

# Physical Activity Patterns During Pregnancy in a Sample of Portuguese Women: A Longitudinal Prospective Study

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## Abstract

**Background:** Physical activity (PA) patterns during pregnancy have not been explored in depth and most previous studies lack assessment of variables such as type, frequency, duration and intensity of activity.

**Objectives:** This study had two goals: 1) to analyze PA patterns during pregnancy according to weekly time spent on different types of activity; and 2) to determine women's perception about health care providers regarding PA advisement during pregnancy.

**Patients and Methods:** A longitudinal prospective study was carried out with a 118-pregnant women cohort. Participants were evaluated during all trimesters. Self-reported questionnaires were used to collect personal and obstetric data. Type, duration and frequency of PA were evaluated using the pregnancy physical activity questionnaire (PPAQ) and intensity levels were calculated. Repeated measure analysis of variance was performed to determine differences between trimesters, and Wilcoxon signed-rank test was performed when appropriate.

**Results:** A decrease in values of self-reported PA (MET.h.wk<sup>-1</sup>) was found from the first to the second and the first to the third trimester of pregnancy, respectively; total (270.91 vs 220.54 vs 210.35;  $P < 0.01$ ), light (109.45 vs 95.11 vs 92.40;  $P < 0.01$ ) and moderate intensity (81.99 vs 50.69 vs 62.94;  $P = 0.002$ ). Time spent on most activities remained fairly stable throughout pregnancy. Women spent most of their weekly time during the entire pregnancy on household and caregiving activities, occupational activities and leisure, except sport activities. Swimming was the most reported organized PA, reaching its highest proportion (12.7%) in the second trimester. Prenatal exercise classes were reported by 39.8% of women during the 3rd trimester. Pregnant women reported that PA was recommended by health professionals: 53.9% in the 1st trimester, 70.4% in the 2nd trimester and 56.8% in the 3rd trimester.

**Conclusions:** Self-reported PA decreased, especially from the first to the second trimester, in total, light and moderate intensity. Women spent most of their weekly time on domestic, occupational and leisure activities, except sport activities. There are some health care providers that do not recommend physical activity during pregnancy.

**Keywords:** Physical Activity, Pregnant Women, Longitudinal Study

## 1. Background

Regular Physical Activity (PA) is promoted for its overall health benefits, particularly in the prevention of chronic diseases and unhealthy weight gain (1).

During pregnancy, the key components that promote a healthy lifestyle include appropriate PA and weight gain (2). Epidemiologic studies have found that women who are more active during pregnancy may have reduced risk of morbidity such as chronic musculoskeletal conditions, gestational diabetes, hypertensive disease (3, 4), preeclampsia and urinary incontinence, as well as better psychological adjustment to pregnancy changes (5, 6). Moreover, it has been suggested that habits adopted during pregnancy could affect a woman's health for the rest of her life (7).

Recommendations concerning exercise during pregnancy have evolved throughout the years (8). Traditional medi-

cal advice has encouraged women to reduce their levels of exertion in pregnancy, based on concerns that exercise could negatively affect pregnancy outcomes or increase the risk of maternal musculoskeletal injury (8, 9).

The American college of obstetricians and gynecologists (ACOG) and Centers for disease control and prevention/American college of sports medicine (CDC/ACSM) guidelines suggest 30 minutes or more of moderate-intensity activity on most days of the week, yet they differ on the type of activity, as ACOG recommends only exercise, and CDC/ACSM recommends any type of PA (6, 10, 11). However, some retrospective studies have suggested that PA among pregnant women declines for recreational, occupational and overall PA (6, 12). Since pregnancy is a life-changing event, associated with social, psychological, behavioral and biological changes, it may not be surprising

that it has been identified as a contributing factor for the decline in exercise among women (6).

However, the current status of physical activity (PA) patterns during pregnancy have not been explored in depth and most previous studies lack assessment of variables such as type, frequency, duration and intensity of activity (6, 13). Besides, little is known about the health care providers attitude regarding the most recent guidelines. The pertinence of this study lies on the need to understand PA patterns and type of tasks performed by pregnant women, so that models of health promotion adjusted to reality and needs of these women could be created.

