Infant Suffocation Incidents Related to Co-Sleeping or Breastfeeding in the Side-Lying Position in Japan

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Co-sleeping and breastfeeding in the side-lying position have recently been pointed out as risk factors for suffocation in sleeping infants; however, there is no actual report on an "incident." "Incident" is defined as a tense or sobering experience without a consequential fatal suffocation accident. It is important to understand infant suffocation incidents to prevent accidents during co-sleeping and breastfeeding in the side-lying position. We investigated factors and frequency of infant suffocation incidents associated with co-sleeping and breastfeeding in the side-lying position using a self-administered questionnaire survey of 895 mothers during their infant’s 1-, 4-, or 10-month health checkups. Co-sleeping and breastfeeding in the side-lying position were practiced by 28.3% and 56.0% of mothers, respectively; thus, 84.3% of the mothers surveyed were practicing either co-sleeping or breastfeeding in the side-lying position. Of those who received guidance from a medical professional, 36.1% practiced only co-sleeping while 60.1% practiced only side-lying breastfeeding. In the co-sleeping group, 10.6% had faced infant suffocation incidents, while 13.2% in the breastfeeding in the side-lying position group had faced similar incidents. Regarding factors associated with suffocation incidents while co-sleeping, the frequency of occurrence was significantly more in mothers of 1-month and 4-month-old infants compared with those of 10-month-old infants. Of mothers who faced suffocation incidents while breastfeeding in the side-lying position, 45% also had faced similar incidents while co-sleeping. These results demonstrate the importance of thoroughly educating mothers about the risks associated with co-sleeping and breastfeeding in the side-lying position for preventing infant suffocation.

Keywords: breastfeeding in the side-lying position; co-sleeping; incident; infant; suffocation

Introduction

In Japan, infants and mothers co-sleep as part of common practice since ancient times, and mothers and infants usually sleep in the face-to-face position. As of 2008-2009, at least 70% of infants in Japan reportedly co-sleep with their parents (Shimizu et al. 2014). In addition, breastfeeding in the side-lying position, while co-sleeping is commonly practiced as it is comfortable for both the mother and the child and allows the mother to easily observe the infant’s condition (Ball 2002).

However, co-sleeping has recently been recognized as one of the risk factors associated with infant suffocation during sleeping (American Academy of Pediatrics 2005, 2011, 2016). According to vital statistics for 2016 (Ministry of Internal Affairs and Communications Statistics Bureau 2016), suffocation accounted for > 80% of accidental infant deaths, which is the fourth-leading cause of infant deaths; accidental infant deaths caused by suffocation occurred most frequently during sleeping. Takatsu et al. (2007) investigated the details of 184 infants who died of accidental suffocation while sleeping during 1982-2006, and reported that most of the cases involved infants within the age span of birth to 6 months. The mortality associated with infants who were co-sleeping was 10.2-times higher than that of those who were not co-sleeping. Similar findings have been reported in other countries. In the UK, Weber et al. (2012) analyzed how infants died of suffocation during 1996-2005 and pointed out that more than half of these deaths occurred while co-sleeping in an adult bed.
While previous reports, including those cited in the present study, reveal the cause of death as co-sleeping on the basis of analysis following infant death; no previous reports are present on actual incidents of infant suffocation occurring in the home during co-sleeping/breastfeeding in the side-lying position. To the best of our knowledge, this is representing the first such report.

In this study, we investigated the frequency of incidents and factors associated with infant suffocation incidents caused by co-sleeping or breastfeeding in the side-lying position in mothers of 1-, 4-, and 10-month-old infants. For this study, “co-sleeping” has been defined as a mother sleeping next to her infant, while “breastfeeding in the side-lying position” refers to breastfeeding while co-sleeping. In addition, “incident” is defined as a tense or sobering experience that did not lead to a fatal suffocation accident and, according to Heinrich’s law (Heinrich 1941), defined as the equivalent of “No-injury Accident.”

**Materials and Methods**

**Participants**

After an explanation of the main purpose of the study to 1,223 mothers visiting an obstetric medical institution and a health center for the infant’s 1-, 4-, or 10-month health checkups between January and September 2011 in a city in Japan, we distributed copies of self-administered questionnaire forms. Mothers were requested to return the completed form anonymously through a dedicated collection box or via mail. Responses were received from 974 mothers (79.6%). Of the 974 responses, after questionnaires with missing data were excluded, we used 895 for the analysis (valid response rate of 91.9%).

