

# Physical Exercise During Pregnancy and its Related Factors: An Observational Study in Japan

Asian/Pacific Island Nursing Journal  
Volume 2(4): 166-173  
©Author(s) 2017  
<http://digitalscholarship.unlv.edu/apin/>

Megumi Haruna<sup>a</sup>, Masayo Matsuzaki<sup>a,b</sup>, Mie Shiraishi<sup>a,b</sup>, and SeonAe Yeoc

## Abstract

This study aimed to investigate the exercise habits of pregnant women in the third trimester ( $N = 303$ ). We assessed participation in physical activities, including exercise or sports, using the Japanese version of the Pregnancy Physical Activity Questionnaire. A total of 183 (60.4%) pregnant Japanese women participated in some form of exercise and 87 (28.7%) exercised for 2 hours or more, per week, in the third trimester. Multiple logistic regression analyses indicated that women who set themselves a gestational weight gain target (adjusted odds ratio [AOR] = 8.10, 95% CI [2.82, 23.4],  $p < .001$ ), were more likely to participate in exercise or sports. In contrast, multiparous women (AOR = 0.44, 95% CI [0.26, 0.72],  $p = .001$ ), and those whose pre-pregnancy body weights suggested obesity (AOR = 0.51, 95% CI [0.30, 0.87],  $p = .013$ ) were less likely to participate in such activities. We found a relationship between non-participation for 2 hours or more, per week, to being multiparous (AOR = 0.33, 95% CI [0.18, 0.94],  $p < .001$ ) and the presence of anemia in the second trimester (AOR = 0.51, 95% CI [0.28, 0.94],  $p = .031$ ). Working status, seasonal differences, concerns about being overweight, and individual dietary nutritional guidance were not related to participation in exercise or sports. While setting a target for gestational weight gain may motivate participation in exercise or sports, women who were multiparous and those who perceived themselves as obese before pregnancy, showed a negative association with participation.

**Keywords:** birth weight, exercise, gestational weight gain, pregnancy, sports

Regular performance of prenatal exercise is reported to have a favorable effect on maternal health, reduce the risk of excessive gestational weight gain (Muktabhant, Lawrie, Lumbiganon, & Laopai-boon, 2015), prevent hypertensive disorders (Magro-Malosso, Saccone, Di Tommaso, Roman, & Berghella, 2017), enhance psychological well-being (Haakstad, Torset, & Bø, 2016), and improve physical fitness (Kramer & McDonald, 2006). The American College of Obstetricians and Gynecologists encourages healthy pregnant women to engage in aerobic and strength conditioning exercise before, during, and after pregnancy. The physical activity guideline for pregnant women recommends participation in moderate-intensity physical activities, at 20–30 minutes per session, most days of the week (approximately 150 minutes per week; American College of Obstetricians and Gynecologists, 2015). The Royal College of Obstetricians and Gynaecologists reported that exercising during pregnancy helps to control weight gain, reduce high blood pressure, prevent gestational diabetes, and improve fitness, sleep patterns, and mood. The Royal College of Obstetricians and

Gynaecologists (2006) recommends participating in moderate-intensity physical activity for at least 150 minutes every week throughout pregnancy.

Because of antenatal checkups, pregnant women have more opportunities to interact with health care professionals, leading to a “teachable moment” through which healthy lifestyle behaviors, including eating and exercise habits, are encouraged. However, only 21.5% of women were found to meet the current American College of Obstetricians and Gynecologists/Royal College of Obstetricians and Gynaecologists recommendations for exercise during pregnancy. In an Irish study, 11.7% of pregnant

<sup>a</sup>The University of Tokyo, Japan

<sup>b</sup>Osaka University, Japan

<sup>c</sup>The University of North Carolina at Chapel Hill, USA

### Corresponding Author:

Megumi Haruna, PhD, RNM

Associate Professor

Global Nursing Research Center, Department of Midwifery and Women's Health, Division of Health Sciences & Nursing, Graduate School of Medicine, The University of Tokyo, Japan

Email: [mharuna-ky@umin.ac.jp](mailto:mharuna-ky@umin.ac.jp)



Creative Commons CC-BY-NC-ND: This article is distributed under the terms of the Creative Commons Attribution 4.0 License (<http://creativecommons.org/licenses/by/4.0/>) which allows others to download your works and share them with others as long as they credit you, but they can't change them in any way or use them commercially.

