose: The effect of physical activity during pregnancy on maternal and fetal health remains controversial and studies have yet to identify the optimal dose of physical activity associated with favorable pregnancy outcomes. The aim of this study was to develop and validate a pregnancy physical activity questionnaire (PPAQ). Methods: To ascertain the type, duration, and frequency of physical activities performed by pregnant women, three 24-h physical activity recalls were administered to 235 ethnically diverse prenatal care patients at a large tertiary care facility in western Massachusetts. The relative contribution of each activity to between-person variance in energy expenditure was used to establish the list of activities for the PPAQ. The PPAQ is self-administered and asks respondents to report the time spent participating in 32 activities including household/caregiving, occupational, sports/exercise, transportation, and inactivity. To validate the PPAQ, 54 pregnant women completed the PPAQ and then wore a Manufacturing Technology, Inc. actigraph for the following 7 d. At the end of the 7-d period, the PPAQ was repeated. Results: Intraclass correlation coefficients used to measure reproducibility of the PPAQ were 0.78 for total activity, 0.82 for moderate activity, 0.81 for vigorous activity, and ranged from 0.83 for sports/exercise to 0.93 for occupational activity. Spearman correlations between the PPAQ and three published cut points used to classify actigraph data ranged from 0.08 to 0.49 for total activity, 0.25 to 0.34 for vigorous activity, and 0.20 to 0.49 for moderate activity, and −0.08 to 0.22 for light-intensity activity. Correlations were higher for sports/exercise and occupational activities as compared to household/caregiving activities. Conclusions: The PPAQ is a reliable instrument and a reasonably accurate measure of a broad range of physical activities during pregnancy. Key Words: ACTIVITY ASSESSMENT, EPIDEMIOLOGIC METHODS, EXERCISE, REPRODUCIBILITY OF RESULTS, WOMEN

According to national surveys, nearly twice as many U.S. women are sedentary during pregnancy compared to the national average among U.S. adults (29). Among pregnant women who are active, physical activity tends to be of lower duration, frequency, and intensity relative to prepregnancy levels (12,19,29). In spite of these observations, recent epidemiologic studies have found that women who are more active during pregnancy may have reduced risks of gestational diabetes, hypertensive disease, and preterm birth (8,10,24). The dose of activity required for favorable pregnancy outcomes, however, remains to be determined.

The primary objective of a questionnaire for epidemiologic applications is to rank individuals (i.e., to discriminate among subjects according to physical activity). Thus, the challenge for questionnaires used to assess physical activity during pregnancy is to rank pregnant women in categories from sedentary to most active within a narrower range of physical activity than in nonpregnant samples. These questionnaires must be sensitive to differences in physical activity levels between pregnant women as well as to the patterns of activity during pregnancy to avoid misclassifying active pregnant women as sedentary when the opposite may be true.

The majority of currently available physical activity questionnaires have been developed and validated in men and emphasize participation in moderate- and vigorous-intensity sports. In addition, most fail to include household or childcare activity, which comprise a substantial portion of pregnancy physical activity (22). Existing questionnaires have also not accounted for the potentially unique energy de-
mands (metabolic cost) of physical activity during pregnancy. The resultant misclassification can bias studies of the relationship between pregnancy physical activity and maternal and fetal health, limiting their ability to detect important associations with disease (1,13,15).

We used an innovative approach inspired by the diet assessment literature to select the activities, and combination of activities, which are important discriminators of physical activity in pregnant women. Our overall goal was to design an instrument able to measure the duration, frequency, and intensity of total activity (household/caregiving, occupational, and sports/exercise) throughout pregnancy and distinguish activity patterns in pregnant women. To be useful for epidemiologic research, the questionnaire was to be short in length, self-administered, and easily understood by respondents in a variety of settings.

**METHODS**

**PPAQ development**

**Study population for the 24-h recalls.** To ascertain the type, duration, and frequency of physical activities performed by pregnant women, we conducted up to three 24-h physical activity recalls among 235 ethnically diverse prenatal care patients at a large tertiary care facility in western Massachusetts. Approximately 58% of the participants were white non-Hispanic, 28% were Hispanic, and 14% were black. Ten percent of women were in the first trimester, 34% were in the second trimester, and 56% were in the third trimester. Women were considered ineligible for the study if they had any of the following characteristics: diabetes requiring insulin, hypertension or heart disease requiring medication, chronic renal disease, nonsingleton pregnancy, or under 16 or over 40 yr of age. Each participant read and signed a written informed consent approved by the Institutional Review Board of the University of Massachusetts, Amherst.

