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ORIGINAL ARTICLE

Age-specific determinants of post-partum fatigue in primiparous women

Miyako TSUCHIYA,[1] Emi MORI,[2] Akiko SAKAJO,[2] Tomoko MAEKAWA,[3] Hiroko IWATA,[2] Kunie MAEHARA,[2] Akiko MORITA,[2] Harumi OZAWA,[2] Yoshimi MOCHIZUKI,[2] Kyoko AOKI,[2] Miyuki MAKAYA[4] and Koji TAMAKOSHI[5]

[1]Division of Cancer Survivorship Research, National Cancer Center, Tokyo, [2]Department of Life Innovation Nursing, Graduate School of Nursing, Chiba University, Chiba, [3]Former Graduate School of Nursing, Chiba University, Chiba, [4]School of Nursing, Kitasato University, Kanagawa and [5]Graduate School of Medicine, Nagoya University, Nagoya, Japan

Abstract

Aim: Post-partum fatigue is a serious concern for mothers worldwide. The aim of this study was to identify age-specific determinants of self-perceived fatigue after childbirth among Japanese primiparous women.

Methods: A multicenter prospective cohort study was conducted in Japan. The degree of fatigue was assessed using the Postnatal Accumulated Fatigue Scale during the hospital stay after childbirth. Associated factors were stratified into two age groups (<35 or ≥35 years old); data were analyzed using stepwise multiple regression.

Results: In the younger group, significant determinants of post-partum fatigue included: anticipated difficulties in child-rearing after discharge; perception of inadequate sleep conditions; dissatisfaction with childbirth; shorter sleep and meal times; longer duration between feeding and infant bedtime; unemployment; and having hyperemesis gravidarum. In the older group, significant determinants of post-partum fatigue included: anticipated difficulties in child-rearing after discharge; perception of inadequate sleep conditions; shorter meal times; formula feeding; and dissatisfaction with childbirth.

Conclusion: Primiparous mothers who anticipated new life with their infants to be difficult and who had an irregular lifestyle tended to report higher levels of fatigue during the post-partum hospital stay. Nurses and midwives should assess maternal sleep and eating conditions, providing support to ensure adequate maternal rest. Special efforts should be made to reduce anxiety about new life with infants among younger primiparous women who had experienced hyperemesis gravidarum.

Key words: determinants, hospitalization after childbirth, Japan, post-partum fatigue, primiparous mothers.

INTRODUCTION

Tiredness or extreme exhaustion is a highly prevalent health problem for post-partum mothers. In a recent Korean study, 63.5% of mothers ($n = 137$) reported tiredness as their most serious symptom on the second day after delivery (Song, Chae, & Kim, 2014). An earlier study in Japan found that 67% of mothers ($n = 3582$) reported tiredness due to sleep loss as their most serious concern at 1 month post-partum (Shimada *et al.*, 2006). In addition, an Australian study observed that approximately 60% of mothers ($n = 1295$) reported extreme exhaustion as their top concern from 2 months post-partum until nearly 6 months post-partum (Thompson, Roberts, Currie, & Ellwood, 2002).

Fatigue is a complex phenomenon that does not simply mean "being tired"; fatigue may not easily be resolved by rest and tends to persist over a long period

Correspondence: Emi Mori, Department of Life Innovation Nursing, Division of Health Promotion Nursing, Reproductive Health Nursing, Graduate School of Nursing, Chiba University, 1-8-1 Inohana, Chuo-ku, Chiba 260-8672, Japan. Email: mori@faculty.chiba-u.jp

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of time (Elek, Hudson, & Fleck, 2002; Shen *et al*., 2006). Persistent fatigue may adversely affect the whole human body, reducing one's physical, emotional, and cognitive function (Shen *et al*., 2006). Some previous studies in Western countries have reported that unresolved fatigue may deplete mothers of the energy and motivation required to adequately care for their infants (Troy, 1999; White, White, & Fox, 2009). Cognitive symptoms, such as decreased concentration, may reduce parental activity levels in completing daily routine tasks (Giallo, Rose, Cooklin, & McCormack, 2013). Fatigue may additionally elicit maternal depressive symptoms (Bozoky & Corwin, 2002; Elek *et al*., 2002; Kuo, Yang, Kuo, Tseng, & Tzeng, 2012) and lead to maladaptive transitions into the motherhood role (Dunning & Giallo, 2012); poor personal and social development of infants may also result (Parks, Lenz, Milligan, & Han, 1999). To prevent such negative effects, the identification of factors contributing to early post-partum fatigue is vital. The determination of these factors will be useful for developing nursing interventions and for promoting the well-being of mothers and their families.

Factors associated with post-partum fatigue in the published work

Previous research has identified certain demographic and physiological determinants of maternal fatigue. Women who had higher educational levels (Taylor & Johnson, 2013), were primiparous (Hattori & Nakajima, 2000), had undergone cesarean section (CS) (Milligan, Parks, Kitzman, & Lenz, 1997), and had experienced sleep fragmentation (Tsuchiya *et al*., 2014a) have been significantly associated with a higher degree of fatigue during the post-partum hospital stay or at 1 week post-partum (Taylor & Johnson, 2013).