women reported performing no exercise at all (Walsh, McGowan, Byrne, & McAuliffe, 2011), while in a study performed in the United States, 23.4% of pregnant women engaged in 150 minutes or more, per week, of leisure-time physical activity (Hesketh, & Evenson, 2016). As per the Danish National Birth Cohort, 31% of women engaged in leisure-time physical activity in the second trimester (Juhl, Olsen, Andersen, Nøhr, & Andersen, 2010). Furthermore, our previous study reported that pregnant Japanese women living in Tokyo were less likely to participate in vigorous exercise compared to women in the United States (Matsuzaki et al., 2014). Previously conducted studies have mainly focused on identifying the key factors that promote healthy eating and participation in physical activity, including daily walking during pregnancy specifically in overweight and obese populations, as well as assessed whether various interventions that lead to healthy lifestyle changes (Muktabhant et al., 2015; Yeo, Walker, Caughey, Ferraro, & Asafu-Adjei, 2017). However, among Japanese women of reproductive age, 17.4% (20–29 years) and 15.6% (30–39 years) of women were found to have a low body mass index (BMI; < 18.5 kg/m<sup>2</sup>; Ministry of Health, Labour and Welfare, 2015). The prevalence of low BMI in such populations has increased over several decades. Furthermore, the mean birth weight of term neonates was found to have decreased in the last 40 years and currently estimated to be 3,050 g in 2015 (Ministry of Health, Labour and Welfare, 2015). Insufficient gestational weight gain is considered one of the risk factors for low birth weight infants. Therefore, in Japan, perinatal guidance focuses on optimal gestational weight gain, as well as the prevention of excessive weight gain. Under these circumstances, the rate of pregnant women participating in exercise, and the key factors promoting habitual exercise during pregnancy are still unclear.

We focused on physical exercise in the third trimester as a representative value during pregnancy because previous studies suggested that total physical activity significantly increased from the first to the second trimester of gestation and remained almost stable after that in normal-weight women (Bacchi et al., 2016; Liu et al., 2011). We aimed to examine the patterns of habitual participation in exercise or sports during pregnancy and the associated factors in Japan.

## Methods

### Participants

We conducted a cohort study from May 2010 to June 2012, on healthy pregnant women aged ≥ 20 years, at a prenatal health checkup clinic in a university hospital in Tokyo, Japan. We distributed

the questionnaires among women in the second (19–26 weeks) and third trimesters (34–37 weeks). Some women, who were recruited between June 2011 and June 2012, participated in the intervention of individual dietary guidance, provided by the researchers after the second trimester survey. The details of the intervention protocol are described elsewhere (Haruna, Shiraishi, Matsuzaki, Yatsuki, & Yeo, 2017).

Exclusion criteria included the presence of multiple pregnancies, diabetes, hypertension, preterm birth, psychiatric diseases, and the inability to speak or read Japanese. In all the women, we estimated the accurate gestational age by using an ultrasound at 8–12 weeks gestation, under usual care. All the women received regular prenatal care and individual counseling routinely by midwives concerning maintaining a healthy diet, exercise, and appropriate weight gain during pregnancy.

The Ethical Committee of the Graduate School of Medicine, The University of Tokyo, approved the study procedures and protocol (#2987[2]). All the participants provided written informed consent before the baseline assessments.

### Measures

We collected data at 19–26 weeks' and 34–37 weeks' gestation, and we obtained demographic data using questionnaires and medical records. We asked participants how they perceived their pre-pregnancy body weight, their concerns about becoming overweight, setting a gestational weight gain target, and paying attention to the healthy eating habits they adopted to prevent the development of excessive gestational weight gain using a self-administered questionnaire. Regarding the perception of body weight, weight control, and healthy eating behaviors, we asked original questions, such as “Do you have a gestational weight gain target?”