**24-h recalls.** Bilingual interviewers asked participants to account for each min of every hour of the previous day from 12:00 midnight through the following 24 h. Interviewers used standardized open-ended forms to record each activity performed, noting the time the activity was started and completed and a description of the activity. One week later, interviewers made a follow-up telephone call to conduct two additional 24-h recalls for the two prior days (ensuring that one of the days was a weekend day). An advantage to this open-ended approach is that important activities are unlikely to be missed; this is particularly important for a population whose activity habits have not previously been well characterized. The relative validity of 24-h physical activity recalls has been described in detail elsewhere with correlations for women of 0.54 for household activity, 0.74 for occupational activity, and 0.68 for leisure time physical activity when compared with a physical activity diary (16).

Activities listed in the 24-h recalls were assigned an activity code and intensity level from the Compendium of Physical Activities (5). Related activities were combined into 64 distinct activities and assigned the mean MET intensity of the combined activities. Because Compendium-based MET intensities are based on data measured among men and nonpregnant women, we used MET intensities measured in pregnant women whenever available. Currently, to our knowledge, pregnancy-specific MET values are available only for walking and light- to moderate-intensity household tasks (21).

For every individual, the number of min spent in each reported activity type was multiplied by its MET intensity and summed to arrive at total daily energy expenditure. The daily estimates per subject were then averaged to calculate average daily total energy expenditure in MET-hours per day (“total energy score”) and average daily activity-specific energy expenditure in MET-hours per day (“activity-specific energy score”).

**Selection of activities for the questionnaire.** We used the relative contribution of each activity to between-person variance in energy expenditure to select activities for the questionnaire. This approach has the potential to identify low intensity activities which otherwise may be overlooked as important contributors to energy expenditure and selects only the most informative items, thus avoiding unnecessarily lengthy questionnaires (27). Specifically, we used stepwise multiple regression with the total energy score as the dependent variable and the activity-specific energy scores as the independent variables. For those activities in which the individual subject did not engage, a value of zero was assigned to the activity-specific energy score. In this process, the activity that explains the most between-person variance in the total energy score is identified as the first independent variable, the activity that explains the most variance not accounted for by the first activity is identified as the second independent variable, and so on (27). The change in the cumulative $R^2$, the statistical significance of the incremental contribution to the cumulative $R^2$, and the total number of activities already in the model were used to determine the inclusion of each respective activity. Activities were also included on the basis of prior information, epidemiological or otherwise, that an association with maternal/fetal disorders might exist. A priori, our goal was to account for an $R^2$ of at least 90% using only a modest number of the activities generated through the open-ended 24 h recalls. Regressions were performed overall and separately for each trimester. Results did not differ substantially across trimesters, thus all trimesters were pooled for further analysis.

**The PPAQ.** Selected activities were integrated into a self-administered, scannable Pregnancy Physical Activity Questionnaire (PPAQ) (Appendix 1). The PPAQ is a semi-quantitative questionnaire that asks respondents to report the time spent participating in 32 activities including household/caregiving (13 activities), occupational (5 activities), sports/exercise (8 activities), transportation (3 activities), and inactivity (3 activities).

For each activity, respondents are asked to select the category that best approximates the amount of time spent in

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**PREGNANCY PHYSICAL ACTIVITY QUESTIONNAIRE**

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that activity per day or week during the current trimester. Possible durations range from 0 to 6 or more hours per day and from 0 to 3 or more hours per week. To determine the category cut points, we examined the frequency distribution of time spent in each questionnaire activity as reported on the 24-h recalls. Categories were selected such that single categories did not encompass substantial variation in participation to further increase the discriminatory capacity of questionnaire items (27). At the end of the PPAQ, an open-ended section allows the respondent to add activities not already listed. Sleeping is not included. Self-administration of the PPAQ takes approximately 10 min. (A Spanish version of the PPAQ may be requested by contacting the corresponding author).

**PPAQ validation**

**Study population for the validation study.** To validate the PPAQ, we recruited 63 subjects from western Massachusetts via flyers posted at local health clinics, advertisements in local papers, as well as recruitment of prenatal care patients at a large tertiary care facility. Women were considered ineligible for the validation study if they had any of the following characteristics: diabetes requiring insulin, hypertension or heart disease requiring medication, chronic renal disease, nonsingleton pregnancy, under 16 or over 40 yr of age, or had participated in the prior study component. Each participant read and signed a written informed consent approved by the Institutional Review Board of the University of Massachusetts, Amherst.

**Methods for the validation study.** Participants completed the PPAQ and then wore a Manufacturing Technology, Inc. (Fort Walton Beach, FL) actigraph (formerly known as the CSA accelerometer), a uniaxial actigraph that detects vertical accelerations ranging in magnitude from 0.05 to 2.00 g with frequency response from 0.25 to 2.50 Hz. The above parameters will detect normal human movement while filtering out high frequency movements such as vibrations. The filtered acceleration signal is digitized and the magnitude is summed over a user-specified time interval (epoch). At the end of each epoch, the activity count is stored in memory and the accumulator is reset to zero (7). A 1-min epoch was used in this study. The actigraph was affixed with an adjustable belt on the right hip under clothing during the waking hours of the following 7 d. While wearing the actigraph, women were given a form on which to note if they removed the actigraph during the day for longer than 1 h to swim, shower, or nap. None of the subjects reported removing the actigraph. At the end of the seven day period, the PPAQ was repeated. Recently, our laboratory reported statistically significant correlations between the actigraph and directly measured energy expenditure during treadmill exercise (0.66–0.82) (9,18).

