

# Is There a Meaningful Level of Activity Restriction for Hospitalized Pregnant Women ? : A Single-Case Experimental Investigation

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入院妊婦の動静制限にはどのような意味があるのか？

— シングルケーススタディ —

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Key words : activity restriction, physical activity, pregnancy, hospitalization

**Aim :** To examine the physical activities of daily living performed by pregnant woman on their working, non-working, and hospitalization days. Physical activity was objectively measured for these days in the same pregnancy period and compared.

**Methods :** A single-subject study design was employed. The participant was 35-year-old who was asked to write down the types of physical activities of daily living she performed throughout the duration of the experiment. She also wore an accelerometer, which was used to measure daily amount of physical activity.

**Results :** Data from four working days, three non-working days, and four hospitalization days were analyzed. Daily physical activity counts for days when the participant was hospitalized were fewer, both statistically ( $p=.012$ ) and visually, when compared with counts for working days. Additionally, the results showed that physical activities of daily living performed during hospitalization largely involved washing at the basin as well as showering. The majority of such activities on non-working days consisted of going to the toilet and going out (e.g., shopping). On working days, these activities were more varied.

**Conclusion :** Individuals are often restricted in the types and amount of physical activity they can perform while hospitalized. According to the results obtained in this study, hospitalized pregnant women, for whom rest is mandated, may not require further restrictions to their physical activities of daily living while in hospital. Further research on outcomes of activity restriction for mothers as well as infants is needed.

## Background

Declining birth and total fertility rates in Japan have raised much concern. In contrast, preterm

births have reportedly increased by approximately a thousand over the past decade, from 60,377 births in 2000 to 61,315 in 2010<sup>1)</sup>, even though their prevention, prediction, and treatment are highly advanced

in Japan. Nakabayashi<sup>2)</sup> reported that, 17% of all births involved preterm labor, and 46.7% had a pregnancy complication in Japan.

Pregnant women hospitalized for preterm labor in Japan are generally restricted in the physical activities of daily living they are allowed to perform. Threatened premature delivery is often treated with intravenous ritodrine hydrochloride or magnesium sulfate ; however, treatment guidelines also stipulate bed rest or activity restriction during hospitalization<sup>3)</sup>, thought to help increase uterine blood flow, reduce pressure on the cervix, and suppress uterine contractions<sup>4-6)</sup>, despite a lack of empirical support.

However, it is questionable as to whether pregnant women who are prescribed bed rest or activity restriction at home can perform as they are advised. Ariei and Natori<sup>4)</sup> compared the activities of outpatients receiving treatment for threatened premature delivery with those of women having normal pregnancies. The two groups did not differ significantly in average number of steps walked or energy consumed in activities. Women who were prescribed bed rest at home could not comply because they needed to care for their children, meet household demands, or work, or did not feel sick, lacked partner or familial support, or experienced discomfort while doing so<sup>4,7)</sup>.

On the contrary, the amount of activity performed by hospitalized pregnant women was less than half that of normal pregnant or non-pregnant women in another study<sup>8)</sup>. However, the influence of different degrees of activity restriction was not examined. In Japan, the primary approach to reducing the total amount of activity performed per day by hospitalized pregnant women is through the prescription of specific levels of daily activity, which differ according to patient condition and each hospital's practices and established guidelines<sup>9,10)</sup>. Thus, it is difficult to apply the study results to actual clinical situations.

The physical activity levels of pregnant women are influenced by a variety of factors that not only

include their hospitalization statuses<sup>11)</sup>, but also the trimesters they are in and the progress of their pregnancies<sup>12,13)</sup>. They also depend on the measurement tools employed in research to record or evaluate physical activity, which include subjective (e.g., daily self-reports, questionnaires, and retrospective interviews) and objective measures of physical activity (e.g., pedometers or accelerometers affixed to women's waists, wrists, or ankles)<sup>14)</sup>. Rousham, Clarke and Gross<sup>12)</sup> examined the health benefits of physical activity for pregnant women, and found that the personality variable of extroversion had an effect on maternal health behaviors<sup>15)</sup>.

Most recent studies have not considered possible influences of measurement bias due to occupation type, personal health beliefs, gestational age, physique, personal habits, or situations surrounding pregnancy on study results. Therefore, the purpose of this study was to examine physical activities of daily living performed by pregnant women on their working, non-working, and hospitalization days. Physical activity was objectively measured for these days in the same pregnancy period and compared.