The Japanese version of the Pregnancy Physical Activity Questionnaire (PPAQ-J) assessed the performance of physical activities, including exercise or sports, in the past month. The original PPAQ is a self-administered questionnaire, which comprises questions regarding the time spent participating in 32 physical activities (Chasan-Taber et al., 2004). The PPAQ-J was developed based on the original version and includes a new item about riding a bicycle. The PPAQ-J assesses total physical activity based on 33 activities in the following categories: (a) household or caregiving (13 activities), (b) occupational activity (5 activities), (c) exercise or sports (8 activities), (d) transportation (4 activities), and (e) inactivity (3 activities; Matsuzaki et al., 2010). *Exercise/sports* includes walking slowly for fun or exercise, walking more quickly for fun or exercise, walking quickly uphill for fun or exercise, jogging, prenatal exercise class, swimming, dance, and doing other things for

**Table 1.** Characteristics of Participants

Demographics	All N = 303	Participation in exercise/sports <sup>a</sup>			Participation in exercise/sports for 2 hr or more per week <sup>b</sup>		
		Yes n = 183	No n = 120	p	Yes n = 87	No n = 216	p
Age (years)	34.8 ± 4.2	34.4 ± 4.1	35.3 ± 4.1	0.056	34.1 ± 3.9	35.0 ± 4.2	0.059
Parity							
Primipara	186 (61.4%)	124 (67.8%)	62 (51.7%)	0.005	68 (78.2%)	118 (54.6%)	< 0.001
Multipara	117 (38.6%)	59 (32.2%)	58 (48.3%)		19 (21.8%)	98 (45.4%)	
Pre-pregnancy BMI (kg/m <sup>2</sup> )	20.7 ± 2.8	20.7 ± 2.9	20.7 ± 2.5	0.884	20.6 ± 3.0	20.8 ± 2.7	0.680
Under weight: BMI < 18.5	48 (15.8%)	34 (18.6%)	14 (11.7%)	0.264	16 (18.4%)	32 (14.8%)	0.264
Normal: 18.5 < BMI < 25.0	227 (74.9%)	132 (72.1%)	95 (79.2%)		63 (72.4%)	164 (75.9%)	
Overweight: 25 < BMI	28 (9.2%)	17 (9.3%)	11 (9.2%)		8 (9.2%)	20 (9.3%)	
Pre-pregnancy body weight (kg)	52.6 ± 7.7	52.5 ± 8.2	52.8 ± 6.9	0.689	52.8 ± 8.7	52.5 ± 7.3	0.822
Gestational weight gain (kg)	8.2 ± 3.4	8.5 ± 3.3	7.8 ± 3.4	0.100	8.6 ± 3.1	81 ± 3.5	0.261
Gestational weight gain (g/day)	32.4 ± 13.4	33.5 ± 13.2	30.8 ± 13.6	0.100	33.8 ± 12.3	31.8 ± 13.8	0.278
Birth weight (g)	3027.1 ± 387.7	3034.7 ± 393.5	3015.4 ± 379.9	0.673	3079.7 ± 415.5	3005.8 ± 374.7	0.134
Low birth weight	23 (7.6%)	13 (7.1%)	10 (8.4%)	0.677	5 (5.7%)	18 (8.4%)	0.436
Education							
High school and below	135 (44.6%)	84 (45.9%)	51 (42.5%)	0.560	37 (42.5%)	98 (45.4%)	0.653
College and above	168 (55.4%)	99 (54.1%)	69 (57.5%)		50 (57.5%)	118 (54.6%)	
Annual income (Yen)							
< 5 million	53 (17.5%)	29 (15.8%)	24 (20.0%)	0.600	11 (12.6%)	42 (19.4%)	0.231
5-7 million	66 (21.8%)	42 (23.0%)	24 (20.0%)		17 (19.5%)	49 (22.7%)	
> 7 million	184 (60.7%)	112 (61.2%)	72 (60.0%)		59 (67.8%)	125 (57.9%)	
Worker							
The 2nd trimester	151 (49.8%)	91 (49.7%)	60 (50.0%)	0.963	47 (54.0%)	104 (48.1%)	0.355
Anemia							
The 1st trimester	46 (15.2%)	32 (17.5%)	14 (11.7%)	0.167	11 (12.6%)	35 (16.2%)	0.435
The 2nd trimester	94 (31.0%)	55 (30.1%)	39 (32.5%)	0.653	19 (21.8%)	75 (34.7%)	0.028
The 3rd trimester	117 (38.6%)	72 (39.3%)	45 (37.5%)	0.747	36 (41.4%)	81 (37.5%)	0.530
Survey seasons (Spring & Summer)	104 (34.3%)	64 (35.0%)	40 (33.3%)	0.769	31 (35.6%)	73 (33.8%)	0.761

<sup>a</sup>Women participated in exercise/sports at the 3rd trimester; <sup>b</sup>Women participated in exercise/sports for 2 or more hr per week at the 3rd trimester.

