



# The impact of sedentary behavior after childbirth on postpartum lumbopelvic pain prolongation: A follow-up cohort study

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(Degree)

博士 (保健学)

(Date of Degree)

2022-03-25

(Date of Publication)

2023-03-01

(Resource Type)

doctoral thesis

(Report Number)

甲第8340号

(URL)

<https://hdl.handle.net/20.500.14094/D1008340>

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# 博士論文

## **The impact of sedentary behavior after childbirth on postpartum lumbopelvic pain prolongation: A follow-up cohort study**

(産後腰骨盤痛の遷延に対する出産後の座位行動の影響：後向きコホート研究)

令和 4 年 1 月 11 日

神戸大学大学院保健学研究科保健学専攻

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○Title page

**The impact of sedentary behavior after childbirth on postpartum lumbopelvic pain  
prolongation: a follow-up cohort study**

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4509

**Running title:**

Impact of sedentary behavior on postpartum LBPP

**Keywords:**

Physical activity, sedentary behavior, low back pain, pelvic girdle pain, postpartum,  
parity

## ○Abstract (244 words)

**Background:** A substantial number of women have postpartum lumbopelvic pain (LBPP). Additionally, many postpartum women stay for long inactivity. Therefore, we examined the impact of sedentary behavior on persistent postpartum LBPP and the difference in this impact due to parity.

**Methods:** This cohort study followed up women who had reported LBPP at 4-month postpartum and divided them into the presence or absence of LBPP at 10-month postpartum. Sedentary time and physical activity were assessed at 4-month postpartum using the International Physical Activity Questionnaire short form. Univariate and multivariate logistic regression analysis was used to calculate persistent LBPP odds ratios (ORs) according to sedentary times, followed by stratification analysis by parity.

**Results:** A total of 182 women ( $32.1 \pm 5.1$  years old) were included for analysis and 112 (61.5%) participants had persistent LBPP at 10 months postpartum. Those with persistent LBPP at 10-month postpartum had increased sedentary time [5.0 (3.0-7.0) hours vs. 3.5 (2.0-6.0) hours,  $p = 0.05$ ] at 4-month compared to those without LBPP.

Even after adjusting for confounding factors, longer sedentary time at 4-month postpartum affected persistent LBPP at 10-month postpartum in primiparas [adjusted OR (95% confidence interval (CI)) = 1.28 (1.05-1.55)], but longer sedentary time at 4-

month postpartum did not affect persistent LBPP at 10-month postpartum in multiparas [adjusted OR (95% CI) = 0.96 (0.86-1.07)].

Conclusion: Sedentary behavior after childbirth is associated with persistent postpartum LBPP in primiparas, but not multiparas. Reducing sedentary time might be beneficial to prevent persistent postpartum LBPP for primiparas.

## INTRODUCTION

Pregnancy-related low back pain (PLBP) and pregnancy-related pelvic girdle pain (PGP) are the most frequent symptom experienced during pregnancy, occurring in almost half of pregnant women.<sup>1,2</sup> PLBP and PGP peak around 36 weeks of gestation and spontaneously subside after delivery.<sup>1,2</sup> However, in a substantial number of cases, PLBP and PGP remains persistent during the postpartum period.<sup>2,3</sup> In this article, we used the term postpartum lumbopelvic pain (LBPP) to refer to this PLBP and/or PGP after childbirth.<sup>2</sup> The prevalence of postpartum LBPP is approximately four times higher than that in women of the same age.<sup>4</sup> Postpartum LBPP has been shown to decrease daily and professional activities, require sick leave, increase postpartum depression, and reduce self-efficacy.<sup>5</sup> PLBP and PGP are largely due to the physical and morphological changes that occur during pregnancy,<sup>1</sup> which continue until approximately 4-6 weeks after delivery, but then resolve.<sup>6</sup> Therefore, new additional factors might contribute to postpartum LBPP prolongation. However, many of the relevant factors considered in postpartum LBPP studies are during pregnancy or pre-pregnancy.<sup>7,8</sup>

Although international guidelines include physical activity (PA) recommendations for postpartum women, many postpartum women do not achieve the recommended

level of PA.<sup>9</sup> A previous prospective study revealed that although the levels of total and moderate activity increased after childbirth over the long term, the change was very small and the sedentary time was very large, as assessed by an accelerometer.<sup>10</sup> While evidence regarding the relevance of inactivity to low back pain is limited,<sup>11</sup> pain intensity is increased in pregnant women with a longer sitting time.<sup>12</sup> Therefore, the inactivity in postpartum women may be considered the most relevant factor in postpartum LBPP prolongation. However, the relation between sedentary behavior after childbirth and persistent postpartum LBPP remains unknown. In addition, postpartum women tend not to have adequate time for ensuring PA, especially primiparas who are unfamiliar with childcare.<sup>13,14</sup> On the other hand, increased activity of the child might enable the mother to come close to the adequate PA.<sup>13</sup> The content of PA accompanying childcare is likely to differ between primiparous and multiparous women. Therefore, it is meaningful to examine the impact of sedentary behavior on persistent postpartum LBPP with stratification by parity.

