Physical activity levels in the second trimester of pregnancy and related demographic factors: A cross-sectional secondary data analysis

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Abstract: Background: Adequate amounts of physical activity during pregnancy have been recognized to have good effects on fetal growth and prevention of pregnancy complications. Aims: This study aimed to examine physical activity levels in the second trimester of pregnancy according to intensity and type of activity, and to identify factors related to physical activity levels. Methods: We utilized the baseline data of the cohort study for our analysis. These data included records of healthy women in the second trimester, undergoing treatment at a university hospital in Tokyo, between 2010 and 2012. Physical activity levels were assessed using a pregnancy physical activity questionnaire. Demographic variables including age, pre-pregnancy body mass index, parity, working status, and education levels were obtained using a self-administered questionnaire. The Mann–Whitney U test or Kruskal–Wallis test was performed to investigate differences in physical activity levels according to demographic variables. Multiple linear regression analysis was conducted to identify the related factors to total physical activity levels. Results: A total of 461 women were analyzed. The mean (standard deviation) of total physical activity level was 22.2 (9.6) metabolic equivalents·hour/day. In a multiple linear regression analysis, multigravidae (β = 0.510) and working women (β = 0.334)

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PUBLIC INTEREST STATEMENT
Adequate amounts of physical activity during pregnancy have a positive impact on gestational weight gain control and prevention of pregnancy complications. The recommended physical activity includes working and household as well as exercise. Physical activity levels and activity type are influenced by individual characteristics. However, demographic characteristics that are associated with physical activity levels have been unclear for pregnant Japanese women. The present study identified that multigravidae and working women had significantly higher total physical activity levels, and indicated that working multigravidae had about twice as much total physical activity level as non-working primigravidae during the second trimester in Japan. The results would be useful for healthcare professionals to identify the high-risk population with deficient physical activity levels and estimate physical activity levels in the second trimester, in consideration with demographic characteristics.
had significantly higher total physical activity levels. Working multigravidae had more than twice as much total physical activity level as non-working primigravidae. 

Conclusions: Parity and working status strongly influence on physical activity levels in the second trimester among Japanese women. The results would be useful for healthcare professionals to estimate physical activity levels in consideration of demographic characteristics.

Subjects: Antenatal Care; Maternal and Child Health; Community Health

Keywords: parity; physical activity; pregnancy; working women

1. Introduction
Physical activity during pregnancy has a positive impact on gestational weight gain control and prevention of pregnancy complications, such as gestational diabetes mellitus and hypertensive disorders of pregnancy (Sanabria-Martínez et al., 2015; Spracklen, Ryckman, Triche, & Saftlas, 2016). Adequate physical activity improves insulin resistance of both skeletal muscle and adipose tissue and lowers blood glucose levels (Bouchard & Katzmarzyk, 2010; Ramirez-Vélez et al., 2011). It also has been proposed to reduce high blood pressure by improving vascular endothelium function, promoting placental growth, and reducing oxidative stress (Genest, Falcao, Gutkowska, & Lavoie, 2012). In addition, an inverted u-shaped association between physical activity during pregnancy and birth weight has been reported (Bisson, Lavoie-Guénette, Tremblay, & Marc, 2016). Moderate amounts of physical activity were associated with an increased birth weight, whereas both low and high amounts of physical activity were associated with a decreased birth weight.