## Methods

### -Study Design

A single-subject study design was used.

### -Participant

Purposive sampling was employed ; the researchers searched for potential participants among their co-workers, acquaintances, and social circles and invited the woman to participate. The participant eventually recruited into the study was a healthy, married woman, aged 35 years, who was employed full-time in an education research post and was expecting her first child. She was in her third trimester, had gained approximately 8 kg (Body Mass Index or BMI=20), and had not experienced any complications with regard to fetal growth. She had undergone combined heparin (self-injected)/aspirin thera-

py and was scheduled to be hospitalized at around 33 weeks' gestation in order to stop heparin use.

#### -Measurement Data

The participant was asked to wear an actigraph monitor for 24 hours over a period of about 2 weeks that included days on which she worked, did not work, and was hospitalized. At the same time, she recorded her activities in a daily activity diary by indicating the types of physical activities of daily living she performed with check marks.

#### -Instruments

To measure amount of daily physical activity, the Actiwatch2™ (Philips Respironics GK) was used. The Actiwatch2™ is a portable measuring device measuring 23×43×10 mm in size and weighing only 16 g. It looks and is worn much like a wristwatch, and is waterproof. The Actiwatch2™ is a two-axis vertical solid-state piezoelectric accelerometer with a sensitivity of 0.01 G and a sampling rate of 32 Hz. The integrated value of current generated by movement was detected and recorded as an activity count when it exceeded the threshold. Configurable epoch lengths were 0.25 to 15 minutes. A 1-minute epoch length was adopted in this study, as in previous investigations<sup>16,17</sup>. The participant wore the Actiwatch2™ on her dominant ankle in the present study for several reasons : to avoid the discomfort of wearing it on her wrist throughout the duration of the 24-hour continuous infusion, minimize the error

associated with isolated arm movement, and more appropriately reflect gross body movements and postural shifts<sup>12</sup>.

The daily activity diary was prepared by researchers for this study. Considering the burden that might be incurred by having to record information on activities performed throughout the entire day, the participant was asked to check the daily activities she performed within the span of no more than an hour. Daily life activities listed in the diary included sleeping, going to the toilet, preparing and consuming food, bathing, cleaning oneself at the basin, commuting, working while sitting or standing, shopping, going out, watching TV, and undergoing medical examinations.

Demographic data were also collected, including information on the participant's age ; height and weight ; occupation ; and marital, pregnancy, and working status.

This study was approved by the Ethics Committee of Tohoku University Graduate School of Medicine (Approval number : 2012-1-599).

#### -Data Analysis

Data were analyzed by using Actiware software (Philips Respironics GK), which allowed the retrieval of recorded activity data, displayed activity as actograms, and provided activity counts for every epoch length. High activity count indicated that woman has lot activities. Since activity counts were not collected for the entire 24 hours on the first and last days of the experiment, the data for these two days were excluded from the analysis. Both visual inspection and statistical methods were adopted in the assessments of data obtained through this single case study. Visual inspection of graphed data and visual checks have traditionally been used for assessing differences, and are still widely used today for this purpose<sup>18</sup>. On the other hand, an array of statistical data analysis methods for single-case experimental research designs has been developed. Because of these reasons, both approaches



Figure 1. Actiwatch2™ (Philips Respironics GK)

to assessment (i.e., visual inspection and statistical methods) were adopted in this study. Statistical analyses in this study were conducted using the SPSS Statistics ver.19.0J for Windows.

### Results

The participant wore the Actiwatch2™ for 2 weeks continuously, from Week 33, Day 0/7 to Week 34, Day 5/7 of her pregnancy. Data gathered on the first and last days of the 14-day measurement period were excluded from the analysis because activity counts were not obtained for the entire 24 hours. Data for the days on which the participant was admitted to and discharged from the hospital were also excluded from the analysis, as neither fell under any of the three specified categories of days examined in this study. In all, data from 4 working days, 3 non-

working days, and 4 hospitalized days were eventually analyzed.

Figure 2 presents an example of a graph depicting daily activity counts from 7 a.m. to 10 p.m. on one of the days for which physical activity data were obtained.