## 2. Objectives

Thus, this study aimed: 1) to analyze PA patterns during pregnancy according to weekly time spent on different types of activity; and 2) to determine women's perception about health care providers regarding physical activity (PA) advisement during pregnancy.

## 3. Patients and Methods

### 3.1. Study Design and Sample

A longitudinal prospective study was carried out with a cohort drawn from a consecutive sample of pregnant women who were seeking prenatal care at eleven health care centers located in the Minho region of Portugal, throughout September 2009 to November 2011. Almost all women (98.7%) in Portugal attended routine prenatal visits in these health maternal centers (14). The sample size was based on already known changes in total physical activity (15). Assuming a power of 80% and  $\alpha = 0.05$ , the estimated sample size was 34. To enable a response rate of 60%, expected for the questionnaire and a dropout rate of approximately 20%

to 25%, at least 58 women were to be recruited.

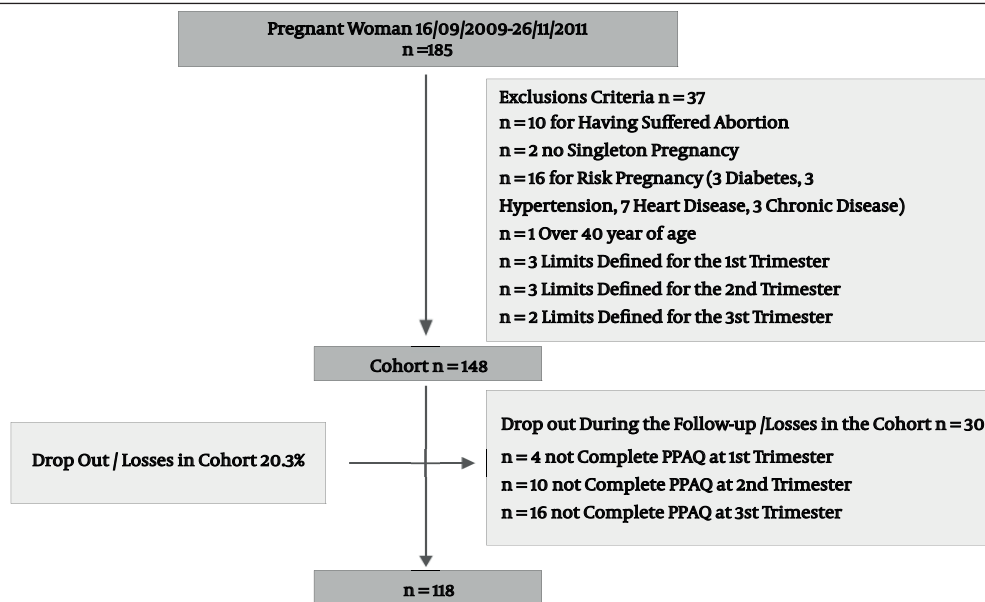
Next, the number of women to be assessed by each health center, based on the average number of births per year, was calculated.

Nurses had identified women with confirmed pregnancies in the first trimester (< 12 weeks of gestation) and invited them to participate in the study. Women who agreed were reassessed during their second (12 to 28 weeks) and third trimester (> 28 weeks). Reassessments were always scheduled from one trimester to the other to coincide with maternal health routine consultations.

All women had an identification code in the pregnant health bulletin. This identification code contained all questionnaires that were given to each woman so as to allow pairing of the questionnaires. The same code was on the follow-up table that each nurse monitored. Women who missed the scheduled day were contacted by phone to reschedule the assessment and in case of a second absence, a home visit was made to ensure reassessment and avoid losses in the follow up.

Women were considered ineligible if they had any of the following characteristics: diabetes, hypertension, heart disease or chronic disease, no singleton pregnancy, age of less than 18 or over 40 years old, lack of competence in the Portuguese language or cognitive inability to answer a questionnaire (16, 17).