Exercise is often viewed as a method to increase physical activity. In Japan, the guideline for safety in sports during pregnancy limits exercise up to 60 min per day, 2 or 3 times per week (Japanese Society of Clinical Sports Medicine, 2004). Another guideline focuses on conditions that could contraindicate exercise during pregnancy and a non-recommended sporting activity (Japan Society of Obstetrics and Gynecology and the Japan Association of Obstetricians and Gynecologists, 2017). These guidelines recommend regular exercise for healthy pregnant women. However, due to the restrictions on exercise, some physicians do not proactively recommend exercise for pregnant women in clinical settings in Japan (Haruna et al., 2010). Meanwhile, other developed countries, such as USA, UK, and Canada, recommend that pregnant women engage in at least 150 min of moderate intensity activity per week to aid in weight management, improve or maintain physical fitness, and reduce the risks of pregnancy complications (Government of Canada, 2012; NICE, 2010; The American College of Obstetricians and Gynecologists, 2015). Most physicians in other countries seem to have positive attitudes regarding exercise recommendation (McGee et al., 2018). These guidelines place a greater emphasis on exercise than on day-to-day activities. In recent years, however, the World Health Organization defines physical activity as any bodily movement produced by skeletal muscles that requires energy expenditure (World Health Organization, 2014), and reported the health benefits of any bodily movement, especially moderate or vigorous-intensity activity. The recommended moderate-intensity physical activity includes working and household (e.g. domestic chores, gardening, carrying moderate loads, and active involvement in games with children) as well as exercise (e.g. brisk walking).

In addition, the day-to-day activities performed by women during pregnancy contribute significantly towards the overall levels of physical activity. Therefore, it is important to consider routine activities including performing household chores, caregiving, and working. In the case that pregnant women do not meet the sufficient daily physical activity levels, they need to increase physical activity in daily life or participate in exercise. Thus, healthcare professionals must vary the advice regarding physical activities based on an individual’s physical activity levels.
Physical activity levels and activity type are influenced by individual characteristics, such as parity and education levels (Nascimento, Surita, Godoy, Kasawara, & Morais, 2015). However, demographic characteristics that are associated with physical activity levels and the amount of the difference in physical activity levels according to the characteristics have been unclear for pregnant Japanese women. Clarifying them may help to identify the high-risk population with deficient physical activity levels. In addition, showing numeric differences in physical activity levels according to demographic characteristics would be useful for healthcare professionals to estimate daily physical activity levels, and make advice regarding daily physical activities or exercise in consideration with individual background.

The aims of the present study were to identify the demographic characteristics related to physical activity levels of Japanese women in the second trimester of pregnancy and to show the numeric differences in physical activity levels classified by their characteristics.

2. Methods

2.1. Study design and participants
The data used in this study were derived from a different cohort study (Haruna, Shiraishi, Matsuzaki, Yatsuki, & Yeo, 2017). The cohort study was based on data obtained from healthy pregnant women. Prior to using the data, consent from authors of the cohort study was obtained. Healthy Japanese women at 16–27 weeks of gestation with singleton pregnancies were recruited at an obstetrical outpatient area of a university hospital in Tokyo, Japan, between June 2010 and April 2012. The university hospital is certified as a perinatal mother and child medical center as well as an emergency center, and has approximately 900 births per year. In Japan, counselling sessions to promote a healthy diet and physical activity during pregnancy are provided at around 20 weeks of gestation. Women in the second trimester often experience lifestyle changes and physical symptoms due to the enlarged uterus. Therefore, counselling during this period is important to ensure that appropriate instructions regarding diet and weight control are being followed. As a result, the second trimester was considered as a suitable period for our investigation. To avoid the excessive burden associated with research participation, patients with hyperemesis, hypertension, threatened preterm delivery, severe psychological diseases, or an abnormal condition of the fetus were excluded. The following women were also excluded: women less than 20 years of age and those with inadequate Japanese literacy skills. All participants were provided with written and verbal information about the study protocol. Written informed consent was obtained from all participants. The ethics committee of the research hospital approved the study procedures and protocol (No. 3812).

2.2. Procedures
Participants answered a questionnaire while waiting for a medical checkup during their second trimester. In the case that participants did not have sufficient time to complete the questionnaires, they filled out the questionnaires after returning home, and submitted them by mail within 7 days. Instances of missing information and unclear data were resolved via telephone interviews.