**Methods**

The survey gathered information regarding age of mother, parity of mother, birth weight of the infant, method of delivering nutrition to the infant, mother’s hours of sleep, infant bedding, and items related to co-sleeping and breastfeeding in the side-lying position (whether mothers practiced co-sleeping/breastfeeding in the side-lying position, whether guidance was given by medical professionals, what the mother paid attention to, and incidents related to infant suffocation).

**Statistical analysis**

Data analysis was performed by simple aggregation, one-way analysis of variance (unpaired), Student’s t-test (unpaired), and chi-squared test (2 × 2 × 3 groups) using SPSSver22.0. In the chi-squared test, intergroup significance probability was calculated after confirming significant differences among the three groups. For this study, the significance level was set at 5%.

**Ethical considerations**

Subjects were informed that participation in the study was voluntary and that they would not be disadvantaged even if they refused to participate in the study. All the subjects provided their personal information anonymously, and none of them were identifiable. Submitting a response meant consent to study participation. The institutional review board at Shinshu University approved the study’s protocol (approval number 1632).

**Results**

**Subjects’ background**

Backgrounds of the subjects are presented in Table 1. The mean age of the mothers was 31.8 years. In all age groups, approximately half of the mothers were primiparous. Regarding infant feeding methods, 63.7% (570) of the mothers were breastfeeding, and 36.3% (325) were mixed/bottle-feeding. No significant differences were noted regarding background among the three infant age-based groups.

**Items related to sleeping environments of mothers and infants and the extent of the practice of co-sleeping or breastfeeding in the side-lying position**

Characteristics related to sleeping environments of mothers and infants are presented in Table 2. The mean

| Characteristics | Total (n = 895) | 1-month-old infants (n = 325) | 4-month-old infants (n = 288) | 10-month-old infants (n = 282) | p value |
|-----------------|----------------|-----------------------------|-----------------------------|-------------------------------|--------|
| **Mother**      |                |                             |                             |                               |        |
| Age (year ± SD) | 31.8 ± 4.8     | 31.9 ± 5.1                  | 31.4 ± 4.6                  | 32.1 ± 4.8                    | 0.149  |
| Parity (% n)    |                |                             |                             |                               |        |
| Primipara       | 51.3 (459)     | 52.3 (170)                  | 49.7 (143)                  | 51.8 (146)                    | 0.791  |
| Multipara       | 48.7 (436)     | 47.7 (155)                  | 50.3 (145)                  | 48.2 (136)                    |        |
| **Infant**      |                |                             |                             |                               |        |
| Birth weight (g ± SD) | 3,012 ± 396   | 2,994 ± 387                | 2,989 ± 385                | 3,055 ± 416                   | 0.356  |
| Feeding methods (% n) |           |                             |                             |                               |        |
| Breastfeeding   | 63.7 (570)     | 60.0 (195)                  | 62.8 (181)                  | 68.8 (194)                    | 0.075  |
| Mixed milk      | 36.3 (325)     | 40.0 (130)                  | 37.2 (107)                  | 31.2 (88)                     |        |

Data are provided as mean ± SD or % (n). SD, standard deviation. Calculated by Chi-squared test (2 × 3 groups) and one-way analysis of variance (unpaired).
Factors and Frequency of Infant Suffocation Incidents

The percent of infants sharing bedding with parents increased significantly with age: 44.9% at 1 month; 56.3% at 4 months; and 76.2% at 10 months. In response to the question of whether co-sleeping or breastfeeding in the side-lying position was practiced regularly, 15.7% of the mothers responded as neither, 28.3% as co-sleeping only, and 56.0% as breastfeeding in the side-lying position. On examining the data based on infant age, 71.3% of mothers of 10-month-old infants were breastfeeding in the side-lying position, which was significantly higher than that for mothers of 1- and 4-month-old infants.