Although Pugh and Milligan (1993) have suggested that performance factors (e.g. infant care activities) and psychological factors (e.g. anxiety about and reaction to child-rearing) would also affect maternal fatigue, existing data on the effects of these two factors have been scarce, particularly for the period of post-partum hospital stays. Because mothers with uncomplicated vaginal deliveries stay at the hospital for 5.5 days on average (Ministry of Health, Labor and Welfare, 2011), and those with uncomplicated CS have even longer post-partum hospital stays in Japan, nurses and midwives have ample opportunity to provide care that addresses the multidimensionality of post-partum fatigue. Further investigation of Pugh and Milligan's (1993) post-partum fatigue factors would thus be worthwhile to conduct among Japanese mothers during post-partum hospital stays.

As a previous study among Japanese mothers has shown (Hattori & Nakajima, 2000), parity is significantly associated with degree of fatigue during the hospital stay after childbirth. This finding suggests that the care required for fatigue is different between primiparous and multiparous women. Because women who have their first child at the age 35 years or older are considered to be at higher risk than younger women for complications during pregnancy, labor, and delivery, the present authors hypothesized in this study that older primiparous women are more vulnerable to fatigue than younger primiparous women, and that factors contributing to levels of fatigue would differ depending on age category.

Therefore, the present study aimed to investigate age-specific factors associated with post-partum fatigue in Japanese primiparous women during the post-partum hospital stay, using a modified version of Pugh and Milligan's (1993) framework of fatigue factors (Fig. 1). Cross-sectional data from a prospective cohort study among Japanese mothers were used to consider potential prenatal and early post-partum nursing interventions for primiparous women.

METHODS

Procedure

The study procedure has been described in detail elsewhere (Iwata *et al*., 2015). Following a small scale pilot study ($n = 23$), a multicenter prospective cohort study was conducted in the eastern and western regions of Japan, to investigate post-partum fatigue, depressive symptomatology, the proportion of breast-feeding mothers, and maternal confidence and satisfaction. These outcomes were assessed by a questionnaire administered 1 day before discharge (baseline). Mothers or infants with major complications either before or after childbirth, which prevented mother–infant rooming-in, and the usual length of hospital stay were excluded. Postal follow-up surveys were conducted at 1, 2, 4, and 6 months post-partum. An incentive (an infant handkerchief) was offered to participants completing the baseline assessment, and an infant bib was offered to participants who returned all of the questionnaires.

Institutional and medical ethics approval was obtained before the study began, and written consent was obtained for each participant. For mothers younger than 20 years old, research nurses explained the study to

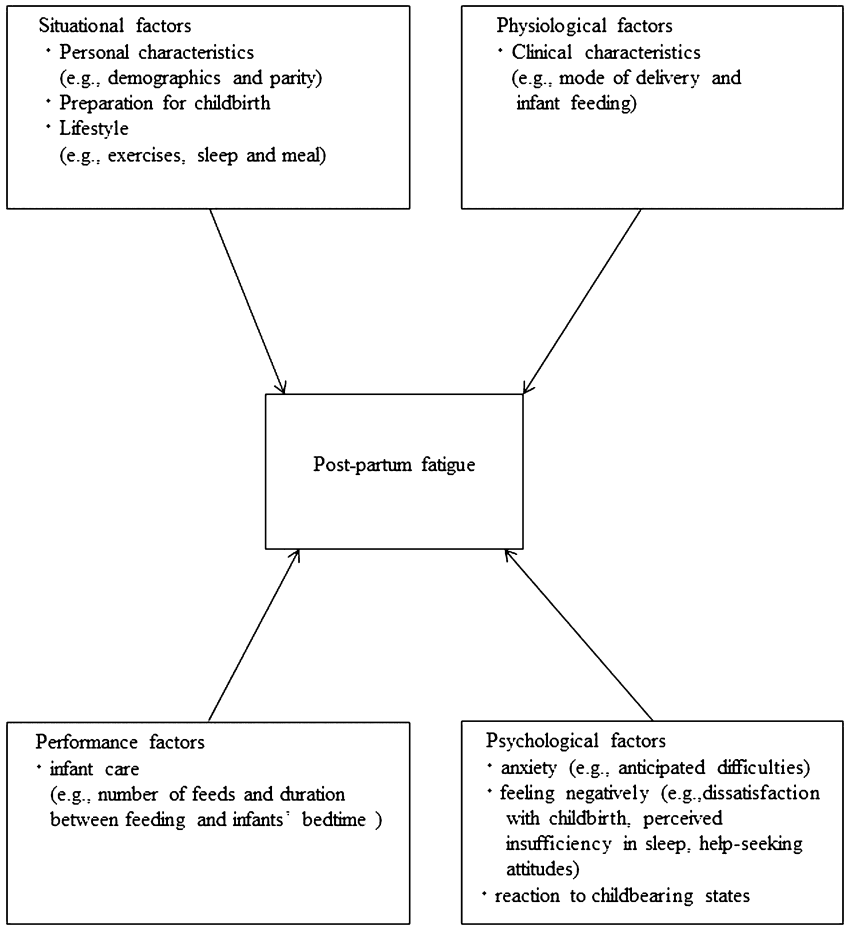

Figure 1 Hypothesized modified model for effects of factors influencing post-partum fatigue (Pugh and Milligan, 1993).

their guardians, and a consent form was signed if both the mother and her guardian agreed.