Hence, the primary aim of this follow-up cohort study was to examine the impact of sedentary behavior after childbirth on postpartum LBPP prolongation. The secondary aim of this study was to investigate the difference in the impact of sedentary behavior between primiparous and multiparous women.



## **MATERIAL AND METHODS**

### **1. Study design and participants**

This study was a follow-up study of a cohort of postpartum women who participated in both 4- and 10-month Well Child Checkups from February 2016 to June 2019 in a city in Hyogo Prefecture, Japan. Participants filled out a self-report questionnaire at each time point 4 months (baseline; Q1) and 10 months (follow-up; Q2) postpartum. Women who had postpartum LBPP at Q1 were thus considered eligible for the study regardless of PLBP and PGP before that, and divided into the presence or absence of LBPP at Q2 to compare their characteristics. The exclusion criteria were as follows: (1) history of spinal disease (fracture, neoplasm, and others); (2) diagnosis of spinal problems in the previous 2 months; (3) history of surgery (spinal, pelvic, or femoral); (4) multiple birth; (5) two births during the study period; and (6) incomplete questionnaire or medical record data.

All participants provided written informed consent prior to participation at 4-month Well Child Checkup, in accordance with the standards of the Declaration of Helsinki. Ethical approval for this study was obtained from the Research Ethics Committee of Kobe University Graduate School of Health Sciences (reference no. 449-1).

## **2. Measurements**

### **2.1. Demographic and clinical variables**

Demographic characteristics and clinical variables were assessed at Q1, and their obstetrical data were obtained from medical records. Demographic characteristics included age, height, weight before pregnancy, at the end of pregnancy, and 4 months postpartum; spinal diseases diagnosed in the previous 2 months; and a history of fracture, surgery, or neoplasm of the spine, pelvis, or femur. Height and weight were used for body mass index (BMI) calculation. Weight gain was calculated as the difference between the weight at 4 months postpartum and the weight before pregnancy. Weight loss was calculated as the difference between the weight at 4 months postpartum and the weight at the end of the pregnancy. Data regarding the number of deliveries, alcohol consumption (yes/ no), smoking history (never/ current/ past), and employment status (yes/ no) were obtained from medical records.

### **2.2. Low back and pelvic pain**

The presence of LBPP at 4 months postpartum, as well as before and during pregnancy, was ascertained at Q1. The presence of LBPP at 10 months postpartum was ascertained at Q2. LBPP before pregnancy was defined as a history of LBPP. LBPP at

10-month postpartum was defined as persistent postpartum LBPP in this study. LBPP was defined as pain between the 12th rib and gluteal folds, between the posterior iliac crest and gluteal folds, and/or proximate to the pubic symphysis, as shown in Figure 2.<sup>15</sup> Participants who indicated pain in two or more of these sites were categorized as having combined pain. The intensity of the LBPP at 4- and 10-month postpartum were assessed using an 11-point numerical rating scale (NRS), ranging from 0 to 10, with 0 points indicating no pain and 10 points indicating the worst possible pain. The NRS is valid, reliable, and appropriate for use in clinical practice, with good sensitivity, and generates data that can be statistically analyzed for auditing purposes.<sup>16</sup>

### **2.3. Sedentary behavior and physical activity**

Sedentary time and PA were measured at Q1 and Q2 using the International Physical Activity Questionnaire short form (IPAQ-SV). The IPAQ-SV contains an item on sitting or lying time per day, which has demonstrated validity and reliability.<sup>17,18</sup> The previous study revealed that the IPAQ sitting question indicated good test-retest reliability (Spearman's  $\rho = 0.77$ ) and acceptable validity against accelerometers (Spearman's  $\rho = 0.43$ ).<sup>18</sup> Following many studies that have examined sedentary behavior, sedentary time was shown in hour increments.<sup>19</sup> The item asks for an estimation of the total number of hours and minutes per day spent sitting or lying at

work, at home, while doing course work, and during leisure time, excluding sleep time.