We also examined the conditions under which the 754 mothers practiced co-sleeping or breastfeeding in the side-lying position (Figs. 1 and 2). Concerning the question of whether specific guidance and warnings were provided by medical professionals (physicians, midwives, public health nurses, and nurses) regarding co-sleeping, only 36.3% of the mothers had received guidance about co-sleeping. More than 60% of the mothers had not received any guidance. When guidance from medical professionals are analyzed according to the infant’s age, only 36.3% of the mothers had received guidance about co-sleeping. More than 60% of the mothers had not received any guidance. When guidance from medical professionals are analyzed according to the infant’s age, only 36.3% of the mothers had received guidance about co-sleeping. More than 60% of the mothers had not received any guidance.

Table 2. Items related to sleeping environments of mothers and infants and the extent of the practice of co-sleeping/breastfeeding in the side-lying position.

| Items                                      | Total (n = 895) | 1-month-old infants (n = 325) | 4-month-old infants (n = 288) | 10-month-old infants (n = 282) | p value |
|--------------------------------------------|-----------------|-------------------------------|-------------------------------|-------------------------------|---------|
| Mother’s hours of sleep (h/day ± SD)       | 6.1 ± 1.3       | 5.6 ± 1.3                     | 6.3 ± 1.2                     | 6.3 ± 1.1                     | a,b: < 0.001*** |
| Infant bedding (% n)                       |                 |                               |                               |                               |         |
| With parents                               | 58.4 (523)      | 44.9 (146)                    | 56.3 (162)                    | 76.2 (215)                    | a: 0.007** |
| Separate from parents(% n)                 | 41.6 (372)      | 55.1 (179)                    | 43.7 (126)                    | 23.8 (67)                     | b,c: < 0.001*** |
| Whether mothers practiced (% n)            |                 |                               |                               |                               |         |
| Not performed                              | 15.7 (141)      | 20.3 (66)                     | 18.7 (54)                     | 7.4 (21)                      |         |
| Only co-sleeping                           | 28.3 (253)      | 33.5 (109)                    | 29.2 (84)                     | 22.3 (60)                     | b,c: < 0.001*** |
| Breastfeeding in the side-lying position   | 56.0 (501)      | 46.2 (150)                    | 52.1 (150)                    | 71.3 (201)                    |         |

Data are mean ± SD or % (N).  SD, standard deviation. Calculated by chi-squared test (2 × 3 groups) and one-way analysis of variance (unpaired). After confirming that there was a significant difference in the three groups, the significance probability among the groups was determined.

a: 1-month-old infants vs. 4-month-old infants, b: 1-month-old infants vs. 10-month-old infants, c: 4-month-old infants vs. 10-month-old infants. **p < 0.01, ***p < 0.001. 1) only co-sleeping vs. breastfeeding in the side-lying position.

Fig. 1. Co-sleeping.
The vertical axis indicates frequency (%). The horizontal axis indicates values of the total and 1-, 4-, and 10-month-old infants. Data indicate frequency (%). Data analysis was performed by chi-square test (2 × 3 groups). After confirming that there was a significant difference in the three groups, the significance probability among the groups was determined. **p < 0.01. (A) Receiving guidance from medical professionals and (B) mothers who were cautious about suffocation.
that guidance given to 44.0% of mothers with infants at 1-month (Fig. 1A). As for the frequency at which mothers were cautious about suffocation during co-sleeping, 29.9% of mothers of 10-month-old infants were paying attention which was significantly lower in comparison with 43.2% of mothers with 4-month-old infants (Fig. 1B).

The overall frequency of receiving guidance from medical professionals about breastfeeding in the side-lying position was 60.1%. When analyzed by infant age, 56.7% of mothers with 4-month-old infants and 53.2% of mothers with 10-month-old infants had received guidance. These figures were significantly lower than the 72.7% of mothers with 1-month-old infants (Fig. 2A). The frequency with which mothers of 10-month-old infants paid attention during breastfeeding in the side-lying position was 35.3%, which was significantly lower than the 48.3% for mothers with 4-month-old infants (Fig. 2B).