One hundred and eighty-five women were eligible for inclusion in the present sample (Figure 1). Thirty-seven women were excluded and the net sample consisted of 118 pregnant women. There were no significant differences between the net sample and losses; the two groups had similar baseline characteristics in terms of age, pre-pregnancy body mass index (BMI), educational level, monthly income and number of gestations.



**Figure 1.** Chart of Exclusions and Losses in the Cohort (PPAQ- Pregnancy Physical Activity Questionnaire)

### 3.2. Assessment Instruments

Data were collected during each trimester of pregnancy by trained nurses, who administered, structured and self-reported questionnaires. Questionnaires were designed to cover personal and socio-demographic data, lifestyle variables, and health status during pregnancy and gynecologic history. The validity of the questionnaires was verified by experts, who offered comments that were used to make amendments to the original surveys and generate final versions.

Pre-pregnancy BMI was estimated from self-reported pre-pregnancy weight and height, using the following Equation:

$$\text{BMI} = \frac{\text{weight}(\text{kg})}{\text{height}^2(\text{m}^2)}$$

Pre-pregnancy BMI was categorized according to the Institute of Medicine guidelines. These guidelines were also used to assign groups by weight gain (18, 19).

Professional status was assessed and subjects were divided into three categories: employed (full time), unemployed and student. Since there were only two subjects in the student category, these subjects were pooled with members of the employed category. Respondents were asked to estimate total income (including pensions, allowances and investments) received by all household members in the last month and to indicate the total, using a single measure comprised of three narrowly-ranged income categories. For the educational level variable, subjects were divided into three categories, reflecting the organization of the Portuguese educational system: mandatory or less ( $\leq 9$  school years), secondary (10 to 12 school years) and college/university ( $> 12$  school years). Concerning the number of gestations, women were considered primigest if this was their first gestation and multigest if they had at least one previous gestation.

The percentage of health professionals who had advised PA during pregnancy was calculated by affirmative answers to the following question: during this trimester of pregnancy, were you advised by a health professional to do physical activity (walking, hiking, swimming, etc.)?

### 3.3. Physical Activity Measurement

PA levels were determined using the pregnancy physical activity questionnaire (PPAQ), a self-reported questionnaire that evaluates PA type, duration and frequency performed by pregnant women. Each activity was classified according to intensity; sedentary ( $< 1.5$  METs), light (1.5 - 3.0 METs), moderate (3.1 - 6.0 METs) or vigorous ( $> 6.0$  METs), and according to type; household/caregiving, occupational and sports/exercise. Questions about two more types of activity were added to the original PPAQ questions: leisure except sports and transportation (leisure except sport = sum of [duration  $\times$  intensity] for questions 11, 12, 13, 14 and transportation = sum of [duration  $\times$

intensity] for questions 20, 21, 22). Time reportedly spent on each activity was multiplied by activity intensity, to achieve a measure of weekly energy expended on average (MET hours.week<sup>-1</sup>). The PPAQ was validated by Chasan-Taber et al. (17).

The PPAQ has been translated for the Portuguese population and has a reliability value for interclass correlation coefficients (ICC), which varies between 0.815 for moderate to 0.949 for sedentary physical activity (unpublished).

### 3.4. Procedures

Meetings were held with nurses of the eleven units of the health center to present the manual of procedures designed to standardize data collection and monitoring procedures.

Questionnaires were individually administered during maternal health consultations that were held during each pregnancy trimesters and returned to the nurse in a sealed envelope. In the first month, weekly telephone contact was established with the nurses in the field by the main researcher; from this point, contact was established monthly.

### 3.5. Ethics

This study was approved by the ethics committee and administrative council of local health unit of Alto Minho (11/08/2009); it was conducted in accordance with the world medical association Helsinki declaration for human studies. All participants provided a written informed consent.

