European Journal of Obstetrics & Gynecology and Reproductive Biology 170 (2013) 90–95

Contents lists available at SciVerse ScienceDirect

European Journal of Obstetrics & Gynecology and Reproductive Biology

journal homepage: www.elsevier.com/locate/ejogrb

Measuring physical activity in pregnancy: a comparison of accelerometry and self-completion questionnaires in overweight and obese women

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ARTICLE INFO

Article history:
Received 29 November 2012
Received in revised form 19 April 2013
Accepted 30 May 2013

Keywords:
Physical activity
Pregnancy
Obesity
Accelerometry

ABSTRACT

Objectives: Increased physical activity in pregnancy may reduce the risk of gestational diabetes and pre-eclampsia, which occur more commonly in overweight and obese women. There is limited assessment of physical activity questionnaires in pregnancy. This study compares self-reported physical activity using two questionnaire methods with objectively recorded physical activity using accelerometry in overweight and obese pregnant women.

Study design: 59 women with booking BMI ≥ 25 kg/m^2 completed the Recent Physical Activity Questionnaire (RPAQ) and Australian Women's Activity Survey (AWAS) or recorded at least 3 days of accelerometry at median 12 weeks' gestation. Accelerometer thresholds of 100 counts/min and 1952 counts/min were used to define light and moderate or vigorous physical activity (MVPA) respectively.

Results: 48% of women were in their first pregnancy and 41% were obese. Median daily self-reported MVPA was significantly higher for both AWAS (127 min, $p < 0.001$) and RPAQ (81 min, $p < 0.001$) than that recorded by accelerometer (35 min). There was low or moderate correlation between questionnaire and accelerometer estimates of total active time (AWAS $\rho = 0.36$, $p = 0.008$; RPAQ $\rho = 0.53$, $p < 0.001$) but no significant correlation between estimates of time spent in MVPA.

Conclusions: These self-report questionnaires over-estimated MVPA and showed poor ability to discriminate women on the basis of MVPA. Accelerometry measurement was feasible and acceptable. Objective methods should be used where possible in studies measuring physical activity in pregnancy. Questionnaires remain valuable to define types of activity.

1. Introduction

There is growing interest in the potential influence of physical activity (PA) on pregnancy outcome. In non-pregnant adults, PA has beneficial effects on glucose metabolism [1]. Evidence relating to pregnancy outcomes is mixed: some studies report that higher levels of PA may reduce the risks of gestational diabetes and pre-eclampsia [2–4], but others have found no beneficial effect [5].

Most studies assessing the effect of PA on pregnancy outcome have assessed PA by self report, often assessing only recreational or leisure time activity [6,7]. Such measures rarely allow accurate assessment of light intensity activity and sedentary time, or of PA-related energy expenditure (PAEE), and may therefore be prone to misclassification. Some questionnaires have been specifically designed to overcome these limitations and to identify the duration of activity at different intensity, including sedentary time [8,9].

The development of activity monitors such as accelerometers has facilitated objective measurement of the duration and intensity of body movement. Accelerometers demonstrate a high

Abbreviations: PA, physical activity; BMI, body mass index; IPAQ, International Physical Activity Questionnaire; IQR, inter quartile range; MVPA, moderate or vigorous physical activity; RPAQ, Recent Physical Activity Questionnaire; AWAS, Australian Women's Activity Survey; PAEE, physical activity energy expenditure; MET, metabolic equivalent; UK, United Kingdom; USA, United States of America.

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http://dx.doi.org/10.1016/j.ejogrb.2013.05.018

degree of reproducibility and validity for quantifying duration and intensity of PA, and correlate with energy expenditure in a variety of populations and settings [10].

There are specific challenges to measuring PA in pregnancy. It is a time of significant physiological change, and PA tends to decline as pregnancy progresses [11,12]. The shape of the pregnant abdomen can alter the placement and tilt of any measurement devices, so affecting recording. Discomfort caused by the elastic belt and forgetting to re-attach the belt will also lead to inaccurate, incomplete data [13]. A significant proportion of PA in women with young children is derived from domestic chores and childcare, which are rarely explicitly measured by questionnaire [14]. Few PA measurement tools have been developed or evaluated for use in pregnancy. Chasan-Taber et al. developed a questionnaire specifically for use in pregnancy, but found only low to moderate correlation with accelerometry-derived estimates [15]. A small number of studies have used accelerometers in pregnancy [13,16,17]. In a study of 57 healthy primiparous women, Rousham et al. found that the correlation between self-reported (via seven day recall interview), and accelerometer-derived estimates of PA declined as pregnancy progressed [16], as did compliance with wearing the device. Harrison et al. compared accelerometry, pedometry and the International Physical Activity Questionnaire (IPAQ), in the second trimester of pregnancy [13]. They found that accelerometer and IPAQ estimates of PA did not correlate and there was poor absolute agreement.