Frequency of infant suffocation incidents during co-sleeping or breastfeeding in the side-lying position

Frequencies of infant suffocation incidents during co-sleeping or breastfeeding in the side-lying position are presented in Fig. 3. Overall, of the mothers (n = 754) who had experienced infant suffocation incidents while co-sleeping,
Factors and Frequency of Infant Suffocation Incidents

10.6% of mothers who were co-sleeping without breast-feeding in the side-lying position had experienced incidents of infant suffocation. Twelve percent of mothers with 1-month-old and 14.1% of 4-month-old infants experienced incidents of infant suffocation which was significantly higher than that experienced by 6.1% of mothers with 10-month-old infants. However, the difference between mothers with 1-month-old infants and mothers with 4-month-old infants was not significant (Fig. 3A). Specifically, incidents where “bedding or surrounding materials covered infant’s mouth or nose” accounted for 58.8% of the total number of incidents of suffocation, followed by “I (mother) fell asleep before the infant,” which accounted for 21.3%.

Next, infant suffocation incidents during breastfeeding in the side-lying position were experienced by 13.2% in total (experienced when mothers breastfeeding in the side-lying position [n = 501] were breastfeeding in the side-lying position). By infant age, mothers of 1-month-old infants (18.7%), mothers of 4-month-old infants (11.3%), and mothers of 10-month-old infants (10.4%) experienced incidents of potential infant suffocation at comparable frequencies with no significant differences (Fig. 3B). Specifically, incidents where “I (mother) fell asleep before the infant” accounted for 59.1% of the total number of incidents of suffocation, followed by “breast blocked infant’s nose”, which accounted for 22.7% of the incidents.

Importantly, no infant suffocation incident during co-sleeping or breastfeeding in the side-lying position actually led to an infant suffocation.

Factors related to infant suffocation incidents during co-sleeping/breastfeeding in the side-lying position

Factors related to infant suffocation incidents during co-sleeping are shown in Table 3. Consequently, mothers of 1-month-old infants (38.8%) and 4-month-old infants (41.2%) experienced significantly more infant suffocation incidents than mothers of 10-month-old infants (20.0%).

Factors related to infant suffocation incidents during breastfeeding in the side-lying position during were presented in Table 4. Regarding breastfeeding in the side-lying position, no significant differences were found for all variables for comparison.

Frequencies of infant suffocation incidents during co-sleeping based on conditions of practicing breastfeeding in the side-lying position

Fig. 4 shows frequencies of infant suffocation incidents during co-sleeping based on the conditions of practicing breastfeeding in the side-lying position. Of the mothers who faced incidents during breastfeeding in the side-lying position, 45.5% also faced incidents during co-sleeping, which was significantly higher than the 6.9% of mothers who did not face any incident and 7.9% of mothers who did not practice breastfeeding in the side-lying position.

Discussion

In this study, we conducted a survey of 895 mothers

| Factors                      | Sub items/Incidents of infant suffocation during co-sleeping | p value |
|------------------------------|-------------------------------------------------------------|---------|
| Age of mother (year ± SD)    |                                                             |         |
| Parity (%, n)                | Primipara 53.8 (43) vs. 48.8 (329) 0.404                   |         |
| Infant’s age (%, n)          | 1-month-old 38.8 (31) vs. 33.8 (228) 1 M vs. 4 M: 0.569     |         |
| Infant’s birth weight (g ± SD)| 3,016 ± 333 vs. 3,009 ± 411 0.813                           |         |
| Infant’s feeding methods (%, n) | Breastfeeding 65.0 (52) vs. 66.3 (447) 0.086               |         |
| Mother’s hours of sleep (h/day ± SD) | Mixed milk 35.0 (28) vs. 33.7 (227) 0.086 |         |
| Infant bedding (%, n)        | With parents 71.3 (57) vs. 66.3 (447) 0.370                 |         |
| Receiving guidance from medical professionals (%, n) | Yes 35.0 (28) vs. 36.5 (246) 0.792 |         |

Table 3. Factors related to infant suffocation incidents during co-sleeping (n = 754).

Data are mean ± SD or % (n). SD, standard deviation. Calculated by Chi-squared test (2 × 2/2 × 3 groups) and Student’s t-test (unpaired). After confirming that there was a significant difference in the three groups, the significance probability among the groups was determined.

*p < 0.05, **p < 0.01.
with infants regarding co-sleeping/breastfeeding in the side-lying position for investigating the frequency of incidents and factors related to infant suffocation in 754 mothers who were co-sleeping/breastfeeding in the side-lying position.