Data were collected from 1517 primiparous women (see Fig. 2). In addition to this cross-sectional data collected during the post-partum hospital stay, this study also used maternal background information that was obtained at the 1 month follow-up assessment.

Measurements

Post-partum fatigue

The Postnatal Accumulated Fatigue Scale (PAFS) was developed from the Self-diagnosis Checklist for Assessment of Worker's Accumulated Fatigue (Ministry of Health, Labor and Welfare, 2004). The PAFS has a three factor structure with 13 subjective fatigue symptoms (physical, emotional, and cognitive functions). The psychometric properties of the PAFS have been previously investigated in mothers during the post-partum hospital stay, and each subscale was found to have good internal consistency (Cronbach's alpha = 0.83, 0.74, and 0.69, for physical, emotional, and cognitive functions, respectively) (Tsuchiya *et al*., 2014b). The PAFS shows a good divergent validity as evidenced by minimal correlation with the Japanese version of the Edinburgh Postnatal Depression Scales (Okano, Murata, & Masuji, 1996). Responses in the PAFS were measured on a 3 point response ranging 0–3 (0 = rarely, 1 = sometimes, 3 = often). A total score was calculated by summing the individual scores from the 13 items (possible range, 0–39). Higher scores indicated higher levels of fatigue. In this study sample, Cronbach's alpha was found to be 0.86.

Situational factors

Participant demographics (e.g. year and month of birth, marital status, employment status, and highest education achieved) were determined by single questionnaire items with open-ended, dichotomous, or polynomial

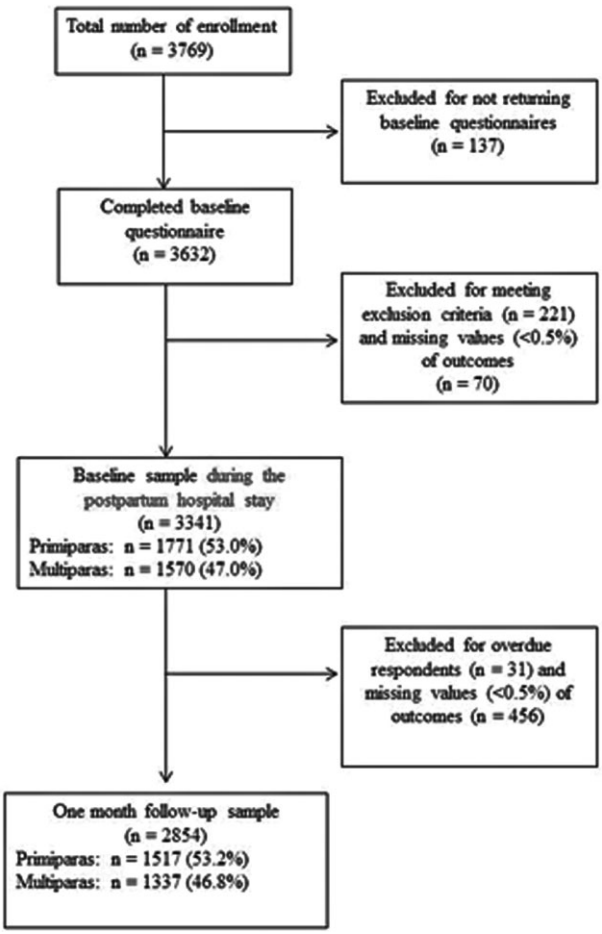

Figure 2 Sampling procedure.

responses. Previous experiences of infant care (for <1 year old) and of exercises practiced during pregnancy were assessed by single questionnaire items with dichotomous responses. Daily maternal activities at the hospital (e.g. taking a nap, total sleep time the previous night, and total daily time taken for meals) were evaluated by single questionnaire items with open-ended or dichotomous responses.

Physiological factors

Participants' clinical characteristics (e.g. hyperemesis gravidarum, pregnancy-induced hypertension [PIH], gestational diabetes mellitus, pregnancy complicated with diabetes mellitus, hospitalization during pregnancy, number of gestation weeks, and mode of delivery) were obtained from medical records. Infants' clinical characteristics (e.g. birthweight; suspected abnormal fetal condition; short-term minor complications, including hypoglycemia and neonatal respiratory disorder; and long-term minor complications, including morphological abnormality) were additionally obtained from medical records. Feeding methods were determined by single questionnaire items with polynomial responses.

Performance factors

Child-care activities (e.g. the number of feeds the previous night and average duration between feeding and infant bedtime) were assessed by single questionnaire items with polynomial or open-ended responses.

Psychological factors

Anticipated difficulties after discharge were assessed by four dimensions with 4 point scale responses (1 = disagree, 2 = disagree a little, 3 = agree a little, 4 = agree). The four dimensions were evaluated by the statements: "It will be hard work for me to change to a child-centered life after discharge", "I do not have enough physical strength to take care of my baby", "It will be difficult to find time for myself after discharge", and "It will become difficult to take care of my health condition after discharge."

Satisfaction with childbirth was determined by the question "How do you feel about your childbirth this time?" with 4 point scale response options (1 = very satisfied, 2 = a little satisfied, 3 = a little dissatisfied, 4 = very dissatisfied).