In this study, the sedentary time was defined as the sitting or lying time per day on the IPAQ-SV.

The IPAQ-SV also contains 6 items on the frequency and duration of three categorized PA (walking, moderate activities, and vigorous physical activities) during the last 7 days. The activities are undertaken at work, as part of the house and yard work, to get from place to place, and in the spare time for recreation, exercise, or sport. The selected metabolic equivalent of task (MET) values were derived from the IPAQ Reliability Study undertaken in 2000-2001.<sup>17</sup> The following values continue to be used to analyze IPAQ data: walking = 3.3 METs, moderate PA = 4.0 METs, and vigorous PA = 8.0 METs. Using these values, four continuous scores were defined: Walking (Moderate, Vigorous) MET-minutes/week = 3.3 (4.0, 8.0) \* activity minutes \* activity days; Total PA MET-minutes/week = sum of Walking + Moderate + Vigorous MET-minutes/week scores.

## **2.4. Disability from low back pain**

The degree of disability experienced during daily activities resulting from low back pain was assessed at Q1 and Q2 using the Roland-Morris Disability Questionnaire (RDQ).<sup>20</sup> The RDQ, which contains 24 items, represents the execution of daily PAs and

functions that may be affected by low back pain, such as housework, sleeping, mobility, dressing, getting help, appetite, irritability, and pain severity. The higher total score (0-24 points) indicates a greater degree of disability. The RDQ is the most comprehensively validated measure in low back pain and is available in many languages. It can be used in patients with acute, subacute, and chronic low back pain.<sup>21</sup>

## **2.5. Depressive symptoms**

Depressive symptoms were assessed at Q1 and Q2 using the 10-item (short form) Center for Epidemiological Studies Depression Scale (CES-D). The scores on each item were summed to calculate the total score. A higher total score (0-30 points) indicates more severe depressive symptoms.<sup>22</sup>

## **3. Statistical analysis**

For continuous variables, data normality was evaluated using the Shapiro–Wilk test. Data are presented as means (standard deviation; SD) or medians (inter-quartile range or range) for continuous variables and as numbers of participants (percentages) for categorical variables. Demographic variables were compared between women with and without persistent LBPP at 10 months postpartum using the independent t-test or Mann-Whitney U test, as appropriate, for continuous variables; the Fisher’s exact test was

used for categorical variables. The association between sedentary behavior and persistent LBPP was evaluated in a univariate logistic regression analysis, followed by multivariate logistic regression analysis. Odds ratios (ORs) and 95% confidence intervals (95% CIs) were calculated. The objective variable was the presence of persistent LBPP, and the explanatory variable was sedentary behavior. We selected the following factors as relevant confounding variables: age, parity, BMI, CES-D, and NRS at 4 months postpartum.<sup>23,24,25</sup> We further examined the impact of sedentary behavior on persistent LBPP with stratification by parity. Statistical significance was set at 0.05. All statistical analyses were performed using the statistical software, EZR 1.40 (based on R 3.5.2).<sup>26,27</sup>

## **RESULTS**

### **1. Characteristics of the participants and comparison based on the persistent postpartum LBPP and parity**

In total, 401 women completed self-report both Q1 and Q2. Of the total sample, 213 participants were included based on the criterion of having LBPP at 4-month postpartum. Thirty-one participants were excluded based on the exclusion criteria, and the remaining 182 postpartum women were included for the analysis. (Figure 1).

The mean age of the participants was 32.1 (SD 5.1) years old; 83 (45.6%) of the women were primiparas. Of the 182 women, 112 (61.5%) had persistent LBPP at 10 months postpartum. Table 1 showed the descriptive information of the participants and comparison based on the presence of persistent LBPP at 10-month postpartum. There were significant differences between women with and without persistent LBPP in the sedentary time at 4 months postpartum [5.0 (IQR 3.0-7.0) hours vs. 3.5 (IQR 2.0-6.0) hours,  $P=0.05$ ] and the CES-D at 4 months postpartum [4.8 (SD 4.2) vs 3.5 (SD3.0),  $P=0.03$ ]. Women with persistent LBPP had a significantly higher prevalence of a history of LBPP (37.5% vs 18.6%,  $P<0.01$ ), LBPP during pregnancy (94.6% vs 84.3%,  $P<0.01$ ), and combined pain at 4 months postpartum (39.6% vs 20.3%,  $P<0.01$ ) than women without persistent postpartum LBPP. There were also significant differences in the pain intensity during pregnancy [5 (IQR 3-7) vs 4 (IQR 3-5),  $P<0.01$ ], and at 4 months postpartum [4 (IQR 3-6) vs 3 (IQR 3-4),  $P<0.01$ ]. Finally, the RDQ total score at 4 months postpartum was higher in women with persistent LBPP than in those without persistent LBPP [2 (IQR 1-4) vs 1 (IQR 0-2),  $P<0.01$ ].

