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General Section

The relationship between the daily step counts and low back pain during pregnancy

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Summary

Purpose: To investigate the relationship between the change of daily step counts and low back pain (LBP) during pregnancy. *Materials and Methods:* Pregnant women at less than eight weeks of gestation (WG) were recruited. Daily step counts were measured with a pedometer. To assess LBP, the Oswestry disability index (ODI) score was recorded. Thirty-six individuals were divided into the LBP and non-LBP groups. The effect of step counts on LBP between the two groups was analyzed. *Results:* At 16–19 WG, step counts were not considerably changed in the non-LBP group but were significantly increased in the LBP group. At 24–27 and 32–35 WG, step counts were increased in the non-LBP group but were significantly decreased in the LBP group. *Conclusions:* Acute increase of daily step counts in early pregnancy is a risk for LBP, and gradual increases of step counts after mid-pregnancy is recommended for women.

Key words: Low back pain; Physical activity; Pregnancy

Introduction

Low back pain (LBP) is considered a minor complication, but is one of the most common discomforts, during pregnancy, and about 70–85% of all pregnant women experience LBP [1-5]. Some postpartum follow-up studies have shown that about 30–45% of women with pregnancy-related LBP complained about the symptom during three months after delivery [6, 7], and LBP persisted for three years in 17% of these women [8]. Pregnancy-related LBP often adversely influences the activities of daily living such as carrying, cleaning, sitting, and walking, hinders the ability of pregnant women to report for work, and causes sleep disturbance [9, 10]. Consequently, these symptoms lower the quality of life of many pregnant women [11]. Therefore, it is important to reduce pregnancy-related LBP to allow for a comfortable pregnancy.

Some randomized controlled trials have been conducted to prevent or reduce pregnancy-related LBP. Interventions that were found effective for LBP include acupuncture treatment, osteopathic manipulation, spinal manipulation and neuro-emotional technique [12-14]. Recently, some systematic physical exercises, for example, stability ball exercise, aerobic and strengthening exercises, and yoga, have succeeded in decreasing the prevalence of pregnancy-related LBP [15-17]. In addition, physical exercise during pregnancy confers maternal benefits, including improved cardiac function, decreased risk for gestational hypertension and diabetes, improved mental state, and less complicated labor [18, 19]. Previous reports suggest that regular physical exercise is recommended not only for preventing pregnancy-related LBP, but also for maintaining desirable weight and improving the risk profiles of pregnant women [18].

Although some systematic physical exercises have been recommended for pregnancy-related LBP [20], they have some limitations. First, the trials were conducted at different times during pregnancy, and the effective timing for administering exercise is unknown. Second, although regular physical exercise during pregnancy is recommended, heavy or physically demanding work increases the risk of pregnancy-related LBP [21]. There is little knowledge about the ideal timing and intensity of physical activity for pregnant women. Furthermore, many women find it difficult to exercise during pregnancy. Some studies have shown that pregnant women commonly complain about hindrances to leisure-time physical exercise such as financial constraints, feeling of tiredness, being too busy, and experiencing physical limitations [22-25]. Therefore, investigating the activities of daily living, not a specific exercise, is necessary. Many physical activity guidelines containing step-based

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recommendations were published for various population such as children, adolescents, adults, older adults, and special populations [26-28]. Similarly, for pregnancy, walking is the activity that is indispensable to everyday life. Nevertheless, few studies have focused on daily life activities in association with LBP and studies focusing on the benefits of daily walking are lacking [29]. Hence recommendations about daily activities such as walking during pregnancy, including the required the amount of walking, are needed.

On the basis of the above considerations, data about the change of pregnancy-related LBP and the timing and amount of daily physical activity for the prevention or treatment of LBP is needed. The purpose of this study was to investigate the change of pregnancy-related LBP in pregnant women depending on the gestational period and to clarify the relationship between LBP and daily step counts during pregnancy.