BMI = body mass index; Anemia = iron deficiency anemia with a hemoglobin level < 11.0 g/dL.

Data analyzed using unpaired student's *t*-test or Chi-square test.

fun or exercise. We verified the validity and reliability of the PPAQ-J using actigraph activity monitors (Actigraph Corp., Pensacola, FL, USA) among healthy pregnant women (Matsuzaki et al., 2014).

In our study, we defined “participation in exercise/sports (exercise)” as cases in which women reported participating in any exercise or sport, regardless of the time spent on it or the intensity in the past month. We defined “participation in regular exercise/sports (regular exercise)” as cases in which women reported spending a total of 2 hours or more, per week, on any exercise or sport, regardless of the

activity intensity, in the past month. We obtained infant birth weight, maternal body weight, gestational weight gain, and maternal hemoglobin levels from medical records.

### Statistical Analysis

We calculated descriptive statistics for all the demographic variables and expressed as means and standard deviations of the quantitative variables and proportions of categorical variables. We used an Unpaired *t*-test and a Chi-square test to compare the

**Table 2.** Perception of Bodyweight, Weight Control and Healthy Eating Behaviors

Related factors	All N = 303	Participation in exercise/sports <sup>a</sup>			Participation in exercise/sports for 2 hr or more per week <sup>b</sup>		
		Yes n = 183	No n = 120	p	Yes n = 87	No n = 216	p
Setting a gestational weight gain target	281 (92.7%)	178 (97.3%)	103 (85.8%)	< 0.001	82 (94.3%)	199 (92.1%)	0.519
Perception of being obese for pre-pregnancy body weight	90 (30.1%)	46 (25.4%)	44 (37.3%)	0.029	20 (23.3%)	70 (32.9%)	0.101
Concern of being overweight	127 (42.9%)	76 (42.2%)	51 (44.0%)	0.767	43 (50.6%)	84 (39.8%)	0.090
Healthy eating for preventing overweight	165 (54.5%)	98 (53.6%)	67 (55.8%)	0.697	48 (55.2%)	117 (54.2%)	0.874
Receiving of individual dietary nutritional guidance	149 (49.2%)	87 (47.5%)	62 (51.71%)	0.482	44 (50.6%)	105 (48.6%)	0.757
Setting a gestational weight gain target	281 (92.7%)	178 (97.3%)	103 (85.8%)	< 0.001	82 (94.3%)	199 (92.1%)	0.519

Note. <sup>a</sup>Women participated in exercise/sports at the 3rd trimester; <sup>b</sup>Women participated in exercise/sports for 2 or more hr per week at the 3rd trimester; <sup>c</sup>Women were allocated to individual dietary guidance group in another study. Data analyzed using Chi-square.

differences among the demographic data, perception of bodyweight, and weight control behaviors between the women who participated in exercise or sports in the third trimester, and those who did not. We compared infant birth weight and the prevalence rate of low birth weight between the two groups using an unpaired t-test and a Chi-square test, respectively. We entered all variables with a *p*-value less than .10 in the bivariate analysis into the multiple regression analysis. We considered all differences with a 2-sided *p*-value less than .05 statistically significant. We performed all the statistical analyses using SPSS v20.0® (IBM Corp, Armonk, NY, USA).

## Results

### Participant Characteristics

A total of 303 women participated in this study. The mean maternal age was 34.8 (*SD* = 4.2) years, and 186 women (61.4%) were primiparous. We compared the demographic characteristics between the women who participated in exercise or sports in the third trimester (exercise: *n* = 183, 60.4%) and those who did not (no exercise: *n* = 120, 39.6%). We also compared the characteristics between women who participated in exercise or sports for 2 hours or more, per week, in the third trimester (regular exercise: *n* = 87, 28.7%) and those who did not (no regular exercise: *n* = 216, 71.3%; Table 1). The demographic characteristics, including age, pre-pregnancy BMI, gestational weight gain, infant birth weight, education status, annual income, working status, and

survey seasons (spring and summer) did not vary significantly between women with different exercise habits (Table 1).