2.3. Instruments
Demographic variables such as age, height, pre-pregnancy weight, marital status, parity, working status, education levels, the presence of pregnancy-associated nausea, and smoking habits were collected, using a self-administered questionnaire. Working was defined as women working or studying at school in the present study. Completed education levels were classified into two categories: high school or junior college, and university or above. We calculated pre-pregnancy body mass index (BMI) from self-reported pre-pregnancy weight and height. Participants were classified into three levels according to the obesity diagnostic criteria of Japan Society for the Study of Obesity: BMI < 18.5 kg/m², 18.5 ≤ BMI < 25.0 kg/m², and 25.0 kg/m² ≤ BMI.
Physical activity was measured using a modified Japanese version of the Pregnancy Physical Activity Questionnaire (PPAQ-J) (Chasan-Taber et al., 2004; Matsuzaki et al., 2010), which is the only validated instrument designed specifically to assess the physical activity of pregnant Japanese women (Matsuzaki et al., 2014). The original PPAQ that was developed in the United States has been translated into several languages such as French, Polish, and Vietnamese, and has been used broadly worldwide (Chandonnet, Saey, Alméras, & Marc, 2012; Ota et al., 2008; Wojtyła, Kapka-Skrzypczak, Paprzycki, Skrzypczak, & Bilinski, 2012). The PPAQ-J is a semi-quantitative questionnaire to determine the time spent participating in 33 activities, categorized into 5 types: household/caregiving (13 items), occupation (5 items), sports/exercise (8 items), transportation (4 items), and inactivity (3 items). For each activity, participants were asked to select a category for the amount of time spent performing that activity per day or week during the preceding 1-month period. The intensity of each activity was based on field-based measurements of pregnant women and the year 2000 version of the compendium-based metabolic equivalent (MET) values (Ainsworth et al., 2011). Each activity is classified by its intensity into four categories: sedentary (<1.5 METs), light (1.5 to <3.0 METs), moderate (3.0 to < 6.0 METs), and vigorous (≥ 6.0 METs). For instance, the intensity of walking as a physical activity is 3.0METs. If a woman walks for half an hour in a day, the physical activity level is 1.5 METs hours per day (METs·h/d). The total physical activity levels were calculated as a summation of all activities of a light intensity and above.

2.4. Statistical analyses

We estimated a total sample size of 414 women for an expected effect size of 0.30 and power of 0.80 at an alpha of 0.05, based on total physical activity levels reported in a previous study (Matsuzaki et al., 2014). This statistical power analysis was conducted using G-Power version 3.1.

Physical activity levels were compared according to demographic characteristics using the Mann–Whitney U test or Kruskal–Wallis test. In addition, multiple linear regression analysis was performed to examine variables related to total physical activity levels during pregnancy. The variables with \( P < 0.05 \) in the univariate analysis were selected as independent variables for multiple linear regression analysis. These variables were checked for multicollinearity.

Statistical analyses were conducted using the IBM Statistical Package for Social Sciences for Windows version 24.0 (IBM Japan, Tokyo, Japan). The level of statistical significance was determined with \( P < 0.05 \) (2-tailed) for all tests.

3. Results

A total of 605 pregnant women met the inclusion criteria. Of these women, 514 (85.0%) gave their written informed consent, and 479 (79.2%) responded to questionnaires. Eighteen women with missing data were excluded from the analysis. Ultimately, data from 461 healthy pregnant women (76.2%) were analyzed.

The participant characteristics are shown in Table 1. The rates of working women were significantly higher in primigravidae than in multigravidae (53.7% vs. 37.4%, respectively, \( P = 0.001 \)). Working women were more likely to complete a university or higher education institution (\( P < 0.001 \)).

The mean (standard deviation) level of total physical activity in the second trimester was 22.2 (9.6) METs·h/d (Table 2). Total physical activity levels had a normal distribution. The median level of moderate and vigorous-intensity activities was approximately 3.0 METs·h/d, and 198 (43.0%) women performed at least 150 min per week of moderate or vigorous activity (99 in primigravidae and 99 in multigravidae). There were 336 (72.9%) women who had any exercise habits such as walking and swimming (228 in primigravidae and 108 in multigravidae). Parity (\( P < 0.001 \)), working status (\( P < 0.001 \)), and education levels (\( P = 0.018 \)) affected total physical activity levels (Table 3), whereas age, pre-pregnancy BMI, and the presence of pregnancy-associated nausea were not associated with total physical activity levels. The above three variables (parity, working status, and education levels), which were significantly associated
with total physical activity levels, were entered into the multiple linear regression model as independent variables. The result showed that multigravidae and working women had significantly higher total physical activity levels (Table 4). Meanwhile, education level was not associated with total physical activity levels after controlling parity and working status.

