# Development of Social Life Impact for Mother (SLIM) Scale At First Trimester to Identify Mothers Who Need Social Support During Postpartum: A Hospital-Based Prospective Study in Japan

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# Abstract

**Background:** Postpartum social problems, such as postpartum depression and bonding disorders, are important risk factors for child maltreatment. Mothers with such problems are known to need social support. The aim of this study was to develop and validate the Social Life Impact for Mother (SLIM) scale to identify mothers in Japan who need social support during postpartum.

**Methods:** Hospital-based prospective study was implemented covering nation-wide area of Japan. A total of 7462 pregnant women completed the SLIM scale at first trimester, and postpartum social problems (postpartum depression and bonding disorders) were assessed at one month after delivery (N=5768, follow-up rate: 77.3%). Multivariate logistic regression was applied to investigate the association between SLIM scale and postpartum social problems.

**Results:** The SLIM scale predicted postpartum social problems in moderate accuracy (AUC=0.63, 95% confidence interval: 0.60-0.65). Further stratification by local clinic and tertiary hospital did not affect the estimates.

**Conclusion:** The SLIM scale at prenatal checkup may be useful for obstetricians to detect mothers with postpartum social problems. Further intervention study using SLIM score is warranted.


# Introduction

Postpartum social problems, such as postpartum depression (PPD) and bonding disorders, are important risk factors for child maltreatment, a global social issue that needs to be addressed [1]. The prevalence of PPD has hit as high as 15% in developed countries [2], although the prevalence rate vary among studies. It is also well-known that PPD has negative effects on child development [3]. In addition to child maltreatment, PPD is also related to maternal suicide during the postpartum period [4]. Another important risk factor for child maltreatment to note is mother-infant boding disorder, according to the Bowlby's attachment theory [5]. It was described that maternal poor attachment behaviors, i.e., bonding disorders, were associated with child abuse and infanticide [6].

As mothers who have PPD and bonding disorders are considered as having a social problem, it can be modified by social support. Previous studies reported that postpartum women with low social support had significantly higher depression scores than those with high social support [7–12]. Similarly, bonding failure was associated with low social support [13–15]. A previous study showed that the number of individuals whom mothers can receive social support and mothers' satisfaction level of social support received during pregnancy have a great influence on bonding failure and depression in the postpartum period [15]. Thus, there is a need to develop a scale to detect such social problems in mothers at the early stage, such as the first trimester, so as to provide the necessary social support for these mothers.

Previous studies have shown several risk factors for postpartum social problems, including young maternal age [16], unintended pregnancy [17], maternal mental disorders [18–23], maternal developmental disorders [24], low socioeconomic status [16, 25–27], lack of existing social support [16, 28, 29], history of childhood abuse [30–32], existence of intimate partner violence (IPV) [33, 34], single motherhood [16, 35], low education [36, 37], and lack of prenatal checkup [38–40]. However, these risk factors were identified in a research setting, in which participants responded more readily since their identity remained anonymous. To our knowledge, no previous studies have developed a scale to identify mothers with postpartum social problems in a hospital setting, in which mothers cannot remain anonymous, so that we can provide social support for the high-risk mothers identified.

Therefore, the aim of this study was to develop the Social Life Impact for Mother (SLIM) scale to identify mothers with postpartum social problems in a hospital setting in Japan.

# Methods

# Sample

This is a hospital-based prospective study. Obstetric clinics and hospitals in four populous prefectures in Japan (Kagawa, Miyagi, Oita and Osaka) were invited to participate, and 58 obstetric medical institutes agreed to take part. These four prefectures had a

population of approximately 13 million (Kagawa, 0.9, Miyagi, 2.3, Oita, 1.1, and Osaka, 8.8 million) with 97,000 births in 2020 (Kagawa, 6.9, Miyagi, 16.2, Oita, 8.2, Osaka, 65.4 thousand) in 214 delivery facilities. The target subjects were expectant mothers who were enrolled during prenatal checkup between April 2019 to October 2020 in participating medical care providers. Written informed consent was obtained from all study subjects. Figure 1 shows the flow chart of enrolment process of this study. Questionnaires including SLIM scale were distributed to the target women at prenatal checkup in the first trimester. Postpartum depression and bonding disorders were assessed at one month after delivery. Questionnaires were filled by the target women in a privacy-protected area, and were collected on the same day. Medical information of target women during perinatal periods was collected from medical records. This research was approved by the ethical review board of Osaka Women's and Children's Hospital (approval number 1125, date of approval: 26 October 2018).