Table 2 showed the characteristics of the participants and comparison based on parity. When comparing both groups, primiparas had significant longer sedentary time [5.0 (IQR 3.0-7.0) vs 4.0 (IQR 2.0-6.0),  $p=0.02$ ] and less moderate PA [0 (range 0-

3600) vs 0 (range 0-5040),  $p<0.01$ ] at 4-months postpartum. Weight loss from end-pregnancy weight to 4-month postpartum was more in primiparas [8.5 (SD 3.7) vs 7.4 (SD 3.6),  $p=0.05$ ].

## **2. Impact of sedentary behavior on persistent postpartum LBPP**

In the entire cohort, sedentary behavior at 4 months postpartum did not have a significant impact on persistent LBPP (Table 3). Factors affecting postpartum LBPP prolongation were the intensity of LBPP and degree of depressive symptoms at 4 months postpartum in all patients. However, using stratification analysis by parity (Table 4), primiparas with a longer sedentary time at 4 months postpartum were more likely to have persistent LBPP than were primiparas with a shorter sedentary time, even after adjusting for age, BMI, CES-D, and NRS at 4 months postpartum (OR: 1.28, 95% CI: 1.08-1.53, adjusted OR: 1.28, 95% CI: 1.05-1.55). In contrast, in multiparous women, sedentary behavior at 4 months postpartum did not have a significant impact on persistent postpartum LBPP. Factors affecting postpartum LBPP prolongation in multiparas was only the intensity of LBPP at 4 months postpartum.

## **DISCUSSION**



In the present study, the univariate analysis suggested that postpartum sedentary behavior was significantly associated with persistent postpartum LBPP. However, regression analysis showed, both in the crude model and the adjusted model, that sedentary behavior impacted postpartum LBPP prolongation only in primiparous women. The impact of sedentary behavior was not significant in all and multiparous women, but instead highlighted the impacts of depressive symptoms and pain intensity at 4-month postpartum LBPP.

A previous cohort study revealed that the association between PA and typical back pain follows a U-shaped model,<sup>28,29</sup> suggesting that both sedentary behavior and high-intensity PA have harmful effects on typical back pain. Postpartum women have greater pelvic floor muscle dysfunction,<sup>30</sup> greater fatigability of the lumbopelvic stabilizing muscles, and lower physical function<sup>31</sup> than do nulliparous women. The adverse effects of sedentary behavior include increased intervertebral disc load<sup>32</sup> and weakened posterior lumbar structure.<sup>33,34</sup> Therefore, the mechanical stress caused by sitting for a long period of time has a stronger effect in postpartum women with support structure failure due to pregnancy and childbirth. However, it should be noted that adjusting the confounding factors in the regression analysis offsets the impact of sedentary behavior; more so, the impact of depressive symptoms and intensity of pain were excluded. In the

systematic review, many psychosocial factors such as depressive symptoms and quality of life are related factors for both postpartum LBPP<sup>35</sup> and sedentary behavior<sup>36</sup> in addition to age and BMI. Therefore, for the prolongation of postpartum LBPP, psychosocial approaches such as depressive symptoms and quality of life, which are the background of sedentary behavior, are also very important.

A comparison of participants' characteristics based on their birth history showed that primiparas had longer sedentary behavior and less moderate PA than multiparous women. In postpartum women, childcare is characteristically one of the major social factors and accounts for the majority of PA, increasing over time as the child becomes more active.<sup>37</sup> There is a strong correlation between the mother's PA and that of infants aged 3-24 months, especially when the mother is the primary caregiver.<sup>38</sup> It is probable that there is a difference in activity levels between mothers of infants who are not yet mobile (primiparas) and mothers in charge of raising an older child (multiparas). Therefore, differences in the child's activity level during childcare may have caused the observed difference between primiparous and multiparous women in the impact of sedentary behavior on persistent postpartum LBPP.

Furthermore, differences in the circumstances leading to more sedentary behavior, physical and psychosocial factors, may underlie the difference observed in the impact of

sedentary behavior on persistent LBPP between primiparous and multiparous women.

In fact, confounding-adjusted models showed the impacts of pain intensity of LBPP at 4-month postpartum and depressive symptoms in all and multiparous women.