As the three groups of mothers in this survey shared a similar background with no significant intergroup differences in terms of mother’s age, parity, or infant’s birth weights, background variables were matched allowing for analysis of analysis of characteristics related to frequency of incidents of infant suffocation.

The extent of co-sleeping or breastfeeding in the side-lying position

In this study, more than 80% of mothers were co-sleeping which was similar to findings reported by previous surveys conducted in Japan (Iwata et al. 2013; Shimizu et al. 2014). This supports the conclusion that co-sleeping is widely practiced in Japan. Conversely, there are differences among countries in the extent of co-sleeping: 20%-30% of mothers in the UK (Blair and Ball 2004), 13.5%-40% in the United States (Tackett et al. 2010; Colson et al. 2013), 8.8%-19% in New Zealand (Hutchison et al. 2011), and

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### Table 4. Factors related to infant suffocation incidents breastfeeding in the side-lying position (n = 501).

| Factors                        | Sub items                  | Incidents of infant suffocation during breastfeeding in the side-lying position | p value |
|--------------------------------|----------------------------|--------------------------------------------------------------------------------|---------|
|                                |                            | Incidents (n = 66) | No incidents (n = 435) |
| Age of mother (year ± SD)      |                            | 32.8 ± 4.5         | 31.7 ± 4.8              | 0.514   |
| Parity (%), n                  | Primipara                  | 48.5 (32)          | 45.7 (199)              | 0.678   |
|                                | Multipara                  | 51.5 (34)          | 54.3 (236)              |         |
| Infant’s age (%), n            | 1-month-old                | 42.4 (28)          | 28.0 (122)              | 0.058   |
|                                | 4-month-old                | 25.8 (17)          | 30.6 (133)              |         |
|                                | 10-month-old               | 31.8 (21)          | 41.4 (180)              |         |
| Infant’s birth weight (g ± SD) |                            | 3,003 ± 343        | 3,042 ± 368             | 0.748   |
| Infant’s feeding methods (%), n| Breastfeeding              | 77.3 (51)          | 74.5 (324)              | 0.626   |
|                                | Mixed milk                 | 22.7 (15)          | 25.5 (111)              |         |
| Mother’s hours of sleep (h/day ± SD) |                    | 6.1 ± 1.3          | 6.1 ± 1.3               | 0.978   |
| Infant bedding (%), n          | With parents               | 69.7 (46)          | 72.9 (317)              | 0.596   |
|                                | Separate from parents      | 30.3 (20)          | 27.1 (118)              |         |
| Receiving guidance from medical professionals (%), n | Yes | 65.2 (43) | 59.3 (258) | 0.367 |
|                                | No                         | 34.8 (23)          | 40.7 (177)              |         |

Data are mean ± SD or % (n). SD, standard deviation.

Calculated by Chi-squared test (2 × 2/2 × 3 groups) and Student’s t-test (unpaired).

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![Figure 4. Frequencies of infant suffocation incidents during co-sleeping.](image)

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The vertical axis indicates frequency (%) of incidents during co-sleeping. The horizontal axis indicates the values obtained during breastfeeding in the side-lying position (incidents, no incidents and no breastfeeding in the side-lying position). Data analysis was performed by chi-square test (2 × 3 groups). After confirming that there was a significant difference in the three groups, the significance probability among the groups was determined. ***p < 0.001.
Factors and Frequency of Infant Suffocation Incidents

88% in China (Nelson et al. 2001). On the basis of these facts, co-sleeping is considered as a part of the Japanese culture and is commonly practiced. While there are no studies comparing the frequency of breastfeeding in the side-lying position by country, it was reported that approximately 40% of mothers in the US reportedly breastfeed during the night in the bed (Tackett et al. 2010). No previous reports exist on the frequency of breastfeeding in the side-lying position in Japan. In the present study, approximately 60% of mothers were breastfeeding in the side-lying position, suggesting that breastfeeding in the side-lying position is also commonly practiced in Japan.