# SLIM Scale

According to previous studies, possible variables to be used in SLIM scale were selected. For example, because child maltreatment is related to the various postpartum social problems, young maternal age [16], unintended pregnancy [17], maternal mental disorders [18–23] and developmental disorders [24], socioeconomic status [16, 25–27], housing instability [41], social support [16, 28, 29], history of childhood abuse [30–32], intimate- partner violence [33, 34], marital status [16, 35], lower educational achievement [36, 37], inadequate prenatal checkups [38–40], were selected. Because it was difficult to assess several risk factors by using self-report questionnaires, we used "Trouble with others" and "Satisfaction of relationship with parents" as indexes of developmental disorders and history of child abuse, respectively. We rated the values on each risk factor, and assigned rating scale to each from zero to two. Based on these studies, we developed the SLIM scale with 3-Lickert response items (see Appendix 1) to be conducted during the first trimester.

# Postpartum social problems

Postpartum social problems were assessed by having either postpartum depression (assessed using the Edinburgh Postnatal Depression Scale [EPDS]) or bonding disorder (assessed using the Japanese version of Mother-to-Infant Bonding Scale [MIBS-J] [42]), at one month postpartum. Following the results of a previous community study in Japan, we defined postpartum depression as having an EPDS score of 9 or higher [43, 44]. Also, we defined bonding disorders as having a MIBS-J score of 5 or higher [45].

# Analysis

The associations between each of the SLIM scale variables and postpartum social problems were analyzed, and odds ratio were calculated using logistic regression. We chose several variables which had strong association (i.e., point estimate of odds ratio was 1.5 or more), and sum up the value of each variable. We categorized the subjects into three groups according to the total score of SLIM scale, that is, low, middle, and high score. All statistical analyses were conducted using the Stata/MP statistical package, version 15 (StataCorp. 2017. College Station, TX, USA).

## Results

We approached 7908 women to participate in this study. The number of valid responses was 7462 in the first trimester (response rate: 94.4%) and 5772 at the one-month postpartum health checkup (follow-up rate: 77.4%). Further, we selected an analytic sample of those who responded to either the EPDS or bonding scale (N=5768) (see Figure 1).

Table 1 shows the distribution of possible risk factors assessed in the first trimester. Most women were 25 years old and above (89.7%), with no history of psychiatric disorder (94.3%), married (90.5%), with high school graduation (95.7%), had someone who can consult with (95.9%), had regular prenatal checkup (95.7%), and not poor (96.8%). Almost half of the women were having a fight/argument with their partner during the pregnancy period.

Table 2 showed the distribution of EPDS score, bonding score, and postpartum social problems (i.e, either EPDS or bonding disorders). The overall prevalence of postpartum depression (an EPDS score ≥9) and bonding disorders (a MIBS-J score ≥5) at one-month postpartum were 8.2% and 7.4%, respectively. Also, the overall prevalence of postpartum social problems was 12.9%.