Obese and overweight pregnant women are at higher risk of developing gestational diabetes and pre-eclampsia, and may particularly benefit from remaining physically active during pregnancy. The aim of this study was to assess the reproducibility, absolute and relative agreement of two self-completion questionnaires with objective measurement by accelerometry for the first time in overweight and obese pregnant women.

2. Materials and methods

2.1. Study population

Pregnant women aged 16 or more, with a first trimester body mass index (BMI) $\geq$ 25 kg/m^2 (based on measured weight and self-reported height), with normal first trimester ultrasound scan and singleton pregnancy were eligible for inclusion. Recruitment took place between October 2007 and January 2008 at the Royal Victoria Infirmary, a tertiary centre in Newcastle upon Tyne, UK, which had approximately 5000 deliveries per year during the recruitment period. Women were excluded if they were unable to give informed consent. Ethical approval was obtained from Durham and Tees Valley 2 Research Ethics Committee (REC reference number 07/H0908/53).

2.2. Data collection

Participants were asked to complete two separate PA questionnaires and to wear a GT1M Actigraph accelerometer for seven consecutive days, therefore including both weekend and week days. Both PA questionnaires were repeated at the end of the data collection period: these second questionnaires related directly to the seven-day time period when the accelerometers were worn, and represented the week subsequent to the first questionnaires. The second questionnaire was therefore used in the validity assessment.

2.3. Physical activity questionnaires

We selected two questionnaires which were of contrasting design and structure, to examine their validity against objective measurement of physical activity in this population group. The PPAQ was not selected, although it had been developed for use in pregnant women, since the published validation had shown relatively poor correlation with accelerometry [15].

2.4. Recent Physical Activity Questionnaire (RPAQ)

The RPAQ was designed for use in a general population and asks questions about activity in four domains: at home, at work, for transport and during leisure time [18]. Respondents are asked either to assess the number of times a particular task is performed, for example, climbing a flight of stairs, or to assess the time spent in an activity (less than 1 h, 1–2 h, 2–3 h, 3–4 h, more than 4 h). For the recreational activity section respondents are asked the number of times an activity was performed in the week and for how long in hours and minutes.

PAEE calculated from RPAQ correlates with that calculated using doubly labelled water ($r = 0.39$, $p = 0.0004$) [18]. This suggests that RPAQ is a moderately valid instrument for ranking individuals according to PAEE. For the current study, the reference time frame (four weeks) was reduced to one week because of the volatility of PA levels during pregnancy.

Estimates of PAEE for the four different domains were calculated by multiplying participation (h/day) by the metabolic cost of each activity, expressed in metabolic equivalents (MET) obtained from the Physical Activity Compendium [19]. Total PAEE was calculated by summing PAEE in each domain. Estimates of time spent at light, moderate and vigorous PA were calculated based on METs with the following cut-offs: light (1.5–2.99 METs), moderate (3–5.99 METs), and vigorous (6 or more METs). Sedentary time was defined as the remaining (non-sleep) time of the day.

2.5. Australian Women's Activity Survey (AWAS)

The AWAS was specifically designed to capture the range of activities common in women of childbearing age, especially those with caring responsibilities for children. In this questionnaire respondents are asked to assess the intensity with which they performed particular tasks, and for how long in hours and minutes. AWAS validity against accelerometry is comparable to other self-report PA questionnaires [20]. It asks respondents to estimate the daily time spent, in a typical week, on activities of specified intensities across five domains: planned activities, employment, childcare, domestic responsibilities and transport. Questionnaire responses are used to calculate average duration of sedentary, light, moderate and vigorous activity per week.

Summary variables for AWAS were obtained by multiplying estimated daily duration of self-reported activities at different intensity by reported frequency during a typical week. Thus women categorised activity intensity themselves based on the guidance given in the questionnaire schedule.

2.6. Accelerometer measurement and data reduction

GT1M Actigraph accelerometers were used to objectively measure PA and as a reference for comparison for the two questionnaires. The GT1M is a uniaxial accelerometer measuring vertical accelerations and provides detailed information about the intensity, frequency and duration of activity. In the current study, accelerations were measured over five-second epochs.

The accelerometer was attached to an elastic belt worn around the waist with the monitor positioned over the right hip. Women were asked to wear it for as much of the day as feasible, removing it for bathing, swimming and sleeping at night, and to complete a daily log indicating when and why the monitor was not worn.