Nine subjects were excluded due to actigraph failure (N = 2) or failure to complete the validation study protocol (N = 7). To prevent significant under-estimation of daily activity, we excluded 23 d of measurement from 14 subjects because the actigraph was not worn for at least 8 h. For these calculations, we assumed the actigraph was not worn during periods where actigraph output was equal to zero for ≥15 continuous minutes. Therefore, the final validation sample included 54 subjects (68% white non-Hispanic, 28% Hispanic, 2% black, and 2% Asian) of whom 30% were in the first trimester, 31% were in the second trimester, and 39% were in the third trimester.

**Estimating activity using the actigraph.** The actigraph data for each subject were downloaded to a PC using the Manufacturing Technology, Inc. reader interface unit. Three separate estimates of the number of minutes per day spent in activity of moderate-intensity and above were calculated using the following count cut points developed from three prior studies: ≥1191 (Hendelman et al. (11)), ≥574 (Swartz et al. (26)), and ≥1592 (Freedson et al. (9)). “Average counts per minute” was defined as the mean actigraph output per 1-min epoch. This measure reflects raw actigraph counts without any categorization according to activity intensity. As average daily wear time of the MTI varied considerably between subjects, all actigraph measures were adjusted for the length of time the monitor was worn.

**Computing energy expenditure using the PPAQ.** The self-reported time spent in each activity was multiplied by its intensity to arrive at a measure of average weekly energy expenditure (MET-h-wk⁻¹) attributable to each activity. Again, field-based measurements in pregnant women (21) were used to represent activity intensity for walking and light- to moderate-intensity household tasks, and Compendium-based MET values (5) were used to estimate the intensity of the remainder of the PPAQ activities. Activities of light intensity and above were summed to derive average MET hours per week for total activity. In addition, each activity was classified by intensity: sedentary (<1.5 METs), light (1.5–<3.0 METs), moderate (3.0–6.0 METs) or vigorous (≥6.0 METs) and the average number of MET-hours per week expended in each intensity level was calculated. Activities were also classified by type (household/caregiving, occupational, and sports/exercise) and the average number of MET hours per week spent in each activity type was calculated.

**Statistical Analysis.** Intraclass correlation coefficients were used to describe the reproducibility of the PPAQ and were calculated as the proportion of total variance explained by between-subject variance (17). Between and within subject variance components were estimated using log transformed activity data assuming a compound symmetric covariance structure in SAS PROC MIXED. Because the activity scores were not normally distributed, Spearman correlation coefficients were calculated between the PPAQ and the actigraph values to evaluate the validity of the PPAQ. Pearson correlation coefficients calculated on log-transformed data did not differ substantively and are therefore not presented. Finally, because the goal of the PPAQ was to measure relative rather than absolute activity levels, we grouped the subjects into tertiles of energy expenditure according to the PPAQ data, and, for each tertile, calculated

the mean actigraph values. In this manner, we evaluated whether the grouping of subjects into tertiles based on the PPAQ yielded groups with different “true” activity.

RESULTS

PPAQ development

Participants reported an average of 17 activities per day in the 24-h recalls with 7,055 total activities recorded by all study participants. Thirty-two principal activity types accounted for more than 94% of the variance in energy expenditure and were selected for the PPAQ. The most discriminatory activity was time spent watching television or videos which accounted for 26% of the variance. Standing or slowly walking at work while carrying a light/moderate load was the most important occupational activity as well as the second most discriminatory activity. Moderate-intensity childcare was the most important household activity as well as the third most discriminatory activity.

PPAQ validation

The median values from the first PPAQ were comparable to the median values from the second administration of the PPAQ for total activity (25.2 MET-h wk$^{-1}$ vs. 22.2 MET-h wk$^{-1}$), as well as across activity intensities and types (Table 1). Mean (SD) Average counts per minute was 177.6 (83.3) (range = 68.4–517.9), and mean (SD) minutes per day spent in activity of moderate or vigorous intensity, for each cut point, were 135.1 (50.0) (range = 46.0–262.3) using the Swartz cut point, 280.9 (76.7) (range = 120.8–473.3) using the Hendelman cut point, and 22.0 (20.6) (range = 2.7–92.7) for the Freedson cut point.

Reproducibility between the two administrations of the questionnaire was strong (0.78 for total physical activity) (Table 2). Reproducibility was highest for moderate intensity activity (0.82) and ranged from 0.78 to 0.81 for light, sedentary, and vigorous activity. Regarding activity type, reproducibility was highest for occupational activity (0.93), and also high for household/caregiving (0.86) and sports/exercise (0.83).