However, there was an association with multiparity (exercise [32.2%] vs. no exercise [48.3%], *p* = .005; regular exercise [21.8%] vs. no regular exercise [45.4%], *p* < .001) and lower rates of participation in exercise or sports (Table 1). Women who had an iron deficiency anemia, with hemoglobin levels less than 11.0 g/dL in the second trimester, were also significantly less likely to participate in exercise or sports for 2 hours or more, weekly, in the third trimester (regular exercise [21.8%] vs. no regular exercise [34.7%], *p* = .028; Table 1).

### Perception of Body Weight, Weight Control, and Healthy Eating Behaviors

We compared the self-perception of pre-pregnancy body weight, weight control, and healthy eating behaviors among women who participated in any exercise or sports and women who did not. We found a significant association between setting a gestational weight gain target (exercise [97.3%] vs. no exercise [85.8%], *p* < .001) and a higher rate of participation in exercise or sports. Meanwhile, women who perceived themselves as obese before pregnancy, were less likely to participate in exercise or sports (exercise [25.4%] vs. no exercise [37.3%], *p* = .029; Table 2). However, their actual average pre-pregnancy BMIs were 23.4 ± 2.9 kg/m<sup>2</sup> (range = 18.6, 33.1). Concerns of being overweight (regular exercise: 50.6% vs no regular exercise: 39.8%; *p* = .090) were associated with a trend in a higher rate of

**Table 3.** Multiple Logistic Regression Analysis of Factors Related to Participation in Prenatal Exercise/Sports in the 3rd Trimester

Related factors	Participation in exercise/sports <sup>a</sup>			Participation in exercise/sports for 2 hr or more per week <sup>b</sup>		
	Odds ratio (95% CI)		<i>p</i>	Odds ratio (95% CI)		<i>p</i>
	Unadjusted	Adjusted		Unadjusted	Adjusted	
Setting a target value of gestational weight gain	5.88 (2.11, 16.4)	8.1 (2.82, 23.4)	< .001			
Perception of being obese for pre-pregnancy body weight	0.57 (0.35, 0.95)	0.51 (0.30, 0.87)	.013			
Multipara (1, 0)	0.51 (0.32, 0.82)	0.44 (0.26, 0.72)	.001	0.34 (0.19, 0.60)	0.33 (0.18, 0.58)	< .001
Anemia in the 2nd trimester (1, 0)				0.53 (0.29, 0.94)	0.51 (0.28, 0.94)	.031
Concern in being overweight (1, 0)				1.55 (0.93, 2.57)	1.54 (0.91, 2.61)	.110

Note. <sup>a</sup>Women participated in exercise/sports at the 3rd trimester; <sup>b</sup>Women participated in exercise/sports for 2 or more hr per week at the 3rd trimester.

CI = confidence interval

Multiple logistic regression analysis was adjusted for the unadjusted variables in this table, Yes = 1, No = 0.

*P* values show for adjusted odds ratio.

participation in exercise or sports for 2 hours or more per week in the third trimester. On the other hand, other factors such as “perception of being obese for pre-pregnancy body weight,” “Setting a gestational weight target,” and “Healthy eating for preventing overweight” were not related (Table 2). Although we provided 149 women individual dietary nutritional guidance as another research intervention, “Receiving individual dietary nutritional guidance” was not related to exercise (Table 2).

### Factors Related to Participation in Exercise or Sports

Multiple logistic regression analyses showed that participation in exercise or sports in the third trimester was related to the following variables: (a) multiparity (adjusted odds ratio [AOR] = 0.44, 95% CI [0.26, 0.72]; *p* = .001), (b) self-perception of being obese before pregnancy (AOR = 0.51, 95% CI [0.30, 0.87]; *p* = .013), and (c) setting a gestational weight gain target (AOR = 8.10, 95% CI [2.82, 23.4]; *p* < .001). The following variables were related to motivation of participation in exercise or sports for 2 hours or more, per week, in the third trimester (Table 3): (a) being multiparous (AOR = 0.33, 95% CI [0.18, 0.58]; *p* < .001) and (b) presence of anemia in the second trimester (AOR = 0.51, 95% CI [0.28, 0.94]; *p* = .031). Although women who had iron-deficiency anemia at the second trimester discouraged from exercising at the third trimester, anemia at the third trimester was not a related factor. There were no women who had severe anemia (Hb < 9.0 g/dL) with contraindications to exercise.