Perceived sleep conditions the previous night were assessed by the question "How do you perceive your night's sleep last night?" with 4 point scale responses (1 = very sufficient, 2 = sufficient, 3 = insufficient, 4 = very insufficient). Maternal perception of help-seeking attitudes from others was assessed by a 10-item subscale of the Childcare Value Scale (CVS) (Chen *et al.*, 2006). The CVS had been previously validated among Japanese post-partum mothers (Mori, Liu, Otsuki, Mochizuki, & Kashiwabara, 2012). Responses in the CVS were measured in 4 point responses ranging 1–4 (1 = strongly disagree, 2 = disagree, 3 = somewhat agree, 4 = strongly agree). A total score was calculated by summing the individual scores from the 10 items (possible range, 10–40). Higher scores indicated more positive maternal attitudes towards support provided by others. In this study sample, Cronbach's alpha was found to be 0.78.

Analysis

Maternal age was calculated using the date of delivery and the mother's birthday. Participants were divided into two groups by maternal age at the time of child-

birth: less than 35 years old (younger group) and 35 years or older (older group). The variable of gestational diabetes mellitus was combined with the variable of pregnancy complicated with diabetes mellitus, creating the new variable "hyperglycemic disorders in pregnancy". The variable of gestation weeks was dichotomized as "preterm birth of less than 37 weeks" or "full-term birth of 37 weeks or more". Responses to each dimension of anticipated difficulties after discharge were dichotomized as "0 = disagree/disagree a little or 1 = agree a little/agree". Responses to perceived sleep conditions the previous night were dichotomized as "0 = very sufficient/sufficient or 1 = insufficient/very insufficient". Responses to degree of satisfaction with childbirth were dichotomized as "0 = very satisfied or 1 = a little satisfied/a little dissatisfied/very dissatisfied".

The χ^2-test was performed to compare group differences on variables about participant and infant background information. One-way ANOVA was performed to examine mean differences between the total PAFS score and the independent variables of each separate group. Spearman's rank correlation coefficients were performed to examine associations between the total PAFS score and the continuous variables of each separate group. Controlling for mode of delivery, stepwise multiple regression analyses were performed on each group, with the total PAFS score as a dependent variable. Variables found to be significant ($P < 0.10$) in the bivariate analyses and variables reported as predictors in previous studies were defined as independent variables. Dummy variables were created to represent polynomial responses in the independent variables; multicollinearity was evaluated. All statistics were performed using SPSS version 21 (SPSS, Chicago, IL, USA).

RESULTS

Participant characteristics

Tables 1 and 2 present the demographics and clinical characteristics of the 1517 participants. The mean age was 31.9 years (standard deviation [SD] = 4.9), and most participants (85.4%) had a vaginal birth. The average length of hospital stay between the time of childbirth and the time of assessment was 4.5 days. The proportion of subjects in the older group having had infertility treatment, PIH, hyperglycemic disorders in pregnancy, or who had undergone CS were significantly higher ($P < 0.10$) than in the younger group. The proportion of infants with a low birthweight in the older group was not significantly different from that in the younger group. The number of women in the older group reporting satisfaction with childbirth were significantly lower ($P < 0.10$) than the younger group. The mean PAFS for all participants was 9.38 (SD = 7.12). The average PAFS score for the younger group was 9.25 (SD = 7.19), and 9.68 (SD = 6.96) for the older group. There was no significant difference in the average PAFS scores between the two groups ($P = 0.271$).

Table 1 Participant demographics

Variables	All participants ($n = 1517$) N (%)	Younger group ($n = 1038$) N (%)	Older group ($n = 479$) N (%)	Group differences (P)
Age (years), mean (SD)	31.9 (4.9)	29.3 (3.3)	37.6 (2.2)	–
Marital status				0.020
Single	39 (2.6)	20 (1.9)	19 (4.0)	
Married	1477 (97.3)	1017 (98.0)	460 (96.0)	
Missing	1 (0.1)	1 (0.1)	0 (0.0)	
Paid job				
Yes	767 (50.6)	504 (48.6)	263 (54.9)	0.022
No	749 (49.3)	533 (51.3)	216 (45.1)	
Missing	1 (0.1)	1 (0.1)	0 (0.0)	
Education				
Junior/high school	270 (17.8)	196 (18.9)	74 (15.4)	0.048
Technical/college	514 (33.9)	332 (32.0)	182 (38.0)	
University or above	732 (48.2)	509 (49.0)	223 (46.6)	
Missing	1 (0.1)	1 (0.1)	0 (0.0)	

Younger group = mothers aged less than 35 years old; older group = mothers aged 35 years or older. *P*-value was the result of χ^2-test.