**Table 1 Distribution of possible risk factors**

| | | Total | | Prefecture | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Osaka (N=1876, 32.5%) | | Miyagi (N=1067, 18.5%) | | Kagawa (N=190, 3.3%) | | Oita (N=2635, 45.7 %) | | p* |
| | | N | % | N | % | N | % | N | % | N | % | |
| Maternal age | 25+ | 5173 | 89.7 | 1691 | 90.1 | 965 | 90.4 | 164 | 86.3 | 2353 | 89.3 | 0.032 |
| | 20-<24 | 529 | 9.2 | 158 | 8.4 | 85 | 8 | 23 | 12.1 | 263 | 10 | |
| | <20 | 54 | 0.9 | 25 | 1.3 | 12 | 1.1 | 1 | 0.5 | 16 | 0.6 | |
| | Missing | 12 | 0.2 | 2 | 0.1 | 5 | 0.5 | 2 | 1.1 | 3 | 0.1 | |
| Feelings when pregnancy was confirmed | Happy | 4176 | 72.4 | 1389 | 74 | 760 | 71.2 | 140 | 73.7 | 1887 | 71.6 | 0.504 |
| | Unexpected but happy | 1402 | 24.3 | 424 | 22.6 | 267 | 25 | 44 | 23.2 | 667 | 25.3 | |
| | Unexpected and confused/did not know what to do/no feelings/other | 184 | 3.2 | 61 | 3.3 | 37 | 3.5 | 6 | 3.2 | 80 | 3 | |
| | Missing | 6 | 0.1 | 2 | 0.1 | 3 | 0.3 | 0 | 0 | 1 | 0 | |
| History of psychiatric disorder | No | 5442 | 94.3 | 1762 | 93.9 | 1005 | 94.2 | 185 | 97.4 | 2490 | 94.5 | 0.538 |
| | Yes (past) | 248 | 4.3 | 83 | 4.4 | 47 | 4.4 | 4 | 2.1 | 114 | 4.3 | |
| | Yes (current) | 72 | 1.2 | 29 | 1.5 | 13 | 1.2 | 1 | 0.5 | 29 | 1.1 | |
| | Missing | 6 | 0.1 | 2 | 0.1 | 2 | 0.2 | 0 | 0 | 2 | 0.1 | |
| Trouble with others | No | 5266 | 91.3 | 1733 | 92.4 | 957 | 89.7 | 174 | 91.6 | 2402 | 91.2 | 0.200 |
| | Sometimes | 472 | 8.2 | 136 | 7.2 | 102 | 9.6 | 14 | 7.4 | 220 | 8.3 | |
| | Often | 26 | 0.5 | 6 | 0.3 | 7 | 0.7 | 2 | 1.1 | 11 | 0.4 | |
| | Missing | 4 | 0.1 | 1 | 0.1 | 1 | 0.1 | 0 | 0 | 2 | 0.1 | |
| Financial status | Rich | 3402 | 59 | 1149 | 61.2 | 602 | 56.4 | 117 | 61.6 | 1534 | 58.2 | 0.163 |
| | Not rich | 2169 | 37.6 | 665 | 35.4 | 428 | 40.1 | 67 | 35.3 | 1009 | 38.3 | |
| | Poor | 184 | 3.2 | 53 | 2.8 | 36 | 3.4 | 6 | 3.2 | 89 | 3.4 | |
| | Missing | 13 | 0.2 | 9 | 0.5 | 1 | 0.1 | 0 | 0 | 3 | 0.1 | |
| Change of living place | No | 5375 | 93.2 | 1760 | 93.8 | 1001 | 93.8 | 182 | 95.8 | 2432 | 92.3 | 0.136 |
| | Sometimes | 357 | 6.2 | 101 | 5.4 | 61 | 5.7 | 8 | 4.2 | 187 | 7.1 | |