Multiparous women have a higher prevalence of postpartum pelvic floor muscle function decline<sup>39</sup> and diastasis recti abdominis.<sup>40</sup> and greater joint mobility during pregnancy<sup>41,42</sup> than primiparous women. In addition, these problems persist after delivery.<sup>42</sup> Also, the prevalence of postpartum depression is higher in primiparas than in multiparas<sup>43</sup>, but in our cohort, the depressive symptoms tended to be severe in multiparas. Thus, the degree of impact of physical dysfunction and postpartum depression behind sedentary behavior was so strong in multiparous women that it resulted differently.

The present study results suggest that reducing sedentary time could help prevent postpartum LBPP prolongation in primiparous women who cannot secure sufficient leisure-time PA. On the other hand, it is desirable for all and multiparous women to pay attention to psychosocial approaches to pain intensity and depressive symptoms instead of sedentary behavior. To our knowledge, this was the first study to examine the impact of sedentary behavior on persistent LBPP during the postpartum period. However, several limitations must be acknowledged in interpreting the results. First, the data were

mainly obtained using self-report questionnaires, and were therefore poor in objectivity and subject to recall bias. Especially for PA, even though a reliable and valid evaluation method was used, it may be difficult for postpartum women who are focused on childcare to remember activity details. Second, our cohort did have postpartum LBPP, but its degree of disability and pain intensity were mild. However, they were not specific and were comparable to previous studies<sup>24,44</sup>, so generalization is possible. Third, as psychosocial factors are related to the impact of sedentary behavior, this study's results may vary by country and culture. Finally, although the support structure failure due to pregnancy and delivery might affect the association between sedentary behavior and persistent postpartum LBPP, the present study did not investigate pelvic floor muscle function or joint hypermobility. Therefore, the investigation of physical factors, such as support structure failure, is needed to further identify the basis of the impact of sedentary behavior on persistent postpartum LBPP.

## **CONCLUSION**

The present study found that sedentary behavior during the postpartum period was associated with persistent postpartum LBPP only in primiparas. The finding suggests that reducing sedentary time after delivery might be beneficial in preventing postpartum

LBPP prolongation in primiparas who cannot secure sufficient leisure-time PA. On the other hand, it is desirable for all and multiparous women to pay attention to psychosocial approaches to pain intensity and depressive symptoms instead of sedentary behavior.

## **ACKNOWLEDGMENTS**

We are grateful to Aoi Ebina and Yuki Kondo for their contributions in designing the study and data collection, and we thank the public-health nurses for their aid in recruiting women to participate in this study. We would like to thank Editage ([www.editage.jp](http://www.editage.jp)) for English language editing.

## **Author contribution statement**

EA has made substantial contributions to conceptualization and methodology, formal analysis, investigation and writing original draft. KK and KT has made substantial contributions to conceptualization and investigation, writing review and editing. YT, NM, KH, and EP have made substantial contributions to investigation. All authors read and approved the final manuscript.

#### Author disclosure statement

No competing financial interests exist.

#### Funding information

No funds were received in support of this work.

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**FIGURE LEGENDS**

Figure 1: Participant selection flowchart

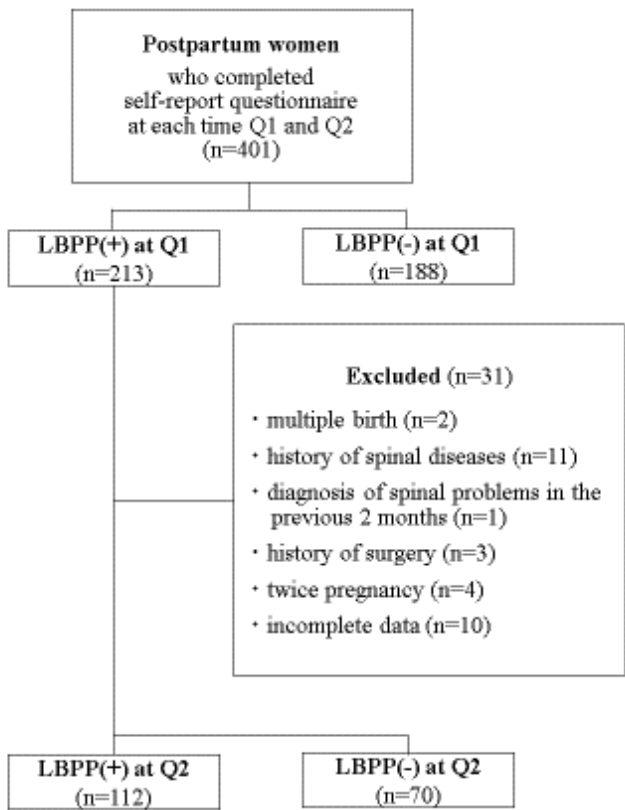


Figure 1: Participant selection flowchart

Q1: 4-month postpartum, baseline; Q2: 10-month postpartum, follow-up  
LBPP: lumbopelvic pain; (+): presence of LBPP; (-): absence of LBPP