### Discussion

This study investigated the rates of participation in exercise or sports, and exercise for 2 hours or more, per week, in the third trimester and their related factors, such as setting a gestational weight gain target. Conversely, perceptions of being obese for pre-pregnancy body weight, multipara, and anemia in the 2nd trimester were related to the discouragement of participation in exercise or regular exercise.

In our study, the rate of women who participated in exercise or sports in the third trimester was 60.4%. Similarly, previous large-scale studies have reported that prevalence in exercise among pregnant women was approximately 50%. In a prospective cohort of British women, 66.1% of women reported engaging in some strenuous physical activity, and 48.9% reported participating in strenuous physical activity for at least 3 hours per week (Liu et al., 2011). The 1999–2006 National Health and Nutrition Examination Survey in the United States included 1,280 pregnant women, out of whom 56.6% reported participating in some form of moderate-to-vigorous leisure activity. Participation in some form of moderate-to-vigorous household activities and moderate leisure activities increased in 2003–2006 compared to the period before the ACOG recommendations for physical activity during pregnancy were released in 2002 (American College of Obstetricians and Gynecologists, 2002; Evenson & Wen, 2010).

Meanwhile, a cross-sectional study conducted in Brazil, which included 1,279 women, showed that the prevalence of participation in exercise was low in the third trimester (13.4%), and only 4.7% of

the women completed the minimum of 150 minutes of aerobic exercise per week. One of the reasons for the low prevalence of participation in exercise was insufficient physical exercise guidance, which less than half of the women (47.4%) received during prenatal visits (Nascimento, Surita, Godoy, Kasawara, & Morais, 2015). Hispanic and Asian women might be the most inactive as suggested in a review (Gaston & Cramp, 2011).

The National Health and Nutrition Survey, conducted a survey in 2016 of the general Japanese population. They found participation in habitual exercise over a one-year period, showed that 9.9% and 9.8% of women in their 20s and 30s, respectively, habitually exercised for a minimum of 30 minutes, twice or more, a week (Ministry of Health, Labour and Welfare, 2016). In our study, the prevalence of habitual exercise for 2 hours or more, per week, in the third trimester was 28.7%; this is higher than the prevalence among non-pregnant Japanese women of reproductive age (< 10%). This suggests that women may be motivated to exercise during pregnancy.

Previously conducted studies have investigated several demographic predictors (i.e., educational attainment and parity) about exercise during pregnancy. It is controversial if higher education levels are significantly associated with exercising during pregnancy (Gaston & Cramp, 2011; Nascimento et al., 2015). In our study, we found no association between education and exercise because more than half of the participants had completed college or university, and almost all the participants had completed high school. With regards to parity, there was an association between being multiparous and the decreased likelihood of participating in exercise or sports; this finding is consistent with that of other studies. This could be because mothers who have an older child may not find the time to exercise.

The results of our study indicate that women who set a gestational weight gain target were likely to participate in some form of exercise or sports. Motivational interviewing, related to setting a target weight, might promote healthy lifestyle changes.

In contrast, women who considered themselves obese before pregnancy, were less likely to participate in exercise or sports. The health behavior, regarding weight management, may be related to the motivation to exercise. One study found that women who were obese before pregnancy had lower odds of reporting participation in brisk-walking than normal-weight women (Liu et al., 2011). However, with regards to the self-perception of being obese, women might have an incorrect body image, despite their normal body weight.

Several studies have found positive associations between body satisfaction and physical activity

(Kruger, Lee, Ainsworth, & Macera, 2008; Zaccagni, Masotti, Donati, Mazzoni, & Gualdi-Russo, 2014). Furthermore, in this study, irrespective of their actual weight, women who were not satisfied with their body size were less likely to exercise. Most of the women who evaluated their pre-pregnancy body weights as obese had a normal BMI.

Similarly, women who had iron-deficiency anemia during pregnancy may have been discouraged from exercising, although woman did not have severe anemia with contraindications to exercise. In participants, 149 women participated in a dietary intervention study. Although, the intervention focused on individual dietary nutrition guidance to encourage pregnant women to improve their dietary behavior, it did not affect the habit of exercise.

### **Limitations**

This study had several limitations. First, it did not adjust for all the potential confounding factors such as residential environments and social support. Second, we recruited participants based on a convenience sample; thus, the generalization of the results to other populations should be carefully considered. We recruited the participants only at a tertiary hospital in metropolitan Tokyo, and the results may apply only to a similar population. Third, the recall bias might exist, as we investigated participation in exercise or sports retrospectively using a self-administrated questionnaire. Therefore, well-designed research should be conducted in the future considering these issues. Despite of these limitations, we clarified the related modifiable factors of participating in exercise among mostly non-obese pregnant Japanese women. This finding might apply to the lifestyles of similar, non-obese Asian women.