To assess the validity of the questionnaire, summary measures from the PPAQ were compared to the actigraph values (Table 3). Overall, correlations between the PPAQ and the actigraph measures using the three previously published cut points were modest, with correlations ranging from 0.08 (Freedson cut point) to 0.43 (Hendelman cut point) for total activity (light intensity and above). Correlations were higher between the PPAQ and actigraph measures for moderate activity (ranging from 0.20 to 0.49) and vigorous activity (ranging from 0.25 to 0.34) compared to correlations for light activity (ranging from −0.08 to 0.22). Correlations were negative for sedentary activity (with the exception of the Freedson cut point), meaning that counts decreased as reported sedentary activity increased. Correlations according to activity type were highest for sports/exercise (ranging from 0.30 to 0.44) and occupational activity among subjects who were employed (ranging from −0.10 to 0.42), compared to household/caregiving activity (ranging from −0.12 to 0.14). Overall, correlations were highest using the Hendelman cut points which have a substantially lower cut point for activity of moderate intensity (191 counts) compared to the Freedson cut points (1952 counts) and the Swartz cut points (574 counts).

We then correlated summary measures from the PPAQ with raw actigraph counts (average counts per minute). Overall, correlations between the PPAQ and average counts per minute were within the range of values observed for the published cut points (0.27 for total activity), while validity coefficients for vigorous activity (0.37) and sports/exercise (0.48) were higher using average counts per minute.

To evaluate whether the grouping of subjects into tertiles based on the PPAQ would yield groups with different “true” activity, we computed mean actigraph values within each tertile of total activity as calculated by the PPAQ (Table 4). There was a significant linear trend of increasing moderate/vigorous activity across tertiles of activity based on the PPAQ for the Hendelman ($P = 0.001$) and the Swartz ($P = 0.014$) cut points, but not for the Freedson cut points ($P = 0.77$). For average counts per minute, mean values also increased with increasing PPAQ tertile, although not significantly ($P = 0.15$).

DISCUSSION

In this reproducibility and validity study of a self-administered PPAQ, moderate to high reproducibility was ob-

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TABLE 1. Median (25th and 75th percentile) values (MET-h wk$^{-1}$) for two self-administered Pregnancy Physical Activity Questionnaires (PPAQs) by activity intensity and type among 54 pregnant subjects; PPAQ validation phase, western Massachusetts, 2000–2002.

<table>
<thead>
<tr>
<th>By intensity</th>
<th>1st PPAQ (MET-h wk$^{-1}$)</th>
<th>2nd PPAQ (MET-h wk$^{-1}$)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>25th</td>
<td>Median</td>
</tr>
<tr>
<td>Total activity (light and above)</td>
<td>19.7</td>
<td>25.2</td>
</tr>
<tr>
<td>Sedentary (&lt;1.5 METs)</td>
<td>6.1</td>
<td>9.3</td>
</tr>
<tr>
<td>Light (1.5–&lt;3.0 METs)</td>
<td>10.5</td>
<td>14.6</td>
</tr>
<tr>
<td>Moderate activity (3.0–6.0 METs)</td>
<td>7.7</td>
<td>10.4</td>
</tr>
<tr>
<td>Vigorous activity (&gt;6.0 METs)</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>By type</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Household/caregiving</td>
<td>7.9</td>
<td>11.3</td>
</tr>
<tr>
<td>Occupational activity</td>
<td>0.0</td>
<td>10.6</td>
</tr>
<tr>
<td>Sports/exercise</td>
<td>0.5</td>
<td>1.8</td>
</tr>
</tbody>
</table>
TABLE 2. Intraclass correlation coefficients* between two self-administered Pregnancy Physical Activity Questionnaires (PPAQs) among 54 pregnant subjects; PPAQ validation phase, western Massachusetts, 2000–2002.

<table>
<thead>
<tr>
<th>Intraclass Correlation Coefficient</th>
<th>Total activity (light and above)</th>
<th>By intensity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Sedentary (&lt;1.5 METs)</td>
</tr>
<tr>
<td>By type</td>
<td></td>
<td>0.78</td>
</tr>
<tr>
<td>Household/caregiving</td>
<td>0.86</td>
<td>0.93</td>
</tr>
</tbody>
</table>

*Intraclass correlations were calculated on log-transformed data.

We selected activities for the PPAQ based upon their ability to discriminate between subjects regarding physical activity energy expenditure. This innovative use of stepwise regression analysis was inspired by the similarity between methods used to assess physical activity and diet and has been used in the development of such questionnaires as the Nurses’ Health Study food frequency questionnaire (27). This approach increases the ability of the questionnaire to correctly classify subjects into activity rankings (e.g., quartiles of activity) and avoids unnecessarily lengthy questionnaires (27). However for the same reason, the questionnaire cannot be used to calculate absolute energy expenditure during pregnancy.