Table 1. — *Comparison of groups with and without low back pain.*

	LBP (n = 21)	Non-LBP (n = 15)	p-value
(Unpaired t-test for the interval scale)	Mean ± SD	Mean ± SD	
Age, years	31.5 ± 4.7	32.9 ± 4.8	0.37
Height, m	1.58 ± 0.05	1.59 ± 0.05	0.34
Weight, kg	53.7 ± 15.0	54.1 ± 7.8	0.92
BMI before pregnancy, kg/m^2	21.7 ± 6.1	21.3 ± 2.5	0.80
Step counts			
8–11 WG	3614 ± 1891	3428 ± 1748	0.77
16–19 WG	4840 ± 2810	3676 ± 1728	0.16
24–27 WG	4340 ± 2043	4814 ± 2791	0.56
32–35 WG	3320 ± 1398	4410 ± 2764	0.13
(χ^2 test for the ordinal scale)	n (%)	n (%)	
Pre-pregnancy LBP	5 (23.8%)	3 (20.0%)	0.79
Parous history	11 (52.4%)	5 (33.3%)	0.26
Occupational status	8 (38.1%)	5 (33.3%)	0.91

Materials and Methods

Participants

Pregnant women were recruited at the obstetrics and gynecology clinics in Aichi Prefecture, Japan, between October 2011 and October 2012. One hundred and fifty-six women who met the inclusion criteria for the survey and agreed to participate in the study were observed from eight to 36 weeks of gestation (WG). Before inclusion, the authors provided verbal and written information about the study. The inclusion criteria were <8 WG and a singleton pregnancy. Women with serious orthopedic disorders or neurological diseases were excluded. Those with a high-risk pregnancy were also excluded. Participants were asked to fill out a questionnaire with personal information (height, weight before the pregnancy, parous history, medical history of LBP, and occupation). The authors provided them with an original leaflet for recording their step counts and Oswestry disability index (ODI) (version 2.1a) scores. The present study was carried out in accordance with the guidelines of the Declaration of Helsinki, and the study protocol was reviewed and approved by the Ethics Committee of the Kyoto University Graduate School of Medicine and written informed consent for the survey was obtained in accordance with the guidelines.

Measurement of daily step counts

Daily step counts were measured using a pedometer. Participants were instructed to wear the pedometer after the prenatal checkup for one week bimonthly (8–11, 16–19, 24–27, and 32–35 WG), except during bathing, sleeping, or performing water-based activities, and to record their step counts on the leaflet. The authors calculated the average number of steps per day during the week.

Assessment of LBP

To assess the LBP daily, ODI (version 2.1a) was used [30]. The ODI is a condition-specific tool used in the management of spinal disorders. It attempts to quantify the level of pain interference on physical activities by providing an estimate of disability expressed as a percentage score [31]. It has been used in previous studies on pregnancy-related LBP [32]. This index is a questionnaire with ten sections covering the assessment of pain intensity, personal care, lifting, walking, sitting, standing, sleeping, sex life, social life, and travelling. Each item is scored from 0 to 5, and the scores are calculated as a percentage. A higher percentage score indicates a greater disability. The participants were instructed to record their answers to the ODI questions on the leaflet once a month (8, 12, 16, 20, 24, 28, 32, and 36 WG). In this study, the ODI score was calculated without the item "sex life," as in previous studies, because of the low response rate in Japan (about 60%) and the reduction in the frequency of sexual activity during pregnancy [33, 34]. The authors determined the presence or absence of LBP in each pregnant woman on the basis of the score at the last period (36 WG) because the intensity of pregnancy-related LBP usually increases throughout pregnancy [35] and reaches a peak in both prevalence and severity during the third trimester [4, 36].