| Table 1. Characteristics of participants (n = 461) | Mean±SD or n (%) |
|-----------------------------------------------|------------------|
| Gestational age [week]                        | 20.4 ± 1.2       |
| Age [years]                                   | 34.5 ± 4.2       |
| ≥35 years                                     | 253 (54.9)       |
| <35 years                                     | 208 (45.1)       |
| Parity: Primigravida                          | 287 (62.3)       |
| Height [cm]                                   | 159.1 ± 5.3      |
| Pre-pregnancy body weight [kg]                | 52.2 ± 7.7       |
| Pre-pregnancy BMI [kg/m²]                     | 20.7 ± 2.9       |
| Underweight (BMI < 18.5 kg/m²)                | 90 (19.5)        |
| Normal (18.5 kg/m² ≤ BMI < 25.0 kg/m²)        | 333 (72.2)       |
| Overweight (BMI ≥ 25.0 kg/m²)                 | 38 (8.2)         |
| Marital status: Married                       | 453 (98.3)       |
| Working status: Working                       | 219 (47.5)       |
| Completed education                           |                  |
| High school or Junior college                 | 219 (47.5)       |
| University or above                           | 242 (52.5)       |
| Pregnancy associated nausea                   | 135 (29.3)       |
| Smoking habits: Smoking                       | 4 (0.9)          |
| BMI: body mass index                          |                  |

| Table 2. Physical activity in the second trimester (n = 461) | Mean ± SD | Median | (Interquartile range) |
|------------------------------------------------------------|-----------|--------|-----------------------|
| Total physical activity †                                   | 22.2 ± 9.6| 21.1   | (15.7–27.9)           |
| Activity intensity                                          |           |        |                       |
| Sedentary (< 1.5 METs)                                      | 3.5 ± 2.2 | 2.6    | (1.6–4.4)             |
| Light (1.5–< 3.0 METs)                                      | 17.3 ± 6.3| 17.3   | (12.3–21.5)           |
| Moderate (3.0–< 6.0 METs)                                   | 4.9 ± 5.2 | 3.0    | (1.1–7.4)             |
| Vigorous (≥6.0 METs)                                        | 0.0 ± 0.2 | 0.0    | (0.0–0.0)             |
| Activity type                                               |           |        |                       |
| Household/Caregiving                                        | 12.2 ± 8.4| 9.6    | (6.1–17.3)            |
| Occupational                                                | 5.3 ± 6.6 | 0.0    | (0.0–10.3)            |
| Sports/exercise                                             | 0.7 ± 0.9 | 0.3    | (0.0–1.1)             |
| Transportation                                              | 3.0 ± 2.3 | 2.8    | (1.1–4.0)             |
| Inactivity                                                  | 4.7 ± 2.9 | 4.0    | (2.6–6.2)             |

The numeric values in the table are METs·hour/day, METs; metabolic equivalents †Total physical activity was calculated from the sum of light intensity, moderate intensity, and vigorous intensity.
Table 3. Differences in physical activity levels according to parity, working status, and education levels (n = 461)