### 3.6. Statistics

Descriptive data were presented as means and standard deviations or median and interquartile range, unless otherwise stated. Associations between variables were analyzed via statistical inference; specifically the chi-square test or Fisher's exact test. Yates continuity correction was used for analysis of  $2 \times 2$  contingency tables.

Repeated measure analysis of variances for continuous variables was performed to assess the difference between first, second and third trimesters, and Friedman test was performed when appropriate. When Friedman test was significant, we used the Wilcoxon signed-rank test to assess differences between pairs of trimesters.

Statistical significance was defined as a P value of  $< 0.05$ . Statistical analysis was conducted using the PASW® statistical software v.18 (SPSS, Chicago, Illinois, USA).

## 4. Results

The baseline characteristics of the sample are shown in Table 1. About half of the women had only mandatory or less education; 86.4% were married or cohabitate, 78.0% were employed full time, and 74.5% had monthly family incomes below 1250 €, a figure equivalent to 2.5 times the national minimum wage. Half of the women were primigest and 34.2% were overweight/obese prior to becoming pregnant.

#### 4.1. Intensity and Type of Physical Activity

Mean or median levels of PA by intensity and type are shown in Table 2. We found a decrease in values of self-reported PA from the first to the second, and the first to the third trimester of pregnancy, respectively; total (270.91 vs 220.54 vs 210.35;  $P < 0.01$ ), light (109.45 vs 95.11 vs 92.40;  $P < 0.01$ ) and moderate intensity (81.99 vs 50.69 vs 62.94;  $P$

= 0.002). Regarding the type of activity, there was only a significant decrease in household/caregiving and occupational activities. These decreases occurred essentially from the first to the second trimester, and there were no significant differences from the second to the third trimester.

**Table 1.** Descriptive Characteristics of the Sample at Baseline<sup>a</sup>

Socio-Demographic and Obstetric Characteristics	N	Total
<b>Age, y</b>	118	
(18, 30)		76 (64.4)
(31, 40)		42 (35.6)
<b>Educational level</b>	118	
Mandatory or less		58 (49.2)
Secondary		44 (37.3)
College/University		16 (13.5)
<b>Marital status</b>	118	
Married/Cohabitate		102 (86.4)
Single/Divorced		16 (13.6)
<b>Professional status</b>	118	
Employed /Student		92 (78.0)
Unemployed		26 (22.0)
<b>Monthly Income, €</b>	102	
< 500		29 (28.4)
500 - 1250		47 (46.1)
≥ 1250		26 (25.5)
<b>Pre-pregnancy BMI</b>	117	
Underweight		4 (3.4)
Normal Weight		73 (62.4)
Overweight/ Obese		40 (34.2)
<b>Number of gestations</b>	118	
Primigest		59 (50.0)
Multigest		59 (50.0)

Abbreviation: BMI, body mass index.

<sup>a</sup>Results expressed as No. (%).

**Table 2.** Mean Score Values (MET.h.wk<sup>-1</sup>) for the Three Self-Administered Pregnancy Physical Activity Questionnaires (PPAQs) During the First, Second and Third Trimesters by Activity Intensity and Type, Among 118 Pregnant Subjects

Physical Activity	1st Trimester	2nd Trimester	3rd Trimester	P Value
<b>Intensity</b>				
Total <sup>a</sup>	270.915 (145.405)	220.541 (117.946) <sup>b</sup>	210.348 (116.753) <sup>b</sup>	< 0.001 <sup>c</sup>
Sedentary <sup>a</sup>	51.904 (35.064)	47.283 (32.184)	46.937 (30.192)	0.053 <sup>c</sup>
Light <sup>d</sup>	109.463 (83.13)	95.113 (50.18) <sup>b</sup>	92.400 (73.24) <sup>b</sup>	< 0.001 <sup>e</sup>
Moderate <sup>d</sup>	81.988 (113.14)	50.688 (86.95) <sup>b</sup>	62.925 (93.86) <sup>b</sup>	0.002 <sup>e</sup>
Vigorous <sup>d</sup>	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.895 <sup>e</sup>
<b>Type</b>				
Household/Caregiving <sup>a</sup>	115.085 (71.532)	97.530 (60.679)	96.509 (68.502) <sup>b</sup>	0.001 <sup>c</sup>
Occupational <sup>d</sup>	100.713 (55.61)	85.663 (47.34) <sup>b</sup>	87.763 (45.63)	0.034 <sup>e</sup>
Sports/Exercise <sup>d</sup>	0.800 (6.51)	1.950 (5.74)	2.925 (9.14)	0.105 <sup>e</sup>
Leisure Except Sport <sup>a</sup>	24.897 (19.116)	24.439 (18.285)	24.439 (17.710)	0.502 <sup>c</sup>
Transportation <sup>d</sup>	19.250 (18.16)	15.750 (18.16)	14.000 (20.13)	0.758 <sup>e</sup>