With the exception of walking and selected household activities, we relied upon MET intensity levels reported in the Compendium of Physical Activities (5). Compendium values are based on data from men and nonpregnant women and therefore may not be applicable to pregnant women. In addition, the Compendium values are derived from laboratory data and subjective judgment, as accurate metabolic measurements in the field have been difficult to obtain (5). Our research group has observed that field measurements among pregnant women may differ anywhere from 6 to 42% (0.2–2.0 METs) from the Compendium-based values (21). Therefore, relying on the Compendium would likely lead to attenuations in observed associations between physical activity during pregnancy and maternal/fetal outcomes. Future studies among pregnant women designed to measure the metabolic intensity of physical activities in the field are warranted.

Wearing an activity monitor during the 1-wk interval between the administration of the questionnaires may have led to a heightened awareness of activity among participants. In addition, although less likely, true changes in activity patterns may have occurred during the one-week interval. However, as the PPAQ assesses usual trimester activity, which is less likely to have changed over a one-week time period, we believe that the correlations will largely reflect the reproducibility characteristics of our questionnaire. However, given these changes in awareness or true activity over the week, the correlations we observed likely provide a lower limit on the questionnaire’s actual reproducibility.

As our criterion measure of usual activity during the current trimester, we utilized estimates of physical activity from an actigraph worn for a 1-wk period. A number of studies have been conducted to determine how many measurement days are needed to reliably estimate habitual physical activity (20). In these studies, the number of days has varied between 4 and 12 depending on the precision that is required, the accuracy of the reference method, and the intraindividual variation in activity (20). In light of these factors and given that the majority of these questionnaires are designed to estimate normal activity over 1 or more years as opposed to a 3-month

TABLE 3. Spearman correlation coefficients between the Pregnancy Physical Activity Questionnaire (PPAQ) and Manufacturing Technology, Inc., actigraph data among 54 pregnant subjects; PPAQ validation phase, western Massachusetts, 2000–2002.

<table>
<thead>
<tr>
<th>PPAQ Measures</th>
<th>Actigraph Cut Points (min·d⁻¹)*</th>
<th>Average counts per minute</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total activity (light)</td>
<td>0.32</td>
<td>0.43</td>
</tr>
<tr>
<td>By intensity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sedentary (&lt;1.5 METs)</td>
<td>−0.17</td>
<td>−0.34</td>
</tr>
<tr>
<td>Light (1.5–&lt;3.0 METs)</td>
<td>0.10</td>
<td>0.22</td>
</tr>
<tr>
<td>Moderate (3.0–6.0 METs)</td>
<td>0.42</td>
<td>0.49</td>
</tr>
<tr>
<td>Vigorous (&gt;6.0 METs)</td>
<td>0.27</td>
<td>0.25</td>
</tr>
<tr>
<td>By type</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Household/caregiving</td>
<td>−0.01</td>
<td>0.14</td>
</tr>
<tr>
<td>Occupational*</td>
<td>0.31</td>
<td>0.42</td>
</tr>
<tr>
<td>Sports/exercise</td>
<td>0.35</td>
<td>0.30</td>
</tr>
</tbody>
</table>

*Activity of moderate-intensity and greater. Count cut points were as follows: ≥574 (Swartz et al. (26)); ≥191 (Hendelman et al. (11)); and ≥1952 (Freedson et al. (9)).

*Among subjects who were currently employed (N = 38 or 70% of the sample).
trimester, we felt that 7 d of actigraph use was appropriately conservative.

The validity results are impacted by errors in the actigraph data as well as in the PPAQ measures. For example, when the actigraph is worn on the hip, error results from the inability of the actigraph to accurately measure activities involving upper body movement, pushing or carrying a load, stationary exercise (e.g., cycling), and weight-lifting (6). In contrast, errors in the PPAQ may result from subject inaccuracy in self-reporting physical activity (14). Given that neither method is perfect, it is critical that the errors inherent in each method be as independent as possible, as correlated errors will result in spuriously high validity coefficients (27). Therefore, because errors associated with the actigraph and PPAQ are largely independent, our correlation coefficients are likely not overstated.

The difference in observed correlations between the PPAQ and actigraph measures using the three previously published cut points largely reflects differences in cut point values. These cut points vary substantially, particularly regarding the threshold for moderate intensity activity, and their use has resulted in widely discrepant estimates of validity (3,23). These differences may be due, in part, to variation in the methods and populations used to generate each of the cut points. We observed higher correlations with the Hendelman and Swartz cut points as compared to the Freedson cut point. The Freedson cut points were derived from laboratory based locomotor activities which, for a given intensity, will generate higher count values than other activities (9,26). In contrast, both the Hendelman and Swartz cut points were based on field activities including indoor and outdoor household tasks, recreational activities, and walking. Additionally, because none of the cut points were developed among pregnant populations (all three studies included both men and nonpregnant women) they may not reflect the true intensity of activity during pregnancy.