Figure 2: Localization of lumbopelvic pain

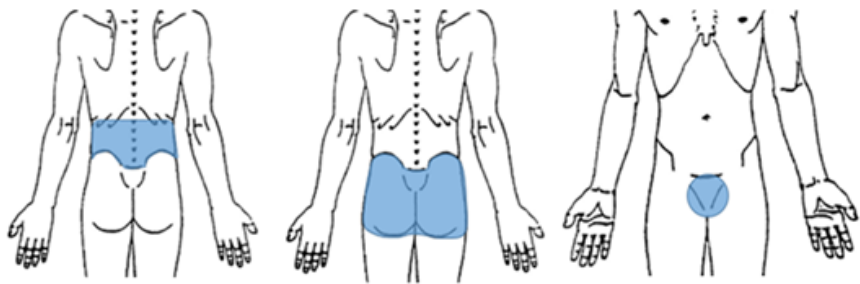


Figure 2: Localization of lumbopelvic pain

Table 1: Descriptive information of the participants and comparison based on the presence of persistent postpartum LBPP at 10-month postpartum

| Characteristics                        | Overall<br>(n = 182) | LBPP at 10M                |                             | P value |
|--|----------------------|----------------------------|-----------------------------|---------|
|  |                      | LBPP at 10M(−)<br>(n = 70) | LBPP at 10M(+)<br>(n = 112) |         |
| Age (y)                                | 32.1 (5.1)           | 32.1 (4.8)                 | 32.1 (5.4)                  | 1.00    |
| BMI (kg/m <sup>2</sup> )               | 21.9 (2.6)           | 21.9 (2.3)                 | 21.9 (2.8)                  | 0.89    |
| Weight (kg)                            | 54.9 (7.5)           | 55.0 (6.6)                 | 54.9 (8.1)                  | 0.97    |
| Weight gain (kg)                       | 1.6 (3.1)            | 1.2 (2.9)                  | 1.8 (3.1)                   | 0.16    |
| Weight loss (kg)                       | 7.9 (3.7)            | 8.3 (3.0)                  | 7.66 (4.0)                  | 0.24    |
| Primipara [n (%)]                      | 83 (45.6)            | 30 (42.9)                  | 53 (47.3)                   | 0.65    |
| Alcohol consumption, yes [n (%)]       | 1 (0.6)              | 1 (1.5)                    | 0 (0.0)                     | 0.38    |
| Smoking, [n (%)]                       | never                | 169 (97.7)                 | 63 (96.9)                   | 1.00    |
|  | current              | 2 (1.2)                    | 1 (1.5)                     |         |
|  | past                 | 2 (1.2)                    | 1 (1.5)                     |         |
| Working, yes [n (%)]                   | 9 (4.9)              | 3 (4.3)                    | 6 (5.4)                     | 1.00    |
| CES-D total 4M                         | 4.3 (3.8)            | 3.5 (3.0)                  | 4.8 (4.2)                   | 0.03    |
| LBPP factors                           |                      |                            |                             |         |
| History of LBPP (%)                    | 55 (30.2)            | 13 (18.6)                  | 42 (37.5)                   | <0.01   |
| LBPP during pregnancy [n (%)]          | 165 (90.7)           | 59 (84.3)                  | 106 (94.6)                  | 0.03    |
| NRS during pregnancy*                  | 5 [3-6]              | 4 [3-5]                    | 5 [3-7]                     | <0.01   |
| Combined pain during pregnancy [n (%)] | 95 (57.6)            | 30 (50.8)                  | 65 (61.3)                   | 0.25    |
| NRS at 4M*                             | 4 [3-5]              | 3 [3-4]                    | 4 [3-6]                     | <0.01   |
| Combined pain at 4M [n (%)]            | 58 (32.2)            | 14 (20.3)                  | 44 (39.6)                   | <0.01   |
| RDQ total 4M*                          | 2 [0-3]              | 1 [0-2]                    | 2 [1-4]                     | <0.01   |
| PA factors                             |                      |                            |                             |         |
| Sedentary time at 4M (hours)*          | 4.0 [2.3-7.0]        | 3.5 [2.0-6.0]              | 5.0 [3.0-7.0]               | 0.05    |
| Total PA at 4M (METs min/week)*        | 396 [132-804]        | 72396 [132-841.5]          | 396 [132-804]               | 0.88    |
| Walking PA at 4M (METs min/week)*      | 297 [90.8-668.3]     | 297 [99-618.8]             | 297 [0-668.3]               | 0.33    |
| Moderate PA at 4M (METs min/week)†     | 0 [0-5040]           | 0 [0-5040]                 | 0 [0-3600]                  | 0.12    |
| Vigorous PA at 4M (METs min/week)†     | 0 [0-720]            | 0 [0-0]                    | 0 [0-720]                   | 0.26    |