Statistical analyses

The participants were divided into two groups (LBP group and non-LBP group) according to the ODI score at 36 WG (≥ 10% or < 10%, respectively), as in a previous study [32]. To compare the interval scale between the two groups, an unpaired t-test was used, and to compare the ordinal scale, the χ^2 test was used. For the change of ODI score through the pregnancy, a two-way analysis of variance (ANOVA) with repeated measures was conducted to determine any significant difference in the measurements by time between the two groups. To analyze the effect of daily step counts on LBP, a two-way ANOVA with repeated measures was used for the step counts of every time point (8–11, 16–19, 24–27, and 32–35 WG) in both groups. When a significant difference was found in the two-way ANOVA, the authors performed a multiple comparison using a paired t-test with Bonferroni correction, for verification. Data were entered and analyzed using the Statistical Package for the Social Sciences. For all analyses, $p < 0.05$ was considered statistically significant.

Results

Characteristics

Among the participants (n = 156), 83 had complete records on the leaflet, whereas 47 were lacking some records of step counts or ODI scores, or gave birth before 36

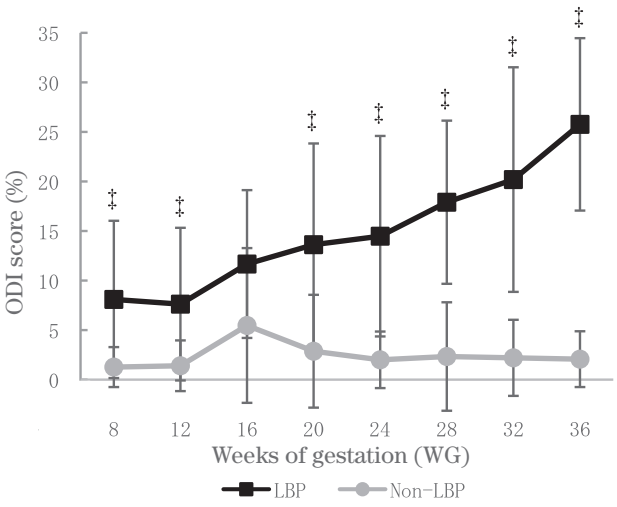

Figure 1. — Changes of the ODI score in the non-LBP and LBP groups. F-value (group × time): [main effect] 11.64, [interaction] 11.81 ($p < 0.001$). ‡Significant differences were found between the two groups ($p < 0.0063$ [0.05/8]).

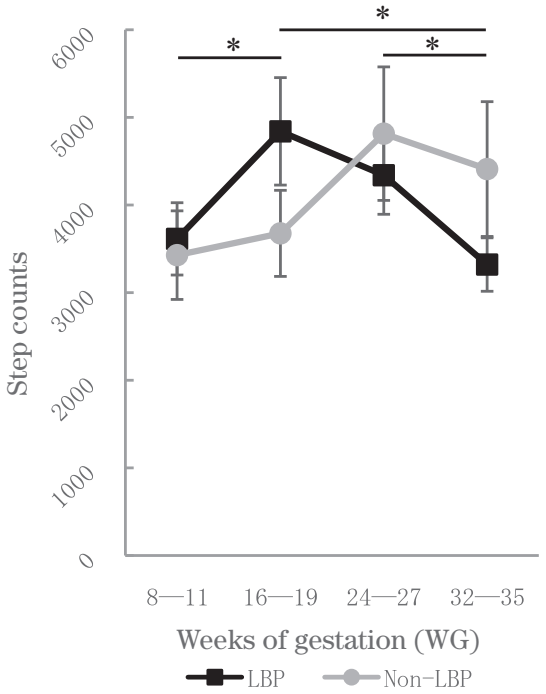

Figure 2. — Changes of physical activity in the non-LBP and LBP groups. F-value (group × time): [main effect] 3.94, [interaction] 4.33 ($p = 0.015$). *Each provided meaningful alternation ($p < 0.013$ [0.05/4]).