### **Conclusions**

Setting a gestational weight gain target may have motivated participation in exercise or sports. Meanwhile, women who were multiparous and those who perceived themselves as being overweight pre-pregnancy were less likely to exercise. Furthermore, maternal anemia in the second trimester and being multiparous was related to the significantly reduced likelihood of participating in exercise or sports for 2 hours or more per week.

### **Acknowledgments**

We thank all the participants for their time and cooperation. We also thank the staff of the Department of Obstetrics at the study site.

## Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest concerning the research, authorship, or publication of this article.

## Funding

This study was supported in part by a grant from the Institute for Food and Health Science, Yazuya Co Ltd, 2009, and the Urakami Foundation for Food and Food Culture Promotion, 2011.

## References

- American Congress of Obstetricians and Gynecologists. (2002). ACOG committee opinion No. 267: Exercise during pregnancy and the post-partum period. *Obstetrics and Gynecology*, *99*, 171-173. <https://doi.org/10.1097/00006250-200201000-00030>
- American Congress of Obstetricians and Gynecologists. (2015). ACOG committee opinion No. 650: Physical activity and exercise during pregnancy and the postpartum period. *Obstetrics and Gynecology*, *126*, e135-42. <https://doi.org/10.1097/AOG.0000000000001214>
- Bacchi, E., Bonin, C., Zanolin, M. E., Zambotti, F., Livornese, D., Donà, S., ... Moghetti, P. (2016). Physical activity patterns in normal-weight and overweight/obese pregnant women. *PLOS ONE*, *11*, e0166254. <https://doi.org/10.1371/journal.pone.0166254>
- Chasan-Taber, L., Schmidt, M. D., Roberts, D. E., Hosmer, D., Markenson, G., & Freedson, P. S. (2004). Development and validation of a Pregnancy Physical Activity Questionnaire. *Medicine & Science in Sports & Exercise*, *36*, 1750-1760. <https://doi.org/10.1249/01.MSS.0000142303.49306.0D>
- Evenson, K. R., & Wen, F. (2010). National trends in self-reported physical activity and sedentary behaviors among pregnant women: NHANES 1999-2006. *Preventive Medicine*, *50*(3), 123-128. <https://doi.org/10.1016/j.ypmed.2009.12.015>
- Gaston, A., & Cramp, A. (2011). Exercise during pregnancy: A review of patterns and determinants. *Journal of Science and Medicine in Sport*, *14*, 299-305. <https://doi.org/10.1016/j.jsams.2011.02.006>
- Haakstad, L. A. H., Torset, B., & Bø, K. (2016). What is the effect of regular group exercise on maternal psychological outcomes and common pregnancy complaints? An assessor blinded RCT. *Midwifery*, *32*, 81-86. <https://doi.org/10.1016/j.midw.2015.10.008>
- Haruna, M., Shiraishi, M., Matsuzaki, M., Yatsuki, Y., & Yeo, S. (2017). Effect of tailored dietary guidance for pregnant women on nutritional status: A double-cohort study. *Maternal & Child Nutrition*, *13*(4), e12391. <https://doi.org/10.1111/mcn.12391>
- Hesketh, K. R., & Evenson, K. R. (2016). Prevalence of U.S. Pregnant Women Meeting 2015 ACOG Physical Activity Guidelines. *American Journal of Preventive Medicine*, *51*, e87-e89. <https://doi.org/10.1016/j.amepre.2016.05.023>
- Juhl, M., Olsen, J., Andersen, P. K., Nøhr, E. A., & Andersen, A-M. N. (2010). Physical exercise during pregnancy and fetal growth measures: A study within the Danish National Birth Cohort. *American Journal of Obstetrics and Gynecology*, *202*, 63.e1-63.e8. <https://doi.org/10.1016/j.ajog.2009.07.033>
- Kramer, M. S., & McDonald, S. W. (2006). Aerobic exercise for women during pregnancy. *Cochrane Database of Systematic Reviews*, *19*, CD000180. <https://doi.org/10.1002/14651858.cd000180.pub2>