Table 2 Participants' clinical characteristics

Variables	All participants ($n = 1517$) N (%)	Younger group ($n = 1038$) N (%)	Older group ($n = 479$) N (%)	Group differences (P)
Hyperemesis gravidarum				0.077
Yes	34 (2.2)	28 (2.7)	6 (1.3)	
No	1483 (97.8)	1010 (97.3)	473 (98.7)	
Infertility treatment				<0.001
Yes	268 (17.7)	106 (10.2)	162 (33.8)	
No	1246 (82.1)	931 (89.7)	315 (65.8)	
Missing	3 (0.2)	1 (0.1)	2 (0.4)	
PIH				
Yes	49 (3.2)	23 (2.2)	26 (5.4)	0.001
No	1468 (96.8)	1015 (97.8)	453 (94.6)	
Hyperglycemic disorders in pregnancy				
Yes	77 (5.1)	36 (3.5)	41 (8.6)	<0.001
No	1440 (94.9)	1002 (96.5)	438 (91.4)	
Gestation (weeks)				0.178
<37	25 (1.6)	14 (1.3)	11 (2.3)	
≥37	1492 (98.4)	1024 (98.7)	468 (97.7)	
Mode of delivery				<0.001
Vaginal	1296 (85.4)	926 (89.2)	370 (77.2)	
CS	221 (14.6)	112 (10.8)	109 (22.8)	

Younger group = mothers aged less than 35 years old; older group = mothers aged 35 years or older. CS, cesarean section; PIH, pregnancy induced hypertension. *P*-value was the result of χ^2-test.

Mean differences in fatigue scores or correlations and independent variables

Table 3 sets out the mean comparisons and correlations of the PAFS, situational factors, physiological factors, performance factors, and psychological factors for each group (with only the significant variables presented). Among the younger group, higher levels of fatigue were more likely to be reported among participants who were older age ($P = 0.013$), had no paid job ($P = 0.007$), had a lower educational level ($P = 0.056$), had no infant care experiences ($P = 0.033$), did not exercise during pregnancy ($P = 0.054$), did not take naps ($P = 0.035$), had shorter sleep times the previous night ($P < 0.001$), and who had shorter mealtimes per day ($P < 0.001$). Higher levels of fatigue were more likely to be reported among participants who had experienced hyperemesis gravidarum ($P = 0.004$), had short-term infant complications ($P = 0.057$), had a longer duration between feeding and infant bedtime ($P < 0.001$), were dissatisfied with childbirth ($P < 0.001$), perceived the previous night's sleep to be insufficient ($P < 0.001$), anticipated change to a child-centered life to be difficult ($P < 0.001$), anticipated their physical strength to take care of their infants to be insufficient ($P < 0.001$), anticipated finding time for themselves to be difficult ($P < 0.001$), and anticipated taking care of their health condition to be difficult ($P < 0.001$).

Among the older group, higher levels of fatigue were more likely to be reported among participants who were married ($P = 0.037$), had not had prior infant care experience ($P = 0.055$), did not exercise during pregnancy ($P = 0.013$), did not take naps ($P = 0.048$), had shorter sleep times the previous night ($P < 0.001$), had shorter mealtimes per day ($P < 0.001$), were hospitalized during pregnancy ($P = 0.081$), had infants with suspected fetal abnormality ($P = 0.033$), had infants with long-term minor complications ($P = 0.064$), underwent formula feeding ($P = 0.006$), and had longer durations between feeding and infant bedtime ($P < 0.001$). Higher levels of fatigue were additionally more likely to be reported among participants who were dissatisfied with childbirth ($P = 0.010$), perceived the previous night's sleep to be insufficient ($P < 0.001$), anticipated change to a child-centered life to be difficult ($P < 0.001$), anticipated their physical strength to take care of their infants to be insufficient ($P < 0.001$), anticipated finding time for themselves to be difficult ($P < 0.001$), anticipated taking

Table 3 Results of bivariate analysis for fatigue scores in the younger and older groups

	Younger group ($n = 1038$)		Older group ($n = 479$)	
Variables	Mean (SD)	*P*	Mean (SD)	*P*
Situational factors				
Age	0.077	0.013†	–0.010	0.825†
Marital status (1M)		0.571‡		0.037‡
Single	10.15 (8.44)		6.42 (5.04)	
Married	9.23 (7.17)		9.82 (7.00)	
Paid job (1M)		0.007‡		0.722‡
Yes	8.63 (6.90)		9.58 (6.90)	
No	9.84 (7.41)		9.81 (7.04)	
Education (1M)		0.056‡		0.641‡
Junior/high school	10.35 (7.75)		9.49 (7.17)	
Technical/college	8.88 (7.12)		9.37 (6.69)	
University or above	9.06 (6.99)		10.00 (7.12)	
Infant care experiences		0.033‡		0.055‡
Yes	8.50 (7.26)		8.72 (6.50)	
No	9.55 (7.15)		10.06 (7.10)	
Exercised in pregnancy		0.054‡		0.013‡
Yes	9.01 (7.07)		9.19 (6.70)	
No	10.01 (7.52)		10.98 (7.47)	
Taking naps		0.035‡		0.048‡
Yes	8.83 (6.89)		9.15 (6.70)	
No	9.79 (7.56)		10.43 (7.23)	
Sleep times the previous night	–0.24	<0.001†	–0.23	<0.001†
Mealtimes per day	–0.12	<0.001†	–0.20	<0.001†
Physiological factors				
Hyperemesis gravidarum		0.004‡		0.447‡
Yes	13.11 (7.55)		11.83 (8.75)	
No	9.14 (7.15)		9.65 (6.94)	
Hospitalization in pregnancy		0.210‡		0.081‡
Yes	10.05 (7.02)		10.78 (7.00)	
No	9.15 (7.21)		9.40 (6.93)	
Infants' suspected abnormality		0.507‡		0.033‡
Yes	9.27 (7.21)		14.88 (9.15)	
No	8.06 (5.91)		9.59 (6.89)	
Infants' short-term complications		0.057‡		0.228‡
Yes	10.39 (7.71)		8.70 (6.26)	
No	9.07 (7.08)		9.83 (7.05)	
Infants' long-term complications		0.329‡		0.064‡
Yes	10.89 (7.69)		12.25 (8.20)	
No	9.22 (7.18)		9.55 (6.87)	
Feeding methods		0.255‡		0.006‡
Breast-feeding	8.77 (7.01)		8.81 (6.91)	
Mixed feeding	9.51 (7.31)		10.00 (6.83)	
Formula feeding	9.76 (6.69)		15.50 (8.47)	
Performance factors				
Duration between feeding and infant bedtime	0.13	<0.001†	0.15	0.001†
Psychological factors				
Satisfaction with childbirth		<0.001‡		0.010‡
Very satisfied	8.05 (6.54)		8.98 (6.61)	
Other	11.55 (7.80)		10.63 (7.30)	
Sleep the previous night		<0.001‡		<0.001‡
Sufficient	5.86 (5.51)		6.49 (5.05)	
Insufficient	10.94 (7.34)		10.88 (7.21)	
Difficulties in a child-centered life		<0.001‡		<0.001‡
Disagree	6.39 (5.56)		7.19 (6.17)	
Agree	10.84 (7.50)		11.18 (6.99)	
Difficulties in physical strength for child-rearing		<0.001‡		<0.001‡
Disagree	6.58 (5.73)		7.06 (5.63)	
Agree	12.05 (7.52)		11.74 (7.19)	
Difficulties finding time for myself		<0.001‡		<0.001‡
Disagree	5.32 (6.02)		5.13 (4.88)	
Agree	9.63 (7.19)		10.07 (6.98)	
Difficulties in taking care of my health		<0.001‡		<0.001‡
Disagree	6.09 (5.29)		6.24 (5.39)	
Agree	11.81 (7.51)		11.94 (6.95)	
Help-seeking attitudes	0.04	0.184†	0.08	0.072†