Table 1 Distribution of possible risk factors

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Often | 34 | 0.6 | 14 | 0.7 | 5 | 0.5 | 0 | 0 | 15 | 0.6 | |
| | Missing | 2 | 0 | 1 | 0.1 | 0 | 0 | 0 | 0 | 1 | 0 | |
| Having someone who can consult with in big trouble | A few | 5531 | 95.9 | 1798 | 95.8 | 1026 | 96.2 | 187 | 98.4 | 2520 | 95.6 | 0.562 |
| | One | 220 | 3.8 | 72 | 3.8 | 37 | 3.5 | 3 | 1.6 | 108 | 4.1 | |
| | None | 14 | 0.2 | 4 | 0.2 | 4 | 0.4 | 0 | 0 | 6 | 0.2 | |
| | Missing | 3 | 0.1 | 2 | 0.1 | 0 | 0 | 0 | 0 | 1 | 0 | |
| Satisfaction of relationship with parents | Yes | 5369 | 93.1 | 1771 | 94.4 | 979 | 91.8 | 180 | 94.7 | 2439 | 92.6 | 0.024 |
| | Little | 313 | 5.4 | 82 | 4.4 | 64 | 6 | 6 | 3.2 | 161 | 6.1 | |
| | No | 67 | 1.2 | 17 | 0.9 | 18 | 1.7 | 4 | 2.1 | 28 | 1.1 | |
| | Missing | 19 | 0.3 | 6 | 0.3 | 6 | 0.6 | 0 | 0 | 7 | 0.3 | |
| Fight with partner | No | 2960 | 51.3 | 979 | 52.2 | 557 | 52.2 | 93 | 48.9 | 1331 | 50.5 | 0.636 |
| | Sometimes | 2648 | 45.9 | 846 | 45.1 | 481 | 45.1 | 95 | 50 | 1226 | 46.5 | |
| | Often | 143 | 2.5 | 44 | 2.3 | 28 | 2.6 | 2 | 1.1 | 69 | 2.6 | |
| | Missing | 17 | 0.3 | 7 | 0.4 | 1 | 0.1 | 0 | 0 | 9 | 0.3 | |
| Marital status | Married | 5221 | 90.5 | 1683 | 89.7 | 975 | 91.4 | 177 | 93.2 | 2386 | 90.6 | 0.095 |
| | Plan to marry | 374 | 6.5 | 128 | 6.8 | 54 | 5.1 | 10 | 5.3 | 182 | 6.9 | |
| | Unmarried/remarried with children | 166 | 2.9 | 61 | 3.3 | 38 | 3.6 | 3 | 1.6 | 64 | 2.4 | |
| | Missing | 7 | 0.1 | 4 | 0.2 | 0 | 0 | 0 | 0 | 3 | 0.1 | |
| Education level | High school or more | 5518 | 95.7 | 1770 | 94.3 | 1022 | 95.8 | 187 | 98.4 | 2539 | 96.4 | 0.002 |
| | Drop out of high school | 157 | 2.7 | 64 | 3.4 | 35 | 3.3 | 1 | 0.5 | 57 | 2.2 | |
| | Junior high school | 91 | 1.6 | 42 | 2.2 | 10 | 0.9 | 2 | 1.1 | 37 | 1.4 | |
| | Missing | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0.1 | |
| Number of prenatal checkup | Every time | 4964 | 86.1 | 1391 | 74.2 | 908 | 85.1 | 179 | 94.2 | 2486 | 94.3 | 0.992 |
| | 4 times or more | 34 | 0.6 | 8 | 0.4 | 6 | 0.6 | 1 | 0.5 | 19 | 0.7 | |
| | 3 times or less | 6 | 0.1 | 2 | 0.1 | 1 | 0.1 | 0 | 0 | 3 | 0.1 | |
| | Missing | 764 | 13.3 | 475 | 25.3 | 152 | 14.2 | 10 | 5.3 | 127 | 4.8 | |

* p for chi-squared test

Table 3 shows the odds ratio (ORs) for each item of SLIM scale on postpartum social problems. The OR of “Trouble with others” and “Having someone who can consult with” was 3.22 (95% CI: 2.66-3.90) and 2.69 (95% CI: 2.06-3.52), respectively. The ORs of “History of psychiatric disorder”, “Financial status”, “Change of living place”, and “Satisfaction of relationship with parents” were also significantly positively associated with postpartum social problems at around an OR of 2. Further, “Feelings when pregnancy was confirmed” and “Fight with partner” were also significantly positively associated with postpartum social problems but with an OR of less that 1.5. Based on these ORs, we weighted 3-times values on “Trouble with others” and “Having someone who can consult with in big trouble”. Similarly, we weighted 2-times for “History of psychiatric disorder”, ”Financial status”, ”Change of living place”, and “Satisfaction of relationship with parents”. Further, based on discussions with experts, we decided to use ”Maternal age”, although a non-significant association in this study, because younger age has been established as a risk factor for child maltreatment [16, 46–48]. Finally, the SLIM scale includes nine risk factors with scores ranging from zero to 34 (see Appendix 1).

Table 2 Distribution of EPDS score, bonding score, and postpartum social problems