|                          | Parity                        | Working status | Education level |
|--------------------------|-------------------------------|----------------|-----------------|
|                          | Primigravida (n = 287)        | Non-working (n = 242) | High school or Junior college (n = 219) | University or above (n = 242) |
|                          | Multigravida (n = 174)        | Working (n = 219) | P               | P               | P               | P               |
| Total physical activity †| 18.3(12.7 – 23.1)             | 23.1(18.9 – 30.1) | < 0.001         | 17.9(12.4 – 26.3) | < 0.001         | 20.0(14.1 – 27.1) | 22.2(16.7 – 29.0) | 0.018 |
| Activity intensity       |                               |                 |                 |                 |                 |                 |                 |       |
| Sedentary (< 1.5 METs)   | 4.4(2.6 – 5.3)                | 2.6(1.5 – 3.3)  | < 0.001         | 4.4(2.6 – 6.1)  | < 0.001         | 4.4(2.6 – 6.1)  | 2.6(1.5 – 4.4)  | < 0.001 |
| Light (1.5 – < 3.0 METs) | 15.7(11.1 – 19.8)             | 19.8(16.6 – 22.9) | < 0.001         | 14.6(10.9 – 18.8) | < 0.001         | 16.3(11.9 – 20.2) | 17.8(13.1 – 22.2) | 0.006 |
| Moderate (3.0 – < 6.0 METs)| 1.5(0.7 – 3.6)                | 3.0(1.2 – 7.4)  | < 0.001         | 2.9(0.9 – 7.5)  | 0.499           | 2.6(1.0 – 7.3)  | 3.7(1.2 – 7.5)  | 0.084  |
| Vigorous (≥ 6.0 METs)    | 0.0(0.0 – 0.0)                 | 0.0(0.0 – 0.0)  | 0.0(0.0 – 0.0)  | 0.0(0.0 – 0.0)  | 0.0(0.0 – 0.0)  | 0.0(0.0 – 0.0)  | 0.0(0.0 – 0.0)  | 0.747  |
| Activity type            |                               |                 |                 |                 |                 |                 |                 |       |
| Household/Caregiving     | 7.1(4.9 – 9.8)                | 7.0(4.5 – 11.9) | < 0.001         | 12.0(7.9 – 20.9) | < 0.001         | 9.6(6.2 – 16.2) | 9.7(5.5 – 18.0) | 0.824  |
| Occupational             | 3.5(0.0 – 11.1)               | 10.8(8.5 – 12.4) | < 0.001         | 0.0(0.0 – 0.0)  | < 0.001         | 0.0(0.0 – 10.2) | 4.8(1.0 – 10.8) | 0.015  |
| Sports/exercise          | 0.3(0.1 – 1.4)                | 0.3(0.0 – 0.8)  | < 0.001         | 0.3(0.0 – 1.4)  | 0.014           | 0.3(0.1 – 1.3)  | 0.3(0.0 – 0.9)  | 0.105  |
| Transportation           | 2.8(1.0 – 3.8)                | 3.0(2.0 – 4.8)  | < 0.001         | 1.9(1.0 – 3.0)  | < 0.001         | 2.3(1.0 – 3.9)  | 2.8(1.8 – 4.1)  | 0.059  |
| Inactivity               | 4.8(3.1 – 7.3)                | 5.2(3.1 – 7.7)  | < 0.001         | 4.8(3.1 – 7.1)  | < 0.001         | 3.7(2.0 – 5.3)  | < 0.001         |       |

Data are shown as median (interquartile range). The numeric values in the table are METs·hour/day. METs; metabolic equivalents Mann-Whitney U test †Total physical activity levels were calculated from the sum of light intensity, moderate intensity, and vigorous intensity.
We showed numeric differences in physical activity levels according to working status among primigravidae or multigravidae (Table 5). Working multigravidae had more than twice as much total physical activity level as non-working primigravidae.

The rates of women who performed at least 150 min per week of moderate or vigorous activity were 27.9% in working primigravidae, 42.1% in non-working primigravidae, 58.5% in working multigravidae, and 56.0% in non-working multigravidae.

4. Discussion
The present study identified that multigravidae and working women had significantly higher total physical activity levels in the second trimester of pregnancy among Japanese women, and showed numeric differences in physical activity levels classified by parity and working status.