The data for the variables were collected during post-partum hospital stay unless specific instruction is given in the table. 1M = 1 month after childbirth. Higher values for sleep times the previous night, mealtimes per day, and duration between feeding and infant bedtime indicates longer sleep time the previous night, longer mealtimes per day, and longer duration between feeding and infant bedtime, respectively. Higher values for help-seeking attitudes indicate positive help-seeking attitudes. Higher values for fatigue scores indicate higher levels of fatigue. Infants' suspected abnormality = suspected abnormality in a fetus. †Spearman's rank correlation. ‡One-way ANOVA. SD, standard deviation.

care of their health condition to be difficult ($P < 0.001$), and had a positive attitude towards the support provided by others ($P = 0.072$).

Factors associated with fatigue scores

Tables 4 and 5 present the results of the stepwise multiple regressions for each group. Among the younger group, higher levels of fatigue were reported among participants who anticipated taking care of their own health condition to be difficult ($P < 0.001$), perceived their previous night's sleep to be insufficient ($P < 0.001$), anticipated change to a child-centered life to be difficult ($P < 0.001$), perceived their physical strength for child-rearing to be insufficient ($P < 0.001$), were dissatisfied with childbirth ($P < 0.001$), had shorter sleep times the previous night ($P = 0.001$), anticipated difficulties in finding time for themselves ($P = 0.001$), did not have a paid job ($P = 0.003$), had longer durations between feeding and infant bedtime ($P = 0.007$), had shorter mealtimes per day ($P = 0.009$), and had hyperemesis gravidarum ($P = 0.024$).

Among the older group, higher levels of fatigue were reported among participants who anticipated taking care of their own health to be difficult ($P < 0.001$), per-

Table 4 Stepwise multiple regression results for factors associated with fatigue scores in the younger group ($n = 1020$)

Variables	β	*P*	95% CI
Mode of delivery (0 = vaginal birth, 1 = CS)	–0.036	0.175	–2.015 to 0.367
Difficulties in taking care of my health (0 = no, 1 = yes)	0.189	<0.001	2.826–5.207
Perceived sleep condition the previous night (0 = sufficient, 1 = insufficient)	0.191	<0.001	2.040–3.772
Difficulties in a child-centered life (0 = no, 1 = yes)	0.158	<0.001	1.899–3.867
Difficulties in physical strength for child-rearing (0 = no, 1 = yes)	0.146	<0.001	1.941–4.238
Dissatisfaction with childbirth (0 = satisfaction, 1 = dissatisfaction)	0.135	<0.001	1.253–2.839
Sleep times the previous night (h)	–0.093	0.001	–0.706 to –0.171
Difficulties in finding time for myself (0 = no, 1 = yes)	0.094	0.001	0.554–2.146
Paid job (0 = no, 1 = yes)	–0.078	0.003	–1.854 to –0.393
Duration between feeding and bedtime (min)	0.071	0.007	0.008–0.047
Mealtimes per day (min)	–0.069	0.009	–0.023 to –0.003
Hyperemesis gravidarum (0 = no, 1 = yes)	0.058	0.024	0.332–4.774
Adjusted R^2	0.331		
F	42.950	<0.001	

Higher values for sleep times the previous night, duration between feeding and bedtime, mealtimes per day indicates longer sleep time the previous night, longer duration between feeding and infant bedtime, and longer mealtimes per day, respectively. Higher values for fatigue scores indicate higher levels of fatigue. Control variable = mode of delivery. CI, confidence interval; CS, cesarean section; *F*, the results of ANOVA.