Recent studies have suggested that raw actigraph counts (average counts per minute) may be a simple but useful marker of physical activity that exceeds resting and low metabolic requirements (3,23). However, because this measure is right skewed (due to the substantial number of 0 counts per minute for inactive min), it is more sensitive to vigorous intensity activity. This is consistent with our observed higher correlations for vigorous activity and sports/exercise using average counts per minute as compared to the published cut points.

To our knowledge, there are no prior studies assessing the reproducibility or validity of physical activity questionnaires among pregnant women. However, several questionnaires have been designed to assess physical activity among nonpregnant women of reproductive age (2,4,28). It is important to note, however, that these questionnaires either focused on recreational activity (28) or occupational activity (4) only, or did not provide estimates of MET hours per day of activity (2). Wolf et al. (28) examined the reproducibility of self-reported recreational activity among a sample of 298 women aged 25–42 yr from the Nurses’ Health Study II. The questionnaire, administered 2 yr apart, was found to be reasonably reproducible (0.59). In a recent study among 50 women aged 20–60 yr, Ainsworth et al. (2) assessed the 1-month reproducibility of the Kaiser Physical Activity Survey (KPAS) (25). Intraclass correlations ranged from 0.79 to 0.91 for all activity indexes (housework/caregiving, active living habits, sports, and occupation). We observed measures of reproducibility for the PPAQ that were stronger (4,28) or comparable (2) to these previous findings.

Few studies have assessed the validity of self-administered questionnaires in women of reproductive age using objective measures as the standard (2,4). In the most recent study, Ainsworth et al. (2) observed overall correlations between the KPAS and Caltrac accelerometer MET-minutes per day of 0.49. Correlations were 0.01 for household/caregiving activities, 0.30 for occupational activities, and 0.57 for sports/exercise. Our observations using the Hendelman cut points were comparable to these data, with higher observed correlations for household/caregiving and occupational activities, and lower observed correlations for sports/exercise.

In summary, our data indicate that the PPAQ is a reliable instrument and provides a reasonable measure of pregnancy physical activity. To our knowledge, the PPAQ is the first validated questionnaire that can be used to determine the lower and upper levels of rigor (frequency, duration, intensity) for activity during pregnancy, and identify the specific parameters that characterize both threshold and dose response effects for investigations of physical activity and maternal and fetal outcomes.

This work was supported by the National Institute for Child Health and Human Development HD39341. The authors are grateful to Dr. Scott Chasan-Taber, Christine Judge, J. Blanca Erickson, Larissa Brunner, Maren Fragala, Sara Pragluski, Rebecca Hasson, Dr. James Fordyce, Erin DeWaard, Anush Yousefian, and Rachel Hecksher for their assistance with data collection and analysis.
REFERENCES

Pregnancy Physical Activity Questionnaire

Instructions:
*Please use an ordinary No. 2 pencil. Fill in the circles completely. The Question will be read by a machine so if you need to change your answer, erase the incorrect mark completely. If you have comments, please write them on the back of the questionnaire.*

Example: During this trimester, when you are NOT at work, how much time do you usually spend:

E1. Taking care of an older adult
   - None
   - Less than 1/2 hour per day
   - 1/2 to almost 1 hour per day
   - 1 to almost 2 hours per day
   - 2 to almost 3 hours per day
   - 3 or more hours per day

It is very important you tell us about yourself honestly. There are no right or wrong answers. We just want to know about the things you are doing during this trimester.

1. Today's Date: [ ]/ [ ]/ [ ]

2. What was the first day of your last period? [ ]/ [ ]/ [ ]

3. When is your baby due? [ ]/ [ ]/ [ ]

During this trimester, when you are NOT at work, how much time do you usually spend:

4. Preparing meals (cook, set table, wash dishes)
   - None
   - Less than 1/2 hour per day
   - 1/2 to almost 1 hour per day
   - 1 to almost 2 hours per day
   - 2 to almost 3 hours per day
   - 3 or more hours per day

5. Dressing, bathing, feeding children while you are sitting
   - None
   - Less than 1/2 hour per day
   - 1/2 to almost 1 hour per day
   - 1 to almost 2 hours per day
   - 2 to almost 3 hours per day
   - 3 or more hours per day

Page 1
During this trimester, when you are NOT at work, how much time do you usually spend:

6. Dressing, bathing, feeding children while you are standing
   ○ None
   ○ Less than 1/2 hour per day
   ○ 1/2 to almost 1 hour per day
   ○ 1 to almost 2 hours per day
   ○ 2 to almost 3 hours per day
   ○ 3 or more hours per day

7. Playing with children while you are sitting or standing
   ○ None
   ○ Less than 1/2 hour per day
   ○ 1/2 to almost 1 hour per day
   ○ 1 to almost 2 hours per day
   ○ 2 to almost 3 hours per day
   ○ 3 or more hours per day