Total physical activity levels in our participants were similar to those of other developed countries such as the United States and Spain (Chasan-Taber et al., 2004; Oviedo-Caro, Bueno-Antequera, & Munguía-Izquierdo, 2018). However, moderate intensity and sports/exercise activity levels were far lower in Japan than these developed countries. The Japanese guidelines for sports during pregnancy mainly describe the limitations in exercise, including the type, intensity, duration, and frequency (Japanese Society of Clinical Sports Medicine, 2004; Japan Society of Obstetrics and Gynecology and the Japan Association of Obstetricians and Gynecologists, 2017). In contrast, the guidelines in the United States and Spain have positive attitudes against exercise during pregnancy, and recommend moderate-intensity activity (Evenson et al., 2014; The American College of Obstetricians and Gynecologists, 2015). Such differences among national guidelines might reflect the results of moderate-intensity activity levels and sports/exercise activity levels. In the present study, approximately half of our participants did not have 150 min per week of moderate or vigorous activity, which was recommended by the American College of Obstetricians and Gynecologists. Healthcare professionals must encourage pregnant women with low levels of moderate activity to undertake day-to-day activities of a moderate intensity, including household chores. Information about simple methods to increase the level of physical activity must also be provided.

Parity and working status were strongly correlated with total physical activity levels in the multiple linear regression analysis. Multigravidae had about 1.5 times higher total physical activity levels as primigravidae. This difference seems to be due to increased household/caregiving activity along with child-rearing. Actually, median physical activity levels for household/caregiving activities among multigravidae were approximately 2.5 times higher than that of primigravidae. In addition, more than half of multigravidae had at least 150 min per week of moderate or vigorous-intensity activity in daily routine activities. On the other hand, the rates of women working or participating in exercise were lower in multigravidae, consistent with previous studies (Nascimento et al., 2015; Okuno, Miyagi, & Nakatsuka, 2008; Suzuki et al., 2006). Some
Table 5. Differences in physical activity levels according to working status among primigravidae and multigravidae (n = 461)

| Activity Type                      | Primigravida (n = 287) | Multigravida (n = 174) | p<sup>§</sup> | p<sup>‡</sup> |
|------------------------------------|------------------------|------------------------|---------------|---------------|
|                                   | Working (n = 154)      | Non-working (n = 133)  | p<sup>†</sup> | Working (n = 65) | Non-working (n = 109) | p<sup>†</sup> | p<sup>‡</sup> |
| Total physical activity<sup>†</sup> | 21.1(17.7 - 25.8)     | 13.4(10.5 - 18.5)     | < 0.001       | 30.4(25.8 - 34.9) | 24.9(19.7 - 31.5)     | < 0.001       | < 0.001       |
| Activity intensity                 |                        |                        |               |                |                          |               |               |
| Sedentary (< 1.5 METs)             | 2.6(1.6 - 4.4)         | 4.4(3.7 - 6.4)         | < 0.001       | 1.5(0.5 - 2.6)  | 2.6(1.5 - 4.4)         | < 0.001       | < 0.001       |
| Light (1.5 -< 3.0 METs)            | 18.3(15.4 - 21.2)      | 11.6(9.1 - 15.6)       | < 0.001       | 22.6(19.1 - 26.2) | 17.7(14.4 - 22.0)     | < 0.001       | < 0.001       |
| Moderate (3.0 -< 6.0 METs)         | 2.1(1.0 - 3.9)         | 1.3(0.3 - 2.9)         | 0.002         | 7.4(4.4 - 12.1) | 6.8(4.4 - 10.5)       | 0.342         | < 0.001       |
| Vigorous (≥ 6.0 METs)              | 0.0(0.0 - 0.0)         | 0.0(0.0 - 0.0)         | 0.419         | 0.0(0.0 - 0.0)  | 0.0(0.0 - 0.0)        | 0.068         | 0.274         |
| Activity type                      |                        |                        |               |                |                          |               |               |
| Household/Caregiving               | 5.5(3.3 - 7.3)         | 9.1(6.5 - 11.2)        | < 0.001       | 14.7(10.8 - 19.2) | 21.1(15.8 - 26.7)     | < 0.001       | < 0.001       |
| Occupational                       | 10.8(8.6 - 12.4)       | 0.0(0.0 - 0.0)         | < 0.001       | 10.2(8.2 - 12.1) | 0.0(0.0 - 0.0)        | < 0.001       | < 0.001       |
| Sports/exercise                    | 0.3(0.0 - 0.9)         | 0.7(0.2 - 1.5)         | < 0.001       | 0.3(0.0 - 0.7)  | 0.1(0.0 - 0.7)        | 0.981         | < 0.001       |
| Transportation                     | 3.0(2.0 - 4.1)         | 1.6(1.0 - 2.8)         | < 0.001       | 4.0(2.9 - 5.1)  | 2.0(1.0 - 3.8)        | < 0.001       | < 0.001       |
| Inactivity                         | 4.0(2.6 - 5.7)         | 6.8(4.8 - 9.0)         | < 0.001       | 2.0(1.0 - 3.1)  | 3.1(2.0 - 5.2)        | < 0.001       | < 0.001       |