<sup>a</sup>Data are presented as mean (standard deviation).

<sup>b</sup> $P < 0.05$ , compared to 1st trimester.

<sup>c</sup>P-values were calculated using repeated measure analysis of variance.

<sup>d</sup>Data are median (IQR).

<sup>e</sup>P-values were calculated using Friedman test.

## 4.2. Time Spent per Task by Type of Activity

We found that women spend most of their weekly time during the entire pregnancy on household and caregiving activities (preparing meals, shopping and light cleaning, occupational activities), standing or slowly walking at work

not carrying anything and sitting at working or in class, as well as watching TV or video, considered as leisure except sport activities. These were also the tasks for which almost all women reported to spend time on, each week (Table 3).

**Table 3.** Median and Range for Time Spent (H.Wk<sup>-1</sup>) Per Task by Type of Activity During the First, Second and Third Trimesters and Reported Percentage of Any Activity for Self-Administered Pregnancy Physical Activity Questionnaires (PPAQs)

Type	Physical Activity	1st Trimester		2nd Trimester		3rd Trimester	
		Any Activity, % <sup>a</sup>	Median (Range), h.wk <sup>-1</sup>	Any Activity, % <sup>a</sup>	Median (Range), h.wk <sup>-1</sup>	Any Activity, % <sup>a</sup>	Median (Range), h.wk <sup>-1</sup>
<b>Household/Caregiving, h/w</b>							
4. Preparing meals (Cooking, setting the table, washing dishes)	L	97.5	10.50 (21.0)	99.2	10.50 (21.0)	98.3	10.50 (21.0)
5. Dressing, bathing and feeding children while sitting	L	44.9	0.00 (17.5)	43.2	0.00 (17.5)	39.8	0.00 (10.5)
6. Dressing, bathing and feeding children while standing	M	51.7	0.00 (17.5)	48.3	0.00 (21.0)	49.2	0.00 (17.5)
7. Playing with children while sitting or standing	L	64.4	1.75 (21.0)	61.9	1.75 (17.5)	59.3	1.75 (21.0)
8. Playing with children while walking or running	M	44.9	0.00 (21.0)	39.0	0.00 (17.5)	38.1	0.00 (21.0)
9. Carrying children	M	42.4	0.00 (21.0)	35.6	0.00 (5.25)	30.5	0.00 (5.25)
10. Taking care of an older adult	M	21.2	0.00 (21.0)	20.3	0.00 (21)	19.5	0.00 (21)
15. Light cleaning (bed making, laundry, ironing and putting things away)	L	98.3	10.50 (21.0)	87.3	10.50 (19.25)	100	5.25 (19.25)
16. Shopping (food, clothes, or other items)	L	96.5	5.25 (21.0)	99.2	5.25 (21.0)	99.2	5.25 (21.0)
17. Heavier cleaning (vacuuming and sweeping)	L	97.5	1.50 (3.0)	95.8	1.50 (3.0)	94.1	0.75 (3.0) <sup>b,c</sup>
18. Mowing the lawn while riding a mower	L	4.2	0.00 (0.75)	2.5	0.00 (1.5)	6.8	0.00 (3.0)
19. Mowing the lawn using a walking mower, raking and gardening	M	24.6	0.00 (3.0)	20.3	0.00 (3.0)	21.2	0.00 (3.0)