#### -Daily Activity Summary for Working Days

The participant typically awoke at around 7 a.m., took her breakfast, and commuted to her workplace by car. She worked mainly in a sitting position, and sometimes in a standing position to deliver a lecture or conduct an experiment. At around 6 p.m. in the evening, she returned home, prepared dinner, and took a shower or bath. She went to bed at about 10 to 11 p.m. at night. The maximum number of activity counts recorded for a working day ranged from 4,616 to 5,735 counts per minute. She per-

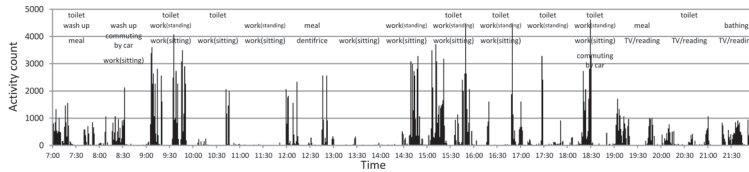


Figure 2-1. Example of daily activity count over time on working day (Day4 ; 7 : 00-22 : 00)  
Items of activities were carried out during that time is shown in the upper part of plot area

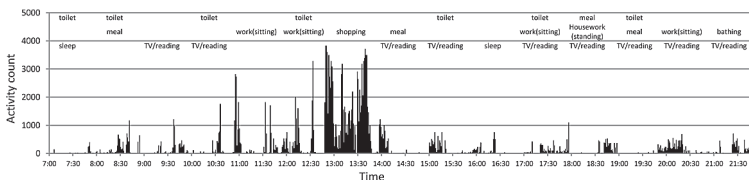


Figure 2-2. Example of daily activity count over time on non-working day (Day3 ; 7 : 00-22 : 00)  
Items of activities were carried out during that time is shown in the upper part of plot area

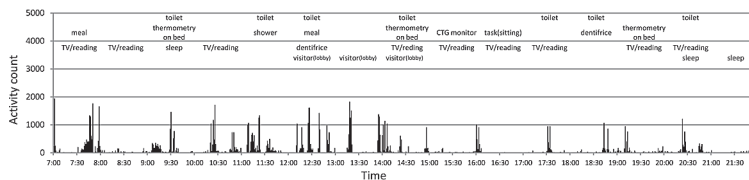


Figure 2-3. Example of daily activity count over time on hospitalized day (Day1 ; 7 : 00-22 : 00)  
Items of activities were carried out during that time is shown in the upper part of plot area

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**Table 1.** Daily activity count

	<i>n</i>	mean	SD	min	max
WORKING	4	330,381.25	106,165.69	262,237.00	486,618.00
NONWORKING	3	217,823.33	41,404.63	171,053.00	249,796.00
HOSPITALIZED	4	147,317.50	25,687.48	112,219.00	172,598.00

**Table 2.** maximum activity count in a day and the items of activity at the time

	maximum activity count (per min.)	Time at the max. amount activity count	Items of activity at the time
<b>WORKING</b>			
-DAY1	5,065	8 : 26, 11 : 05, 13 : 29, 18 : 21	Toilet, shopping, task, lunch
-DAY2	5,735	16 : 35	Toilet
-DAY3	5,065	19 : 41	Standing work, commuting by car
-DAY4	4,616	18 : 29	Standing work, commuting by car
<b>NONWORKING</b>			
-DAY1	3,285	10 : 32-33	Toilet, shopping
-DAY2	3,185	18 : 43	shopping
-DAY3	3,834	12 : 49-50	shopping
<b>HOSPITALIZED</b>			
-DAY1	1,938	7 : 01	Basin, breakfast
-DAY2	3,389	10 : 10	Taking a shower
-DAY3	2,815	6 : 47, 6 : 54	Basin, breakfast
-DAY4	4,207	11 : 47	Taking a shower

formed a variety of physical activities during which maximum activity counts were recorded, such as shopping, completing errands, having lunch, going to the toilet, working while standing, and commuting by car. Maximum activity counts were most frequently recorded in the evening.