Data are presented as mean (standard deviation), or \*median[inter-quartile range], †median[range]

LBPP: lumbopelvic pain; (−): absence of pain; (+): presence of pain; 4 (10)M: 4 (10)-month postpartum; BMI: body mass index; CES-D: The Center for Epidemiologic Studies Depression Scale; NRS: Numerical Rating Scale; RDQ: Roland-Morris Disability Questionnaire; PA: Physical Activity; MET: metabolic equivalent of task; min: minutes; Weight gain = weight at 4-month postpartum − pre-pregnancy weight, weight loss = end-pregnancy weight − weight at 4-month postpartum; Combined pain = two or more pain between the 12th rib and gluteal folds and / or the posterior iliac crest and the gluteal fold and / or proximate to the pubic symphysis

Table2. Descriptive information of the participants and comparison based on parity

| Characteristics                        | Overall<br>(n = 182) | Parity              |                     | <i>P</i> value |
|--|----------------------|---------------------|---------------------|----------------|
|  |                      | primipara<br>(n=83) | multipara<br>(n=99) |                |
| Age (y)                                | 32.1 (5.1)           | 31.3 (5.9)          | 32.7 (4.4)          | 0.06           |
| BMI (kg/m <sup>2</sup> )               | 21.9 (2.6)           | 22.1 (2.8)          | 21.7 (2.5)          | 0.36           |
| Weight (kg)                            | 54.9 (7.5)           | 55.0 (7.7)          | 54.8 (7.4)          | 0.88           |
| Weight gain (kg)                       | 1.6 (3.1)            | 1.8 (2.8)           | 1.4 (3.3)           | 0.44           |
| Weight loss (kg)                       | 7.9 (3.7)            | 8.5 (3.7)           | 7.4 (3.6)           | 0.05           |
| Alcohol consumption, yes [n (%)]       | 1 (0.6)              | 1 (1.3)             | 0 (0.0)             | 0.44           |
| Smoking [n (%)]                        | never                | 169 (97.7)          | 74 (97.4)           | 1.00           |
|  | current              | 2 (1.2)             | 1 (1.3)             |                |
|  | past                 | 2 (1.2)             | 1 (1.3)             |                |
| Working, yes [n (%)]                   | 9 (4.9)              | 3 (3.6)             | 6 (6.1)             | 0.51           |
| CES-D total 4M                         | 4.3 (3.8)            | 4.2 (3.3)           | 4.4 (4.2)           | 0.87           |
| LBPP factors                           |                      |                     |                     |                |
| History of LBPP [n (%)]                | 55 (30.2)            | 24 (28.9)           | 31 (31.3)           | 0.75           |
| LBPP during pregnancy [n (%)]          | 165 (90.7)           | 74 (89.2)           | 91 (91.9)           | 0.61           |
| NRS during pregnancy*                  | 5 [3-6]              | 4 [3-6]             | 5 [3-7]             | 0.28           |
| Combined pain during pregnancy [n (%)] | 95 (57.6)            | 41 (55.4)           | 54 (59.3)           | 0.64           |
| NRS at 4M*                             | 4 [3-5]              | 4 [3-5]             | 4 [3-5]             | 0.68           |
| Combined pain at 4M [n (%)]            | 58 (32.2)            | 26 (32.1)           | 32 (32.3)           | 1.00           |
| RDQ total 4M*                          | 2 [0-3]              | 2 [1-3]             | 1 [0-3]             | 0.19           |
| LBPP at 10M [n (%)]                    | 112 (61.5)           | 53 (63.9)           | 59 (59.6)           | 0.09           |
| PA factors                             |                      |                     |                     |                |
| Sedentary time at 4M (hours)*          | 4.0 [2.3-7.0]        | 5.0 [3.0-7.0]       | 4.0 [2.0-6.0]       | 0.02           |
| Total PA at 4M (METs min/week)*        | 396 [132-804]        | 396 [132-759]       | 297 [112.5-1071.4]  | 0.89           |
| Walking PA at 4M (METs min/week)*      | 297 [90.8-668.3]     | 396 [132-594]       | 198 [66-693]        | 0.25           |
| Moderate PA at 4M (METs min/week)†     | 0 [0-5040]           | 0 [0-3600]          | 0 [0-5040]          | <0.01          |
| Vigorous PA at 4M (METs min/week)†     | 0 [0-720]            | 0 [0-720]           | 0 [0-480]           | 0.89           |