8. Playing with children while you are walking or running
   ○ None
   ○ Less than 1/2 hour per day
   ○ 1/2 to almost 1 hour per day
   ○ 1 to almost 2 hours per day
   ○ 2 to almost 3 hours per day
   ○ 3 or more hours per day

9. Carrying children
   ○ None
   ○ Less than 1/2 hour per day
   ○ 1/2 to almost 1 hour per day
   ○ 1 to almost 2 hours per day
   ○ 2 to almost 3 hours per day
   ○ 3 or more hours per day

10. Taking care of an older adult
    ○ None
    ○ Less than 1/2 hour per day
    ○ 1/2 to almost 1 hour per day
    ○ 1 to almost 2 hours per day
    ○ 2 to almost 3 hours per day
    ○ 3 or more hours per day

11. Sitting and using a computer or writing, while not at work
    ○ None
    ○ Less than 1/2 hour per day
    ○ 1/2 to almost 1 hour per day
    ○ 1 to almost 2 hours per day
    ○ 2 to almost 3 hours per day
    ○ 3 or more hours per day

12. Watching TV or a video
    ○ None
    ○ Less than 1/2 hour per day
    ○ 1/2 to almost 2 hours per day
    ○ 2 to almost 4 hours per day
    ○ 4 to almost 6 hours per day
    ○ 6 or more hours per day

13. Sitting and reading, talking, or on the phone, while not at work
    ○ None
    ○ Less than 1/2 hour per day
    ○ 1/2 to almost 2 hours per day
    ○ 2 to almost 4 hours per day
    ○ 4 to almost 6 hours per day
    ○ 6 or more hours per day

14. Playing with pets
    ○ None
    ○ Less than 1/2 hour per day
    ○ 1/2 to almost 1 hour per day
    ○ 1 to almost 2 hours per day
    ○ 2 to almost 3 hours per day
    ○ 3 or more hours per day

15. Light cleaning (make beds, laundry, iron, put things away)
    ○ None
    ○ Less than 1/2 hour per day
    ○ 1/2 to almost 1 hour per day
    ○ 1 to almost 2 hours per day
    ○ 2 to almost 3 hours per day
    ○ 3 or more hours per day

16. Shopping (for food, clothes, or other items)
    ○ None
    ○ Less than 1/2 hour per day
    ○ 1/2 to almost 1 hour per day
    ○ 1 to almost 2 hours per day
    ○ 2 to almost 3 hours per day
    ○ 3 or more hours per day
During this trimester, when you are NOT at work, how much time do you usually spend:

17. Heavier cleaning (vacuum, mop, sweep, wash windows)
   ○ None
   ○ Less than 1/2 hour per week
   ○ 1/2 to almost 1 hour per week
   ○ 1 to almost 2 hours per week
   ○ 2 to almost 3 hours per week
   ○ 3 or more hours per week

18. Mowing lawn while on a riding mower
   ○ None
   ○ Less than 1/2 hour per week
   ○ 1/2 to almost 1 hour per week
   ○ 1 to almost 2 hours per week
   ○ 2 to almost 3 hours per week
   ○ 3 or more hours per week

19. Mowing lawn using a walking mower, raking, gardening
   ○ None
   ○ Less than 1/2 hour per week
   ○ 1/2 to almost 1 hour per week
   ○ 1 to almost 2 hours per week
   ○ 2 to almost 3 hours per week
   ○ 3 or more hours per week

Going Places...

During this trimester, how much time do you usually spend:

20. Walking slowly to go places (such as to the bus, work, visiting)
    Not for fun or exercise
   ○ None
   ○ Less than 1/2 hour per day
   ○ 1/2 to almost 1 hour per day
   ○ 1 to almost 2 hours per day
   ○ 2 to almost 3 hours per day
   ○ 3 or more hours per day

21. Walking quickly to go places (such as to the bus, work, or school)
    Not for fun or exercise
   ○ None
   ○ Less than 1/2 hour per day
   ○ 1/2 to almost 1 hour per day
   ○ 1 to almost 2 hours per day
   ○ 2 to almost 3 hours per day
   ○ 3 or more hours per day

22. Driving or riding in a car or bus
   ○ None
   ○ Less than 1/2 hour per day
   ○ 1/2 to almost 1 hour per day
   ○ 1 to almost 2 hours per day
   ○ 2 to almost 3 hours per day
   ○ 3 or more hours per day

For Fun or Exercise...