WG. The authors analyzed 36 subjects (mean age: 32.1 ± 4.7 years, body mass index (BMI): 21.7 ± 4.64 kg/m^2). Among them, eight (22.2%) women have had LBP before pregnancy, six (4.4%) were multiparas, and 11 (30.6%) worked full- or part-time. The authors assigned 21 women into the LBP group and 15 women into the non-LBP group. The demographic characteristics of the LBP group and the non-LBP group are summarized in Table 1. There were no significant differences between the two groups (LBP *vs.* non-LBP) in age (31.5 ± 4.7 years *vs.* 32.9 ± 4.8 years), height (1.58 ± 0.05 m *vs.* 1.59 ± 0.05 m), BMI before pregnancy (21.7 ± 6.1 kg/m^2 *vs.* 21.3 ± 2.5 kg/m^2), pre-pregnancy LBP ($n = 5$: 23.8% *vs.* $n = 3$: 20.0%), parous history ($n = 11$: 52.4% *vs.* $n = 5$: 33.3%), and occupation status ($n = 8$: 38.1% *vs*. $n = 5$: 33.3%).

Change of ODI score in the LBP and non-LBP groups

Figure 1 shows the changes of ODI score over time between the two groups. The change of ODI score was small in the non-LBP group, but progressively increased during pregnancy statistically significantly in the LBP group ($p < 0.0063$ [0.05/8]). When the score was compared between the two groups at each gestational period, the average ODI score of the LBP group was higher than that of the non-LBP group at eight, 12, 16, 20, 24, 28, 32, and 36 WG, with statistical significance ($p < 0.0063$ [0.05/8]).

Change of daily step counts in the LBP and non-LBP groups

Figure 2 shows the changes of step counts over time between the two groups. Significant differences were observed between the two groups with significant group × time interactions (F-value: [main effect] 3.94, [interaction] 4.33; $p = 0.015$). From the first to the second trimester (from 8–11 to 16–19 WG), step counts were not considerably changed in the non-LBP group (from 3428 ± 1748 to 3676 ± 1728 steps), but were significantly increased in the LBP group (from 3,614 ± 1,819 to 4,840 ± 2,810 steps) ($p < 0.013$ [0.05/4]). Conversely, in the second trimester (from 16–19 to 24–27 WG), step counts were increased in the non-LBP group (from 3,676 ± 1,728 to 4,814 ± 2,791 steps) but were decreased in the LBP group (from 4840 ± 2810 to 4,340 ± 2,043 steps). From the second to the third trimester (from 24–27 to 32–35 WG), step counts gradually decreased in both groups (from 4,340 ± 2,043 to 3,320 ± 1,398 steps in the LBP group and from 4,818 ± 2,791 to 4,410 ± 2,764 steps in the non-LBP group). In the LBP group, the decrease in step counts was statistically significant ($p < 0.013$ [0.05/4]).

Discussion

The average ODI score of all participants increased during pregnancy. In comparing the score between the two groups, LBP had little impact on the daily life of women in the non-LBP group throughout their pregnancy, while it increasingly negatively affected the daily life of pregnant women in the LBP group (Figure 1). In comparing the

change of step counts between the two groups, the LBP group was increasingly more active than the non-LBP group from 8–11 to 16–19 WG. Thereafter, women in the LBP group reduced their step counts from 16–19 to 24–27 WG, whereas those in the non-LBP group increased their daily step counts (Figure 2).

The average ODI score of pregnancy in the current study was equivalent to those of previous reports [7, 37, 38]. Comparing the score between the two groups, the results suggest that in pregnant women with LBP in pregnancy, the impact of LBP on daily life increases gradually, and it might become increasingly difficult to minimize the symptoms. Therefore, preventing the occurrence of pregnancy-related LBP is desirable. Additionally, the difference in the score between the two groups became larger after 16 WG, and therefore the authors recommend treating LBP in pregnant women during this time. The ODI score indicated that LBP primarily disturbed the women's ability to maintain a sitting or standing position (data not shown). These results indicate that the simple daily movements of pregnant women are limited by pregnancy-related LBP. Therefore, recommendations for pregnant women about basic daily physical movements such as ways of standing that reduce the load on the back are needed.