| | | Total | | Prefecture | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Osaka | | Miyagi | | Kagawa | | Oita | | |
| | | Mean or N | SD or % | Mean or N | SD or % | Mean or N | SD or % | Mean or N | SD or % | Mean or N | SD or % | p* |
| EPDS score | | | | | | | | | | | | |
| Total score | | 3.23 | 3.45 | 3.34 | 3.31 | 2.76 | 3.19 | 2.64 | 3.41 | 3.38 | 3.62 | <0.001 |
| Category | <9 | 5,231 | 90.7 | 1,705 | 90.9 | 975 | 91.4 | 177 | 93.2 | 2,374 | 90.1 | <0.001 |
| | 9+ | 471 | 8.2 | 145 | 7.7 | 63 | 5.9 | 13 | 6.8 | 250 | 9.5 | |
| | Missing | 66 | 1.1 | 26 | 1.4 | 29 | 2.7 | 0 | 0 | 11 | 0.4 | |
| Bonding score | | | | | | | | | | | | |
| Total score | | 1.45 | 2.17 | 1.70 | 2.32 | 1.01 | 1.72 | 1.08 | 1.68 | 1.48 | 2.24 | <0.001 |
| Category | <5 | 5,254 | 91.1 | 1,624 | 86.6 | 1,017 | 95.3 | 182 | 95.8 | 2,431 | 92.3 | <0.001 |
| | 5+ | 428 | 7.4 | 174 | 9.3 | 46 | 4.3 | 8 | 4.2 | 200 | 7.6 | |
| | Missing | 86 | 1.5 | 78 | 4.2 | 4 | 0.4 | 0 | 0 | 4 | 0.2 | |
| Postpartum social problems | Low | 5024 | 87.1 | 1,612 | 85.9 | 975 | 91.4 | 172 | 90.5 | 2,265 | 86.0 | <0.001 |
| | High | 744 | 12.9 | 264 | 14.1 | 92 | 8.6 | 18 | 9.5 | 370 | 14.0 | |

*p for ANOVA or chi-squared test

| Table 3 Results of logistic regression to predict mothers with postpartum social problems by information at first trimester | |
|---|---|
| | Total |
| | OR (95%CI) |
| Maternal age | 0.91 (0.72 - 1.15) |
| Feelings when pregnancy was confirmed | **1.41 (1.24 - 1.62)** |
| History of psychiatric disorder | **2.17 (1.78 - 2.63)** |
| Trouble with others | **3.22 (2.66 - 3.90)** |
| Financial status | **1.52 (1.34 - 1.74)** |
| Change of living place | **1.57 (1.25 - 1.98)** |
| Having someone who can consult with | **2.69 (2.06 - 3.52)** |
| Satisfaction of relationship with parents | **1.93 (1.59 - 2.34)** |
| Fight with partner | **1.33 (1.16 - 1.53)** |
| Marital status | 1.13 (0.95 - 1.35) |
| Education level | 1.23 (0.98 - 1.56) |
| Number of prenatal checkup | 1.51 (0.79 - 2.86) |

Bold means p<0.001

According to the total score of SLIM scale, we divided the women into 3 categories: Low (SLIM=0-4), Middle (SLIM=5-10), and High (SLIM=11-34) based on the distribution as shown in Table 4. The OR of having postpartum social problems in the Middle and High categories was 2.58 and 6.73, respectively. The SLIM categories showed an association with “high-risk mother” (AUC=0.63, 95% CI=0.60-0.65).

| Table 4. Odds ratio of categorized SLIM score and postpartum social problems | | | | |
|---|---|---|---|---|
| | | Total | | |
| Social Life Impact for Mother (SLIM) | | n | % | OR (95%CI) |
| Total score (0-34) | | | | **1.18 (1.15 - 1.20)** |
| Category | Low (0-4) | 4,667 | 82.0 | Ref |
| | Middle (5-10) | 919 | 16.1 | **2.58 (2.15 - 3.10)** |
| | High (11-34) | 107 | 1.9 | **6.73 (4.54 - 9.99)** |

## Discussion

We developed the SLIM scale to identify mothers who may need social support at one month postpartum. The scale was feasible for use in a hospital setting in Japan at the first trimester. We identified two risk factors, “Trouble with others” and “Having someone who can consult with in big trouble”, but on the contrary, maternal age, marital status, education level, number of prenatal checkup, were not associated with postpartum social problems.

Because teen pregnancy is considered as a risk factor for child maltreatment [16, 46–48], we divided maternal age into under 20 years old, 20 to 24 years old, and 25 years old and older. Although we found a non-significant association between maternal age and postpartum social problems in this study, we chose it as an index for the SLIM scale because pregnant teenagers may have

already received high social support during pregnancy from a municipality, which might prevent postpartum depression and bonding disorders. In addition, as younger mothers are more likely to drop out of this study (drop-out rate in this study under 20 years old, 20 to 24 years old, and 25 years old and older was 28.0%, 23.0% and 22.6%, respectively), our findings on the non-association between young age and mothers who need social support might be underestimated. Further study using a sample with high retention rate, such as that of an anonymous internet survey, is needed.