Table 5 Stepwise multiple regression results for factors associated with fatigue scores in the older group ($n = 469$)

Variables	β	*P*	95% CI
Mode of delivery (0 = vaginal birth, 1 = cesarean section)	–0.039	0.333	–1.969 to 0.668
Difficulties in taking care of my health (0 = no, 1 = yes)	0.234	<0.001	2.055–4.571
Perceived sleep condition the previous night (0 = sufficient, 1 = insufficient)	0.186	<0.001	1.647–4.110
Difficulties in physical strength for child-rearing (0 = no, 1 = yes)	0.177	<0.001	1.272–3.676
Mealtimes per day (min)	–0.148	<0.001	–0.049 to –0.016
Duration between feeding and bedtime (min)	0.136	0.001	0.019–0.069
Feeding methods (0 = breast-feeding, 1 = formula feeding)	0.102	0.010	1.178–8.615
Dissatisfaction with childbirth (0 = satisfaction, 1 = dissatisfaction)	0.093	0.022	0.191–2.422
Difficulties in a child-centered life (0 = no, 1 = yes)	0.086	0.042	0.043–2.421
Adjusted R^2	0.287		
F	21.946	<0.001	

Higher values for mealtimes per day and duration between feeding and bedtime indicates longer mealtimes per day and longer duration between feeding and infant bedtime, respectively. Higher values for fatigue scores indicate higher levels of fatigue. Control variable = mode of delivery. CI, confidence interval; *F*, the results of ANOVA.

ceived their previous night's sleep to be insufficient ($P < 0.001$), perceived their physical strength to be insufficient for child-rearing ($P < 0.001$), had shorter mealtimes per day ($P < 0.001$), had longer durations between feeding and infant bedtime ($P = 0.001$), undertook formula feeding ($P = 0.010$), were dissatisfied with childbirth ($P = 0.022$), and anticipated changing to a child-centered life to be difficult ($P = 0.042$).

DISCUSSION

The present authors investigated which factors were independently associated with the level of fatigue during the post-partum hospital stay after taking into account the effects of various modes of delivery. This study appears to be the first study investigating age-specific determinants of fatigue among Japanese primiparous women during the post-partum hospital stay. In both younger and older groups, the most dominant set of factors associated with post-partum fatigue were psychological factors, and the second most dominant set of factors were situational factors; performance and physiological factors, however, correlated less to the degree of fatigue. The findings of the present study support the framework for understanding the factors affecting post-partum fatigue identified by Pugh and Milligan (1993).

Despite the present authors' hypothesis, average PAFS scores between age groups were not significantly different in this study. Average scores were approximately 9 points in both younger and older groups, and this value was nearly one quarter the total score. These scores can be interpreted as relatively low levels of fatigue. This finding may be because the baseline assessment was conducted 1 day before discharge (an average of 4.5 days after childbirth), at a point when most mothers have physically recovered from childbirth-related fatigue. A previous study (Milligan *et al*., 1997) reported that CS was a significant determinant of post-partum fatigue during the hospital stay after childbirth, a finding inconsistent with the results of the present study. This suggests that future studies investigating the effect of childbirth on maternal fatigue should carefully consider the time of assessment during the post-partum hospital stay.

Key determinants associated with early post-partum fatigue were quite similar between the younger and older groups; however, the order of importance of these key determinants appeared to differ in each group. Among the younger group, the factor most strongly associated with fatigue was maternal anticipation of difficulty in taking care of personal health, followed by perceived insufficient sleep at night and anticipated difficulties in a child-centered life. Such results were surprising, as younger women generally have sufficient physical strength to carry out certain workloads (Ministry of Education, Culture, Sports, Science, & Technology, 2011); the present authors would not have predicted that mothers in the younger group would be anxious about their own health condition. It is possible, however, that younger mothers may be unable to adjust to the required lifestyle changes for their infants solely based on their physical strength prior to infant care. Infant care includes frequent feeds at night, which often results in substantial sleep loss, increasing risk of somatic symptoms, physical fatigue, depressive symptoms, and eating disorders (Broman, Lundh, & Hetta, 1996; Michael, Valle, Cox, Kalns, & Fogt, 2013; Tsuchiya *et al*., 2014a; Ulman *et al*., 2012). Mothers who perceive such a lifestyle change as difficult may feel helpless to manage their new life with their infants after discharge; anxieties may increase while self-confidence may decrease (Pond & Kemp, 1992). Mothers who felt dissatisfied with childbirth may also struggle adjusting to a lifestyle that is more child-centered (Matsuno & Ito, 1995).

Among the older group of mothers, the strongest effect on the level of fatigue was the anticipation of difficulty in taking care of their own health, followed by perceived insufficiency of sleep at night and anticipated difficulties in having sufficient physical strength for child-rearing. These findings were intuitively sensible considering the age of these mothers (average age, 37.6 years). Additionally, older primiparous women generally do not have as abundant a milk supply as their younger counterparts (Fujita, 1994; Kim, Kim, & Yoo, 2013), so they typically require longer durations of feeding times. Such longer feeding times, however, may deprive mothers of opportunities for physical and psychological recovery after childbirth. Although dissatisfaction with childbirth and anticipated difficulties in a child-centered life after discharge significantly contributed to the level of fatigue, the impact was relatively small among this age group ($\beta = 0.093$ and 0.086, respectively). As a previous qualitative study had suggested (Sakajo *et al*., 2014), this finding may be attributed to older mothers' maturity and ability to solve difficulties, both traits of which may have been developed from previously coping with other unrelated experiences prior to pregnancy.