- Kruger, J., Lee, C-D., Ainsworth, B. E., & Macera, C. A. (2008). Body size satisfaction and physical activity levels among men and women. *Obesity*, *16*, 1976-1979. <https://doi.org/10.1038/oby.2008.311>
- Liu, J., Blair, S. N., Teng, Y., Ness, A. R., Lawlor, D. A., & Riddoch, C. (2011). Physical activity during pregnancy in a prospective cohort of British women: Results from the Avon longitudinal study of parents and children. *European Journal of Epidemiology*, *26*, 237-247. <https://doi.org/10.1007/s10654-010-9538-1>
- Magro-Malosso, E. R., Saccone, G., Di Tommaso, M., Roman, A., & Berghella, V. (2017). Exercise during pregnancy and risk of gestational hypertensive disorders: A systematic review and meta-analysis. *Acta Obstetrica et Gynecologica Scandinavica*, *96*, 921-931. <https://doi.org/10.1111/aogs.13151>
- Matsuzaki, M., Haruna, M., Nakayama, K., Shiraishi, M., Ota, E., Murayama, R., ... Yeo, S. (2014). Adapting the Pregnancy Physical Activity Questionnaire for Japanese pregnant women. *Journal of Obstetric, Gynecologic & Neonatal Nursing*, *43*, 107-116. <https://doi.org/10.1111/1552-6909.12267>
- Matsuzaki, M., Haruna, M., Ota, E., Yeo, S., Murayama, R., & Murashima, S. (2010). Translation and cross-cultural adaptation of the Pregnancy Physical Activity Questionnaire (PPAQ) to Japanese. *Bioscience Trends*, *4*, 170-177. <http://www.biosciencetrends.com/action/downloaddoc.php?docid=329>
- Ministry of Health, Labour and Welfare. (2015). Vital statistics in Japan: Trends up to 2015. Retrieved from <http://www.mhlw.go.jp/english/database/db-hw/dl/81-1a2en.pdf>
- Ministry of Health, Labour and Welfare. (2016). National Health and Nutrition Survey. Retrieved from [http://www.mhlw.go.jp/file/04-Houdouhappyyou-10904750-Kenkoukyoku-Gantaisakukenkouzoushinka/kekkgaiyou\\_7.pdf](http://www.mhlw.go.jp/file/04-Houdouhappyyou-10904750-Kenkoukyoku-Gantaisakukenkouzoushinka/kekkgaiyou_7.pdf)
- Muktabhant, B., Lawrie, T. A., Lumbiganon, P., & Laopai-boon, M. (2015). Diet or exercise, or both, for preventing excessive weight gain in pregnancy. *Cochrane Database of Systematic Reviews*, *15*, CD007145. <https://doi.org/10.1002/14651858.cd007145.pub3>
- Nascimento, S. L., Surita, F. G., Godoy, A. C., Kasawara, K. T., & Morais, S. S. (2015). Correction: Physical activity patterns and factors related to exercise during pregnancy: A cross sectional study. *PLoS One*, *10*(7), e0133564. <https://doi.org/10.1371/journal.pone.0133564>

- Royal College of Obstetricians and Gynaecologists. (2006). RCOG Statement No. 4. Exercise in pregnancy. Retrieved from <http://www.progresshealth.co.uk/pdfs/Exercise%20in%20Pregnancy.pdf>
- Walsh, J. M., McGowan, C., Byrne, J., & McAuliffe, F. M. (2011). Prevalence of physical activity among healthy pregnant women in Ireland. *International Journal of Gynecology & Obstetrics*, 114, 154-155. <https://doi.org/10.1016/j.ijgo.2011.02.016>
- Yeo, S., Walker, J. S., Caughey, M. C., Ferraro, A. M., & Asafu-Adjei, J. K. (2017). What characteristics of nutrition and physical activity interventions are key to effectively reducing weight gain in obese or overweight pregnant women? A systematic review and meta-analysis. *Obesity Reviews*, 18, 385-399. <https://doi.org/10.1111/obr.12511>
- Zaccagni, L., Masotti, S., Donati, R., Mazzoni, G., & Gualdi-Russo, E. (2014). Body image and weight perceptions in relation to actual measurements by means of a new index and level of physical activity in Italian university students. *Journal of Translational Medicine*, 12, 42. <https://doi.org/10.1186/1479-5876-12-42>