The findings of the association between each item of the SLIM scale and postpartum social problems were consistent with those of previous studies. Women's feeling when pregnancy was confirmed has been identified as a risk factor at 3-month neonatal health checkup in Japan [17]. Because in this study we asked women's feeling during prenatal checkup, it is less likely that the women had forgotten about the first impression about their pregnancy. History of psychiatric disorder is an established risk factor for child maltreatment and postpartum depression [18–23]. We divided this factor into past and current because the suicide risk varies according to the type and duration of psychiatric disorder [23]. Further, the association between maternal developmental disorder traits and child mistreatment was shown in a previous study [24]. Because it was difficult to directly ask woman whether or not she had developmental disorders, we used "Trouble with others" as an index of developmental disorders for self-report questionnaires. As for social factors, a number of previous studies reported that poverty is risk factor for child maltreatment or PPD [25–27, 49]. Similar to poverty, housing instability was reported as a risk factor for intimate partner violence [41]. In addition to physical social environment, social support should be considered, as a lack of such support was also reported as a risk factor for child maltreatment and PPD [16, 28, 29]. Although previous reviews did not conclude if childhood abused history was an associated factor, owing to methodological issues,[30] one of the most robust risk factors for child maltreatment is history of childhood maltreatment. Several reports from Japan showed the association between maternal history of child abuse and their own child maltreatment or their psychiatric disease [31, 32]. As it was difficult to ask maternal history of child abuse in a hospital setting, we used "Satisfaction of relationship with parents" as an index of history of child abuse for self-report questionnaires. In conjunction with childhood maltreatment history, intimate partner violence [33, 34] and unmarried status [16, 35] are also risk factors for child maltreatment, and intimate partner violence was confirmed to be associated with mothers who need social support during the postpartum period.

Parents with intellectual disabilities are at risk of high levels of parenting stress [36] and lower education was related to physical punishment of children in Japan [37]. In this study, however, we found that several factors, such as maternal education and prenatal checkup, were not significantly associated with postpartum social problems. Education until the completion of junior high school is mandatory in Japan, so we rated this index as "junior high school", "drop out of high school", and "high school or higher". This might have led to sampling bias, i.e., mothers with lower education were more likely to drop out. Thus, we did not find an association between maternal education and postpartum social problems. Inadequate prenatal checkups were associated with increased risk of physical child abuse [38, 39], but it was not the case in the current study. When asking the number of prenatal checkups, we used three times or less as inadequateness according to the Japanese guideline for pregnant women with inadequate prenatal checkups [40]. Again, we need to recategorize the frequency of prenatal checkups, such as those who had no prenatal checkups.

The novelty of this study is that we selected and weighted nine risk factors as the SLIM score, which ranges from 0-34 and categorized into three groups (low (SLIM score: 0-4), middle (SLIM score: 5-10), and High (SLIM score: 11-34) to identify mothers who need social support during pregnancy with moderate predictability (AUC=0.63). Our findings suggest that applying the SLIM scale at the first trimester may be useful in detecting women who have postpartum social problems in a hospital setting.

The current study is also helpful when it comes to preventing postpartum social problems by identifying high-risk mothers and to provide social support promptly from the first trimester. Social support programs on parenting includes financial and psychosocial support, and such programs are based on home visits carried out by health professionals, center-based parenting programs and peer-to-peer groups. Nurse-managed home visiting programs in the United States have resulted in improved maternal mental and physical status,[50] while in Europe, community-based postpartum care programs by health-care professionals are provided [51]. In the US, the Nurse-Family Partnership (NFP) is a home visiting program for families that covers the start of the pregnancy period through to when the child is 2 years old years [50]. In Japan, families with newborns are entitled to the "Hello Baby" home visiting program conducted by public health nurses or midwives until the baby is 4 months old [52]. Following that, the families receive

infant health checkup at 4 months, 1.5 years, 3 years, and 5 years old at a municipal health center. We propose that public health nurses should focus on mothers with high SLIM score and to provide the necessary support continuously.