<b>Occupational, h/w</b>							
32. Sitting at working or in class	S	73.0	8.75 (42.0)	73.4	8.75 (42.0)	76.9	21.0 (42.0)
33. Standing or slowly walking at work while carrying things (heavier than a 1 gallon milk jug)	M	66.3	1.75 (42.0)	67.1	1.75 (42.0)	67.7	1.75 (42.0)
34. Standing or slowly walking at work, not carrying anything	L	85.4	8.75 (42.0)	91.1	8.75 (42.0)	95.4	8.75 (42.0)
35. Walking quickly to work while carrying things (heavier than a 1 gallon milk jug)	M	40.4	0.00 (42.0)	32.9	0.00 (35.0) <sup>b</sup>	35.4	0.00 (35.0) <sup>c</sup>
36. Walking quickly to work not carrying anything	M	52.8	1.75 (42.0)	59.5	1.75 (42.0)	52.3	1.75 (42.0)
<b>Sports/Exercise, h/w</b>							
23. Walking slowly for fun or exercise	M	57.6	0.25 (3.0)	66.1	0.25 (3.0)	69.5	0.25 (3.0)
24. Walking more quickly for fun or exercise	M	28.8	0.00 (3.0)	30.5	0.00 (2.5)	28.8	0.00 (3.0)
25. Walking quickly up hills for fun or exercise	V	16.9	0.00 (1.5)	17.8	0.00 (1.5)	22.9	0.00 (1.5)
26. Jogging	V	4.2	0.00 (1.5)	2.5	0.00 (2.5)	2.5	0.00 (0.25)
27. Prenatal exercise	M	4.2	0.00 (1.5)	10.2	0.00 (2.5)	39.8	0.00 (3.0) <sup>b,c</sup>
28. Swimming	M	9.3	0.00 (3.0)	12.7	0.00 (3.0)	8.5	0.00 (3.0)
29. Dancing	M	9.3	0.00 (2.5)	8.5	0.00 (0.75)	8.5	0.00 (1.5)
<b>Leisure Except Sport, h/w</b>							
11. Sitting and using a computer or writing, while not at work	S	60.2	1.75 (21.0)	68.6	1.75 (21.0)	78.0	1.75 (21.0)
12. Watching TV or a video	S	98.5	8.75 (21.0)	97.5	8.75 (21.0)	98.3	8.75 (35.0)
13. Sitting and reading, talking, or on the phone, while not at work	S	86.4	1.75 (42.0)	90.7	1.75 (35.0)	92.4	1.75 (21.0)
14. Playing with pets	M	26.3	0.00 (10.5)	17.8	0.00 (5.25)	19.5	0.00 (5.25)
<b>Transportation, h/w</b>							
20. Walking slowly to go places (such as to the bus, work, visiting others) not for fun or exercise	L	80.0	1.75 (21.0)	70.7	1.75 (21.0)	79.7	1.75 (17.5)
21. Walking quickly to go places (such as to the bus, work, or school) not for fun or exercise	M	55.1	1.75 (21.0)	47.5	0.00 (5.25)	39.0	0.00 (10.5) <sup>b</sup>
22. Driving a car or bus	S	90.7	5.25 (21.0)	89.8	5.25 (17.5) <sup>b</sup>	90.7	5.25 (21.0) <sup>b,c</sup>

Abbreviations: I, Classification of Intensity for each task based on the PPAQ instructions, L, Light; M, Moderate; S, Sedentary; V, Vigorous.

<sup>a</sup>Percentage of participants that reported any physical activity in mode of type.

<sup>b</sup>P < 0.05, compared to the 1st trimester.

<sup>c</sup>P < 0.05, compared to the 2nd trimester (P-values calculated using the Wilcoxon signed-rank test).