Some other important differences in associations with the level of fatigue were noted between the two age groups. The association of hyperemesis gravidarum with

maternal fatigue was observed only in the younger group. Mothers with hyperemesis gravidarum in this study may delay acquiring maternal skills and emotionally preparing for their new life with their infants, as one previous qualitative study had suggested (Meighan & Wood, 2005). However, as only a small number of mothers in the present study had hyperemesis gravidarum ($n = 28$), this association should be interpreted with caution. The association of anticipated difficulties in finding time for themselves was also observed among the younger group of mothers. These mothers might have felt stressed with child-care activities during their post-partum hospital stay, which might have increased anticipation of difficulties in their new life with an infant; self-perception of fatigue might have consequently been affected.

The association of feeding methods (formula feeding) observed only in the older group was unexpected, as formula feeding is often clinically considered to be one of the least tiring feeding methods; one recent study had also reported no associations between feeding methods and post-partum fatigue (Taylor & Johnson, 2013). Because the number of mothers in the present study's cross-sectional data analysis who had undertaken formula feeding was small ($n = 10$), this association should be interpreted with caution, and causality cannot be inferred. Considering the current practices in Japan, it is rare that mothers do not undergo any breast-feeding during post-partum hospitalization, so it is possible that there may be specific reasons why these mothers undertook formula feeding.

Limitations

Despite the relatively large scale nature of this study, having been conducted in both eastern and western regions of Japan, the study sample is not fully representative of Japanese mothers who have only given birth to a single child. Additionally, mothers who had consented to this study and did not complete the baseline assessment might have felt higher levels of fatigue than those in the present study's final sample; generalization of the findings in this study is therefore limited. The variances explained for each model were small (33% for the younger group and 28% for the older group), indicating that there were other significant factors associated with the fatigue scores. This study was also cross-sectional, so causality between the extracted factors and degree of fatigue cannot be concluded. Further studies should investigate such causal relationships using longitudinal data.

Implications for nursing interventions

Despite limitations, this study may suggest some age-specific nursing interventions and some core components of nursing care for both younger and older primiparous women. As core components, nurses and midwives should assess whether primiparous women spend sufficient time sleeping and eating and whether they spend appropriate time between feeding and infant bedtime. Provision of support to shorten the duration between feeding and infant bedtime would be helpful for optimizing maternal rest during the hospital stay after childbirth. Nurses and midwives should additionally listen carefully to mothers' childbirth experiences when they are ready to talk, as dissatisfaction with childbirth may lead to depressive symptoms (Gürber *et al.*, 2012). Regardless of maternal age, nurses and midwives should provide first-time mothers with strategies for obtaining adequate rest and a healthy lifestyle after discharge; one such strategy may include advising mothers to nap or relax when their infants are sleeping. Information about how the lives of primiparous mothers would change according to their infants' growth and development may be helpful for foreseeing daily life with their new infants and for decreasing maternal anticipation of difficulties in making this life transition.

Among younger primiparous mothers, concerns about maternal health conditions and physical strength for child-rearing should not be underestimated. Information about lifestyle changes after childbirth should be provided during pregnancy, particularly for younger mothers who perceived that finding time for themselves would be difficult after discharge. Additionally, among younger primiparous women who had experienced hyperemesis gravidarum, nurses and midwives should carefully assess maternal degree of fatigue and emotional preparation for motherhood; these women may need more individualized support for acquiring maternal skills that would reduce their anticipated difficulty in adapting to a child-centered life.

CONCLUSIONS

Age did not significantly affect the degree of maternal fatigue during the post-partum hospital stay. Core factors associated with maternal fatigue were found in both younger and older groups; however these factors contributed differently to maternal fatigue in each group. Hyperemesis gravidarum and anticipated difficulties in finding time for themselves were found as determinants in the younger group only. Other important factors among the younger group included antici-

pation of difficulties in taking care of their own health after discharge and negative perception of sleep conditions and of childbirth. Important factors among the older group included anticipation of difficulties after discharge, negative perception of sleep conditions, and shorter mealtimes. Nurses and midwives should pay special attention to psychological and situational factors by providing adequate support and information to reduce the degree of maternal fatigue during the postpartum hospital stay.

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DISCLOSURE

The authors declare that they have no conflicts of interest.

AUTHOR CONTRIBUTIONS

Conception and design: E. M., A. S., K. M., H. I., M. M., A. M., and M. T. Data collection: M. T., E. M., A. S., T. M., H. I., K. M., A. M., H. O., and Y. M. Analysis and interpretation of data: M. T., E. M., A. S., T. M., and K. A. Drafting manuscript: M. T., E. M., A. S., K. M., H. I., H. O., Y. M., and K. T. Final approval: M. T., E. M., A. S., T. M., H. I., K. M., A. M., H. O., Y. M., K. A., M. M., and K. T.

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