Data are presented as mean (standard deviation), or \*median[inter-quartile range], †median[range]

LBPP: lumbopelvic pain; (—): absence of pain; (+): presence of pain; 4 (10)M: 4 (10)-month postpartum; BMI: body mass index; CES-D: The Center for Epidemiologic Studies Depression Scale; NRS: Numerical Rating Scale; RDQ: Roland-Morris Disability Questionnaire; PA: Physical Activity; MET: metabolic equivalent of task; min: minutes; Weight gain = weight at 4-month postpartum — pre-pregnancy weight, weight loss = end-pregnancy weight — weight at 4-month postpartum; Combined pain = two or more pain between the 12th rib and gluteal folds and / or the posterior iliac crest and the gluteal fold and / or proximate to the pubic symphysis



Table 3: Logistic regression analysis of the association between sedentary behavior and persistent postpartum LBPP in the entire cohort

|                               | Crude model      |                | Adjusted model   |                |
|-------------------------------|------------------|----------------|------------------|----------------|
|                               | OR (95% CI)      | <i>P</i> value | OR (95% CI)      | <i>P</i> value |
| Sedentary time at 4M          | 1.08 (0.99-1.17) | 0.08           | 1.04 (0.96-1.14) | 0.33           |
| Age                           |                  |                | 1.02 (0.95-1.09) | 0.63           |
| BMI                           |                  |                | 0.96 (0.85-1.09) | 0.55           |
| Parity (reference: primipara) |                  |                | 0.88 (0.45-1.69) | 0.69           |
| CES-D at 4M                   |                  |                | 1.11 (1.01-1.23) | 0.03           |
| NRS at 4M                     |                  |                | 1.33 (1.11-1.60) | < 0.01         |

LBPP: lumbopelvic pain; 4M: 4-month postpartum; BMI: body mass index; CES-D: The Center for Epidemiologic Studies Depression Scale; NRS: Numerical Rating Scale; OR: odds ratio; CI: confidence interval  
Odds ratios and confidence intervals are adjusted for all variables in this table

Table 4: Logistic regression analysis of the association between sedentary behavior and persistent postpartum LBPP stratified by parity (primiparous/ multiparous)

|                      | Primipara           |          |                     |          | Multipara           |          |                     |          |
|----------------------|---------------------|----------|---------------------|----------|---------------------|----------|---------------------|----------|
|                      | Crude model         |          | Adjusted model      |          | Crude model         |          | Adjusted model      |          |
|                      | OR                  | <i>P</i> | OR                  | <i>P</i> | OR                  | <i>P</i> | OR                  | <i>P</i> |
|                      | (95% CI)            | value    | (95% CI)            | value    | (95% CI)            | value    | (95% CI)            | value    |
| Sedentary time at 4M | 1.28<br>(1.08-1.53) | <0.01    | 1.28<br>(1.05-1.55) | 0.01     | 0.99<br>(0.90-1.09) | 0.84     | 0.96<br>(0.86-1.07) | 0.45     |
| Age                  |                     |          | 1.07<br>(0.97-1.17) | 0.17     |                     |          | 0.98<br>(0.88-1.09) | 0.69     |
| BMI                  |                     |          | 0.99<br>(0.82-1.19) | 0.91     |                     |          | 0.96<br>(0.80-1.17) | 0.70     |
| CES-D at 4M          |                     |          | 1.10<br>(0.94-1.29) | 0.24     |                     |          | 1.11<br>(0.98-1.26) | 0.11     |
| NRS at 4M            |                     |          | 1.22<br>(0.90-1.65) | 0.20     |                     |          | 1.43<br>(1.11-1.84) | < 0.01   |

LBPP: lumbopelvic pain; 4M: 4-month postpartum; BMI: body mass index; CES-D: The Center for Epidemiologic Studies Depression Scale; NRS: Numerical Rating Scale; OR: odds ratio; CI: confidence interval

Odds ratios and confidence intervals are adjusted for all variables in this table