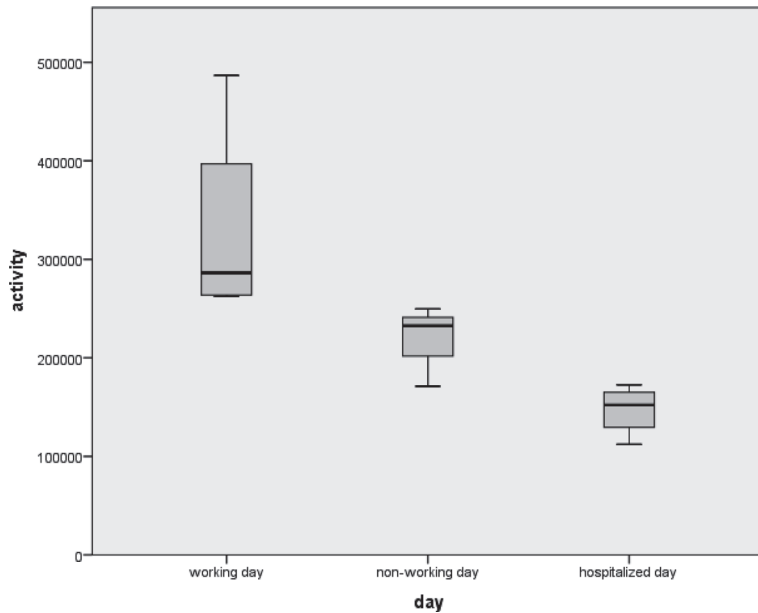
**-Daily Activity Summary for Non-Working Days**

The participant usually awoke at around 7 to 8 a.m. in the morning, took her breakfast, cleaned her room, and spent some time watching TV or reading a book. More than once during the day, she would go out for approximately 2 hours to shop or take a walk. Sometimes, she took a nap for a few hours in the daytime. She usually took a shower or bath after dinner, and went to bed at around 11 p.m. at night. The maximum number of activity counts re-

corded for non-working days ranged from 3,185 to 3,834 counts per minute. Physical activities during which maximum activity counts were recorded were shopping and going to the toilet. Maximum activity counts on these days were usually recorded during the daytime.

**-Daily Activity Summary for Hospitalized Days**

She was allowed to move relatively freely while being hospitalized in the ward. She could have her meals while sitting up, go to the toilet, take a shower every day, and meet with visitors at the lobby in the ward. However, she was not permitted to leave the ward. The 24-hour continuous infusion was stopped on the second day that she was hospitalized. The maximum number of activity counts recorded for days on which the participant was hospitalized



**Figure 3.** Amount of daily physical activity  
 Box plot explanation ; Upper and lower hinge of the box represent 75<sup>th</sup> percentile and 25<sup>th</sup> percentile, respectively ; whiskers indicate range ; thick horizontal line within box indicate median.

ranged from 1,938 to 4,207 counts per minute. Maximum activity counts were recorded while taking a shower, at the basin, and having breakfast. Maximum activity counts were most often recorded in the morning, before noon.

Amount of daily physical activity as measured by activity counts is detailed in Table 1. Mean daily physical activity counts for working, non-working, and hospitalized days were 330,381.25, 217,823.33, and 147,318.50, respectively. The results of a Kruskal-Wallis test indicated significant differences between the three categories of days in terms of amount of physical activity performed ( $H(2)=8.326$ ,  $p=0.016$ ). Post-hoc tests further revealed that daily physical activity counts for hospitalized days were significantly lower than those recorded for working days (Bonferroni-adjusted  $p$ -value=0.012). Physical activity counts recorded on working days were more widely scattered ( $SD=106,165.69$ ), while those for non-working days and days on which the

participant was hospitalized demonstrated less variation ( $SD=41,404.63$  and  $25,687.48$ , respectively).

Figure 3 depicts box plots of daily physical activity counts for each of the respective categories of days. A visual inspection of graphed data for the three different types of days showed that amount of daily physical activity tended to decrease in the following order : working days, non-working days, and hospitalized days. Differences in daily physical activity levels were apparent between working days and days during which the participant was hospitalized. In contrast, variations in daily physical activity levels were not as apparent between working and non-working days, and non-working days and days hospitalized, because the ranges of maximum and minimum activity counts for these days overlapped.