We also found that women spent very little time on sports/exercise related activities whether for fun, exercise or sport. Walking slowly for fun or exercise was also an activity for which most women reported to spend time (57.6%, 66.1% and 69.5% of women in the first, second and third trimesters, respectively). However, over half of these women spent less than 0.25 (0.375) h.wk<sup>-1</sup> on this activity during their pregnancy. Swimming was the most reported organized PA, reaching its highest proportion (12.7%) in the second trimester. Prenatal exercise classes were reported by 39.8% of women during the 3rd trimester.

Time spent on most activities remained fairly stable throughout pregnancy, regardless of type. A significant decrease was found in the amount of time spent on heavier cleaning, walking quickly to go places not for fun or exercise and playing with pets ( $P < 0.05$  for all). Significant differences were also found in the amount of time spent walking quickly at work while carrying things as well as driving or riding a car or bus ( $P < 0.05$ ). Prenatal exercise classes were the only activity for which women spent significantly increased amounts of time during the third trimester ( $P < 0.05$ ).

Concerning occupational activities, among the female employees (78%), three were on sick leave during the first, five during the second and 12 during the third trimester. Moreover, we found that among the 12 women who were on sick leave in the third trimester, most of them had physically demanding jobs (four factory workers, three cooks and five cleaners).

#### 4.3. Women's Perception about Healthcare Providers

We found that at least about a third of health professionals had not yet recommended PA during pregnancy. Among those who recommend PA, they had done so mainly during the second trimester (70.4%), followed by the third (56.8%) and first (53.9%).

## 5. Discussion

The present study showed a significant decrease in total PA levels especially from the first to the second trimester of pregnancy, as previously described by some authors (6, 13, 15, 20).

A progressive decrease in light and moderate self-reported values of PA throughout pregnancy was found. Although this decline can be explained by hormonal, cardiorespiratory and musculoskeletal changes that occur during pregnancy, resulting in a lower tolerance to effort for pregnant women (2), our results might be considered undesirable in terms of public health considering the most recent guidelines of CDC-ACSM (11). Nonetheless, other authors also found a decrease in the "fairly light" intensity category (6).

Our findings also suggest that household/caregiving activities and other obligatory activities (e.g., occupational and transportation), which decreased from the first to

the second trimester, were those that contributed the most to energy costs until late in pregnancy. On the other hand, sports/exercise-related activities were not important contributors of energy expenditure.

Some studies have found that mean total domestic activity ratios did not change significantly across pregnancy (15, 21) while others reported a decrease, as seen in our study (6, 13, 22). A decline was also found in occupational (13, 22), recreational (6, 13, 22), transportation (13, 22) and sports and exercise (22) activities, although women tend to remain active in occupational and recreational activities (6).

Regarding time spent per task, we found that women spent most of their weekly time during the pregnancy on household and caregiving activities, occupational activities, and leisure activities except sport activities. Also other works, household and family (6, 13, 21), as well as recreational activities (6, 13) made up a major portion of women's activities.

We also observed that time spent on most activities remained fairly stable throughout pregnancy, regardless of type. Considering household and caregiving activities, this trend was not present for heavier cleaning, where a decrease in the amount of time spent on this activity during pregnancy was found. On the other hand, we found that time spent on light cleaning tasks did not change until late in pregnancy.

The same was found by other studies mainly in late pregnancy, which has sometimes been referred to as the "nesting effect", as pregnant women prepare their home for the arrival of a new baby (15, 23). Activities involving childcare were performed by about half of women, which is in agreement with the characteristics of the sample (50% primigest).

Regarding occupational activities, we found that time spent on these tasks remained unchanged throughout pregnancy, with the exception of walking quickly at work while carrying things. The number of women on sick leave quadrupled from the first to the third trimester and most of them had physically demanding jobs (data not shown). Indeed, women involved in physically strenuous jobs tended to change their duties to something less intense and were more likely not to work at all during the third trimester compared with women in less physically demanding jobs (23).