During this trimester, how much time do you usually spend:

23. Walking slowly for fun or exercise
    ○ None
    ○ Less than 1/2 hour per week
    ○ 1/2 to almost 1 hour per week
    ○ 1 to almost 2 hours per week
    ○ 2 to almost 3 hours per week
    ○ 3 or more hours per week

24. Walking more quickly for fun or exercise
    ○ None
    ○ Less than 1/2 hour per week
    ○ 1/2 to almost 1 hour per week
    ○ 1 to almost 2 hours per week
    ○ 2 to almost 3 hours per week
    ○ 3 or more hours per week

25. Walking quickly up hills for fun or exercise
    ○ None
    ○ Less than 1/2 hour per week
    ○ 1/2 to almost 1 hour per week
    ○ 1 to almost 2 hours per week
    ○ 2 to almost 3 hours per week
    ○ 3 or more hours per week
During this trimester, how much time do you usually spend:

<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>○ None</td>
<td>○ None</td>
<td>○ None</td>
</tr>
<tr>
<td>○ Less than 1/2 hour per week</td>
<td>○ Less than 1/2 hour per week</td>
<td>○ Less than 1/2 hour per week</td>
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<td>○ 1/2 to almost 1 hour per week</td>
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<td>○ 1 to almost 2 hours per week</td>
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<td>○ 3 or more hours per week</td>
<td>○ 3 or more hours per week</td>
<td>○ 3 or more hours per week</td>
</tr>
</tbody>
</table>

29. Dancing

<table>
<thead>
<tr>
<th>30. Name of Activity</th>
<th>○ None</th>
<th>○ Less than 1/2 hour per week</th>
</tr>
</thead>
<tbody>
<tr>
<td>○ None</td>
<td>○ Less than 1/2 hour per week</td>
<td>○ 1/2 to almost 1 hour per week</td>
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<tr>
<td>○ 1/2 to almost 1 hour per week</td>
<td>○ 1/2 to almost 1 hour per week</td>
<td>○ 1 to almost 2 hours per week</td>
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<td>○ 1 to almost 2 hours per week</td>
<td>○ 1 to almost 2 hours per week</td>
<td>○ 2 to almost 3 hours per week</td>
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<td>○ 2 to almost 3 hours per week</td>
<td>○ 2 to almost 3 hours per week</td>
<td>○ 3 or more hours per week</td>
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<td>○ 3 or more hours per week</td>
<td>○ 3 or more hours per week</td>
<td>○ 3 or more hours per week</td>
</tr>
</tbody>
</table>

Doing other things for fun or exercise? Please tell us what they are.

<table>
<thead>
<tr>
<th>31. Name of Activity</th>
<th>○ None</th>
<th>○ Less than 1/2 hour per week</th>
</tr>
</thead>
<tbody>
<tr>
<td>○ None</td>
<td>○ Less than 1/2 hour per week</td>
<td>○ 1/2 to almost 1 hour per week</td>
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<td>○ 1 to almost 2 hours per week</td>
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<td>○ 2 to almost 3 hours per week</td>
<td>○ 3 or more hours per week</td>
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<td>○ 3 or more hours per week</td>
<td>○ 3 or more hours per week</td>
<td>○ 3 or more hours per week</td>
</tr>
</tbody>
</table>

Please fill out the next section if you work for wages, as a volunteer, or if you are a student. If you are a homemaker, out of work, or unable to work, you do not need to complete this last section.

At Work...

During this trimester, how much time do you usually spend:

<table>
<thead>
<tr>
<th>32. Sitting at working or in class</th>
<th>33. Standing or slowly walking at work while carrying things (heavier than a 1 gallon milk jug)</th>
<th>34. Standing or slowly walking at work not carrying anything</th>
</tr>
</thead>
<tbody>
<tr>
<td>○ None</td>
<td>○ None</td>
<td>○ None</td>
</tr>
<tr>
<td>○ Less than 1/2 hours per day</td>
<td>○ Less than 1/2 hour per day</td>
<td>○ Less than 1/2 hour per day</td>
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<tr>
<td>○ 1/2 to almost 2 hours per day</td>
<td>○ 1/2 to almost 2 hours per day</td>
<td>○ 1/2 to almost 2 hours per day</td>
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<td>○ 2 to almost 4 hours per day</td>
<td>○ 2 to almost 4 hours per day</td>
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<td>○ 4 to almost 6 hours per day</td>
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<td>○ 4 to almost 6 hours per day</td>
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<tr>
<td>○ 6 or more hours per day</td>
<td>○ 6 or more hours per day</td>
<td>○ 6 or more hours per day</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>35. Walking quickly at work while carrying things (heavier than a 1 gallon milk jug)</th>
<th>36. Walking quickly at work not carrying anything</th>
</tr>
</thead>
<tbody>
<tr>
<td>○ None</td>
<td>○ None</td>
</tr>
<tr>
<td>○ Less than 1/2 hour per day</td>
<td>○ Less than 1/2 hour per day</td>
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<td>○ 1/2 to almost 2 hours per day</td>
<td>○ 1/2 to almost 2 hours per day</td>
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<td>○ 6 or more hours per day</td>
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</tbody>
</table>

Thank You