Data are shown as median (interquartile range). The numeric values in the table are METs-hour/day. METs; metabolic equivalents<sup>†</sup>Total physical activity levels were calculated from the sum of light intensity, moderate intensity, and vigorous intensity.<sup>‡</sup>Mann-Whitney U test: Comparison of two groups (working and non-working)<sup>§</sup>Kruskal-Wallis test: Comparison of four groups (working primigravidae, non-working primigravidae, working multigravidae, and non-working multigravidae).
Reasons for nonparticipation in exercise could be lack of time and feeling that there is no further need for exercise from sufficient activity levels through household and caregiving (Suzuki et al., 2006). Healthcare professionals would need to assess the necessity of exercise recommendations in the case of multigravidae, by considering moderate and vigorous activities regarding household/caregiving activities.

In accordance with a previous study (Nascimento et al., 2015), working led to higher physical activity levels. The occupational activity levels in our study were similar to those in the non-pregnant Japanese study (mean levels: 8.0–10.6 MET-h/day; Namba, Yamada, Ishida, Takase, & Kimura, 2015). As a result of classification by parity and working status, working multigravidae had approximately twice as much total physical activity level as non-working primigravidae. In particular, non-working primigravidae need to be paid attention to as a high-risk population related to inactivity. On the other hand, the rate of women performing at least 150 min per week of moderate or vigorous activity was lowest in working primigravidae. Thus, healthcare professionals might need to recommend moderate-intensity activities and provide information on the type of moderate activities in the case that working primigravidae do not consciously perform moderate activities.

The current study had four limitations. First, the characteristics of the participants might be biased because the research location was a university hospital in an urban area. For instance, the mean age of participants was a little older than that in national reports (34.5 years vs. 31.2 years) (Ministry of Health, Labour and Welfare of Japan, 2010). A higher maternal age among pregnant women is a characteristic of urban areas (Ministry of Health, Labour and Welfare of Japan). Therefore, these results may be generalized for a population in urban areas. Second, the participants were only in the second trimester. Thus, generalization of the results is limited in the second trimester. In the first and third trimesters, different characteristics have potential to be associated with physical activity levels. Third, psychosocial variables including social desirability might affect the results because we used a self-administered questionnaire for assessing physical activity. Fourth, a recall bias might have occurred as the pre-pregnancy weights of the participants were self-reported. However, during initial examinations, the pre-pregnancy weights are usually recorded to establish overall weight gain goals during the pregnancy. The recall in early pregnancy may have reduced the recall bias during the investigation. Most Japanese women are knowledgeable about their own usual weight (Okamoto et al., 2017), because they have access to a weighing scale, and their weights are measured during annual physical examinations. Thus, the self-reported values were considered to be reliable.

Our strength was that this study is the first study to identify the demographic factors related to physical activity levels and compare physical activity levels among different demographic characteristics in pregnant Japanese women. In most clinical settings, the activity level of individuals is estimated empirically from the demographic background, rather than from an accurate assessment of physical activity. However, the estimation is not based on clear evidence. The differences in physical activity levels according to parity and working status, which were indicated by the present study, would be useful for healthcare professionals to consider whether women should increase their daily physical activities or perform exercises.

5. Conclusion
The present study identified parity and working status as factors related to physical activity levels, and indicated that working multigravidae had about twice as much total physical activity level as non-working primigravidae during the second trimester in Japan. The results can be adapted to populations living in urban areas. Healthcare professionals can estimate the necessity of increase in physical activity levels in the second trimester, taking the numeric differences in physical activity levels according to demographic characteristics into consideration.
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