Concerning leisure time PA (except sports), a high percentage of women reported watching TV or videos and a large amount of time was spent on this sedentary activity, considering that less than one quarter of the sample was unemployed. These findings are in agreement with other studies (6, 13, 15, 24) and thus, sedentary activities may be the target of intervention for enhancing PA levels, since it is not expected for women to change their domestic and occupational tasks (6, 13).

We found that women did not have sport habits during the entire pregnancy and a few were those who engaged in structured PA. These findings are consistent with previ-

ous studies (15, 23, 25, 26). We also found that despite being a relatively recent practice (15), more than one third of women engaged in exercise prenatal classes in the third trimester, which make us think that the main issue relates to generating opportunities for exercise during pregnancy.

Concerning health care providers and health promotion, we found that despite CDC-ACSM and ACOG recommendations encouraging pregnant women to exercise, there is still a considerable proportion of health care providers that do not recommend PA during pregnancy, mainly in the first trimester and we identified that the decline of PA occurred between the first and the second trimester. A change in the attitude of health caregivers is expected (13, 27, 28) that will promote earlier counseling on PA in prenatal and pregnancy services, given the potential benefits of exercise for the reduction of obstetric risk, postpartum weight retention and childhood obesity, (19) and for the improvement of long-term health and normalization of infant birth weight, as well as the lack of evidence of harmful effects on the mother and newborn.

We are aware that physiological and anatomical changes that occur during pregnancy could plausibly contribute to PA being less attractive and more difficult to perform. Besides, reductions in PA could be a method for pregnant women to meet the increasing energy demands of pregnancy, especially during the third trimester (23). However, pregnant women are particularly concerned about the health of their unborn baby and are in frequent contact with their health care providers, so this may be a powerful source for the promotion of healthy behaviors (27, 29, 30). Moreover, women are a role model for their new child and may even positively influence the whole family. Thus, pregnant women are a key element in the promotion of individual, familiar and community health (29).

Our study was strengthened by its prospective design and large cohort. We have evaluated all the major dimensions of PA. Besides, we quantified routine PA levels of pregnant women in a free-living environment and did not impose a predetermined exercise program. The decline in activity found in our study is unlikely to be attributable to seasonal changes, since the study ran from September 2009 to November 2011 and recruitment was staggered over a 12-month period (17).

Nevertheless, the findings of this study might present certain limitations. Firstly, self-reported measure of physical activity may lead to potential misclassification that would tend to bias the results towards the null and other biases such as social desirability. However, this concern was minimized through the use of a PPAQ, developed and validated for the targeted population.

Secondly, MET values assigned for each activity were not specific to pregnant women, but rather standardized for an average adult, thus the activity levels may have been underestimated. Finally, PA during pregnancy may not be stable within a trimester, due to rapid changes in the

mother's body. Thus, it is important to evaluate PA changes during the entire trimesters and not only in a single determined moment.

There is a need for well-designed longitudinal investigations that should document pregnancy-related changes in PA at frequent intervals during pregnancy using validated and more precise measures such as accelerometers that use non-pregnant controls.

Self-reported PA decreased especially from the first to the second trimester of pregnancy in total, light and moderate intensity. Women spent most of their weekly time on domestic, occupational and leisure (except sport) activities. There are still some health care providers that do not recommend PA during pregnancy. These findings can be used to design culturally appropriate interventions for the reduction of pregnancy complications through the promotion of PA during pregnancy.

Pregnancy may be a powerful source for the promotion of healthy behaviors. Thus, health care providers should encourage healthy pregnant women to remain active during pregnancy and efforts should be made towards creating opportunities for exercise such as prenatal classes.

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## Footnotes

**Authors' Contribution:** Paula Clara Santos and Sandra Abreu made substantial contributions to conception and design of the data. Paula Clara Santos, Sandra Abreu and Carla Moreira carried out the data collection, statistical analysis, interpretation of the data, and wrote the manuscript. Paula Clara Santos, Sandra Abreu, Carla Moreira, Rute Santos, Odete Alves, Margarida Ferreira, Pedro Moreira and Jorge Mota were involved in drafting of the manuscript. All authors read and approved the final manuscript.

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