## Discussion

In this study, in order to remove potential measurement bias caused by occupation type, personal

health beliefs, gestational age, personal habits, physique, and situations surrounding pregnancy, the amount of physical activity was measured using a single-case research design on working days, non-working days, and hospitalized days. The results showed that daily physical activity counts of hospitalized were both statistically and visually lower than were those for working days. Although no previous study has compared amounts of physical activity performed by pregnant women between days on which they are hospitalized and days on which they work, a few studies have investigated the amount of physical activity of women who are hospitalized. Natori, Arii, Okabe, Kobayashi and Takizawa<sup>19)</sup> reported that hospitalized women ( $n=8$ ) engaged in significantly less physical activity than did normal pregnant women ( $n=15$ ; 6 working women, 9 non-working women). Arii and Natori<sup>4)</sup> also found that the amount of daily physical activity was significantly lower in women who were hospitalized ( $n=11$ ) than in normal pregnant women ( $n=12$ ; no descriptions about the women's occupations). Although the level of activity restriction implemented in a hospital setting<sup>4,19)</sup> was a factor in this study as in others, the results of our study imply that hospitalization itself reduces the amount of physical activity performed regardless of the extent to which activities are restricted in hospital.

In addition, the present study revealed that physical activities of daily living performed by the participant during hospitalization largely involved washing her face and brushing her teeth at the basin, having breakfast, and showering. The majority of such activities on non-working days consisted of going to the toilet and going out. On working days, these activities were more varied, including going to the toilet, shopping, completing errands, having lunch, working while standing, and commuting by car. Natori, Arii, Okabe, Kobayashi and Takizawa<sup>19)</sup> investigated both the content and activity counts of daily living activities performed by pregnant women at

home and during hospitalization. They reported that activities requiring large amounts of physical activity were those related to daily living (e.g., housework, as well as cleaning-, transport-, and recreation-related activities) as opposed to those associated with hospitalization (e.g., undergoing medical examinations, meeting with visitors, transferring by the wheelchair). Taking a shower, categorized as Level 4 activity, required an amount of physical activity similar to that involved in swimming or stair-climbing in Natori, Arii, Okabe, Kobayashi and Takizawa<sup>19)</sup>. It is important to let hospitalized women know that certain activities, such as taking a shower and washing her face and brushing her teeth at the wash basin would require considerable amounts of physical activity to complete. Therefore, it is better for hospitalized pregnant women under activity restriction to avoid engaging in daily living tasks that require large amounts of physical activity at the same time. Furthermore, taking a longer time to perform activities would make them less exacting<sup>8)</sup>. Clarke, Rousham, Gross, Halligan and Bosio<sup>20)</sup> have suggested that activity type and social contexts surrounding activities affect physical activity patterns during pregnancy more. Individual guidance on activity restriction is needed, taking into account one's social background.

From these observations, it is necessary for health care providers to provide pregnant women with individual guidance for activity restriction, taking into account their social background, rather than just prescribing activity restriction.

### Study Limitations

Since data were obtained from a single participant, the accumulation of more cases for investigation is needed. Second, it is necessary to consider differences in daily physical activity in terms of occupation. Further research is required to reveal specific characteristics of physical activity patterns or amounts of physical activity required according to

various types of occupations, in order to enable health care providers to link guidance provided to expectant mothers on activity restriction with reviews of their daily physical activity. In this study, information on the participant's health beliefs and personal habits were not collected. In evaluating daily physical activity and behavior, it would be essential to consider the influence of these variables on individual physical activity. Further, the varying levels of activity restriction in hospital settings and the progress of pregnancies should both be considered when providing expectant mothers with concrete instructions pertaining to the performance of physical activities of daily living.

### Conclusion

Using a single-subject study design, this study objectively examined physical activities of daily living performed by a pregnant woman on her working, non-working and hospitalization days in the same pregnancy period and compared. Mean daily physical activity counts on hospitalization days were statistically and visually lower than for working days. While physical activities of daily living varied on working days, going to the toilet and shopping were predominant on non-working days, and taking a shower, having breakfast, and cleaning up at the basin were tasks that required large activity counts during hospitalization. According to the results obtained in this study, hospitalized pregnant women, for whom rest is mandated, may not require further restrictions to their physical activities of daily living while in hospital. Further research on outcomes of activity restriction for mothers as well as infants is needed, as is concrete guidance for expectant mothers regarding activity restriction and recommended levels of physical activity.

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