Nonetheless, we acknowledge that our study has several limitations. First, we may have selection bias due to social desirability. Because mothers are generally expected to accept their babies, participants may underreport their feelings against babies in the Mother-to-Infant Bonding Scale, especially when surveys were not anonymous. Also, women with PPD are often hesitant to divulge their mood and anxiety symptoms because of the guilt of having such symptoms when motherhood is expected to be a joyful event. Second, there might be measurement errors due to the survey being self-reported. We used “Satisfaction of relationship with parents” as an index of maternal history of childhood abuse. It is known that retrospective reports in adulthood of major adverse childhood experiences might be underestimated when self-reported [53]. Further, such experiences might be underreported due to the unwillingness of individuals to disclose embarrassing events or painful memories. We considered that it may be possible to estimate the history of childhood abuse by asking pregnant women about their relationship with parents, because history of childhood abuse could be regarded as an insufficiency of parent-child relationship. Third, although we collected postpartum data at the one month health checkup of infants, timing and frequency of survey can be controversial. PPD is defined strictly in the psychiatric nomenclature as a major depressive disorder with a specifier of postpartum onset within one month after childbirth [2]. However, depression in women during the postpartum period may start during pregnancy or may have onset beyond the first postpartum month. According to previous data, women generally increase in bonding with their infant six months postpartum [54]. Further study is needed to determine if the SLIM can predict women’s long-term mental problem. Finally, we extracted women with postpartum social problems in this study, but these women may not necessarily maltreat their children. Further development of a more accurate SLIM scale is warranted

# Conclusions

Our study suggested that the use of SLIM scale at prenatal checkup in a hospital setting might be effective for obstetricians to detect mothers who need social support during postpartum. There is a need to investigate whether offering appropriate social support for the identified mothers would prevent child maltreatment.

# Declarations

### Details of Ethics Approval

This research was approved by the ethical review board of Osaka Women’s and Children’s Hospital (approval number 1125, date of approval: 26 October 2018).

### Availability of data and materials

The datasets generated and/or analysed during the current study are not publicly available due to privacy and ethical concernes but are available from the corresponding author on reasonable request.

### Disclosure of Interests

None.

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### Contribution of Authorship

NM and TF conceptualized and designed the study and supervised the analysis, and undertook the critical revision of the manuscript. NM, YO, JS, KM, and SS conducted the survey. YO conducted literature searches, provided summaries of previous

research studies, and wrote the first draft of the manuscript. SD and AI conducted the statistical analysis. All authors have approved the final manuscript.

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## Figures

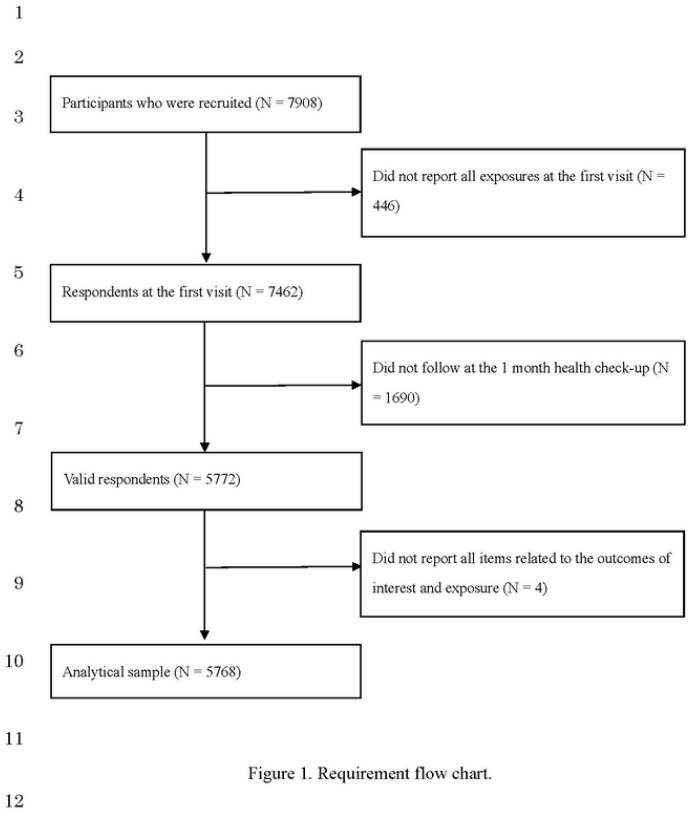


**Figure 1**

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