From the findings of the current study, excessive increase in physical activity during early pregnancy might be a risk factor for LBP, and the authors recommend that pregnant women should be more active after mid-pregnancy. Physical symptoms during the first period of pregnancy, such as nausea and vomiting, usually begin and peak in the first trimester [39, 40] and these symptoms cause a reduction in physical activity among pregnant women [41]. In addition, pregnant women are advised to avoid strenuous activity to reduce the risk of miscarriage in the first trimester. Accordingly, the step counts of the study participants might be low in the first period. Nevertheless, according to ACOG Committee on Obstetric Practice, pregnant women are also advised to perform moderate exercises during pregnancy for the health benefits of both the fetus and the mother [42]. In the subjects of the LBP group, we can assume that the rapid increase of daily step counts from the first to the second trimester was due to the recommendation to exercise; however, as a result of increased steps, a rapid decrease of step counts occurred at the next period in this group. Pregnant women who have no risks related to exercise are advised to maintain regular physical activity (ACOG Committee on Obstetric Practice, 2002), and it was shown that women who performed regular exercise in the third trimester experienced less pregnancy-related pelvic girdle pain and that pre-pregnancy regular exercise was a factor for continued physical exercise in the third trimester [43]. However, as shown by the results of this study, excessive activity such as a high number of steps in early pregnancy may cause a reduction of activity level in the third trimester. Although, regular physical activity during pregnancy has beneficial outcomes for women and their babies, incorrect timing of being active might be harmful because it may lead to increased LBP. In addition, the present authors used step counts, not special exercises, to investigate the influence of daily physical activity. The results of this study show that daily physical activity such as a moderate amount of steps daily can also have an influence on LBP. Therefore, the authors recommend that pregnant women should increase their daily physical activity after mid-pregnancy in order to minimize risk for LBP.

As the increase of daily step counts in early pregnancy was found to contribute to LBP, the influence of hormones should be considered. Serum relaxin concentrations reach a peak in the first trimester [44]. Relaxin increases the laxity of muscles and ligaments, and previous studies have reported a significant relation between serum relaxin concentrations and pelvic pain [35]. Excess physical activity such as a high number of steps from the first to the second trimester can place an extra load on the lumbar spine or pelvic girdle of pregnant women, causing LBP. In this study, LBP contributed to a reduction in the step counts of women in the LBP group. In addition, the reduction of daily physical activity might worsen LBP considering that moderate exercise is recommended for LBP. Therefore, the influence of hormones should be considered when advising pregnant women about physical activity.

This study has several limitations. First, there is a sampling bias because the number of target subjects decreased because of the long period of data collection, and results of the analysis might have deflection. Second, there were differences in the activity level of pregnant women between this study and other previous study. The change of physical activity with advancing pregnancy in this study is comparable to that reported in the study by Renault *et al.* [45]. However, from the data of step counts, the participants of this study were less active than those of the previous study throughout pregnancy. These differences in results suggest that physical activity in pregnancy depends not only on personal factors but also on the differences in lifestyle among pregnant women. Therefore, it can be difficult to make a recommendation about the ideal step count during pregnancy. In the future, a similar study should be performed with a large number of pregnant women with various lifestyles. The goal is recommendations to all pregnant women for daily physical activity during each trimester of the pregnancy in order to minimize risk for pregnancy-related LBP.

Conclusion

According to the ODI score in this study, LBP had little impact on the daily life of women throughout their pregnancy in the non-LBP group, whereas it increasingly disturbed the quality of life of women in the LBP group. This suggests that the impact of LBP on daily life during pregnancy increases gradually, and therefore measures to min-

imize the risk for LBP should be applied. Comparing the change of step counts between the two groups, the LBP group was more active than the non-LBP group in the first trimester. Thereafter, the LBP group reduced their daily step counts in the second trimester, whereas the non-LBP group increased their step counts. This finding shows that an increase in steps taken in the first trimester is a risk factor for LBP; therefore, pregnant women should be advised to be more active after the first trimester.

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