The necessity of guidance for mothers for the prevention of infant suffocation when co-sleeping or breastfeeding in the side-lying position

In this study, 36.3% of co-sleeping mothers and 60.1% of mothers breastfeeding in the side-lying position had received guidance on specific ways of practicing this nursing method as well as caution on inherent risks from medical professionals. Approximately 40% of mothers were actively exercising caution. It is difficult to conclude that guidance on prevention of suffocation is being adequately provided. While there are no recommendations for preventing the suffocation of infants during sleeping in Japan, there has been a call for attention to this issue based on the Child Product Safety Guide (European Child Safety Alliance 2014) which specifies the following: ensuring that bedding or items do not block the mouth and nasal cavities; use of a hard mattress for infant bedtime, and not falling asleep while co-sleeping. However, the call for attention does not include breastfeeding in the side-lying position. For this reason, we feel that it is necessary to provide knowledge regarding ways of preventing infant suffocation including suffocation during breastfeeding in the side-lying position.

Frequency of incidents and factors related to infant suffocation during co-sleeping or breastfeeding in the side-lying position

In this study, 10.6% of all mothers had infant suffocation incidents during co-sleeping. During co-sleeping, the infant’s mouth and nasal cavities can be obstructed by bedding or objects when the mother and infant are close to each other. Furthermore, the significantly higher frequency of mothers with 1-month-old infants and 4-month-old infants experiencing incidents of infant suffocation compared with mothers of 10-month-old infants suggest a possible risk-based association with infant stage of growth and development. In general, infants can hold their head up in 3-4 months, can roll over in 5-6 months, and can sit up alone in 10 months (Ministry of Health, Labor and Welfare 2010). Until infants are able to move their own body and are capable of rolling over, they are unable to avoid danger (Colvin et al. 2014) and are likely at increased risk for suffocation from bedding covering mouth and nasal cavities. In addition, mothers become accustomed to the handling of infants as the infant’s age increases; it can be inferred that this is a factor in reducing risk of infant suffocation.

There were 21 reports of infant suffocation associated deaths/accidents with co-sleeping in Japan and other countries (Table 5: Nixon et al. 1995; Drago and Dannenberg 1999; Nakamura et al. 1999; Kemp et al. 2000; Thogmartin et al. 2001; Aoki et al. 2006; Takatsu et al. 2007; Kikuchi et al. 2008; Blabey and Gessner 2009; Senter et al. 2010; Weber et al. 2012; Brixey et al. 2011; Schnitzer et al. 2012; Suzuki et al. 2014; Colvin et al. 2014; Sauber-Schatz et al. 2015; Bugeja et al. 2016; Thompson and Moon 2016; Chu et al. 2016; Kassa et al. 2016; Gaw et al. 2017). Of the sudden unexpected infant deaths and accidental suffocation and strangulation in bed (ASSB, ICD-10-W75) incidents, 20%-80% occurred during co-sleeping. The mean age at the time of occurrence was 3.8 months in the United States (Gaw et al. 2017), while infants under 6 months were involved in more than 90% of deaths/accidents in Australia (Bugeja et al. 2016) consistent with more frequent occurrence at a lower age. On the basis of these reports and the results of the present study, co-sleeping was shown to increase the risk for infant suffocation incidents during early infancy, with some incidents potentially leading to deaths/accidents. Therefore, the decreasing frequency of incidents associated with co-sleeping can also lead to a decrease in deaths of infant suffocation associated with co-sleeping. The need to implement the aforementioned preventive measures is urgent.

In addition, 13.2% of the mothers in the survey faced incidents during breastfeeding in the side-lying position. Many of these incidents were attributed to the mother falling asleep before the infant. In all reported deaths/accidents caused by infant suffocation related to breastfeeding in the side-lying position, infant suffocation occurred after the mother fell asleep during breastfeeding in the side-lying position (Table 6: Abramson 1944; Byard 1998; Shigeta 2005; Hutchison et al. 2011; Feldman and White 2013; Hoffend and Sperhake 2014; Thach 2014). When breastfeeding in the side-lying position, the mother and infant are closer to each other than when co-sleeping. Furthermore, when the mother falls asleep during breastfeeding in the side-lying position, she may not notice the obstruction of the infant’s mouth and nasal cavities early on; therefore, the risk of suffocation is likely to increase.

In this study, 45.5% of mothers who faced incidents during breastfeeding in the side-lying position also faced incidents during co-sleeping. This rate was significantly higher compared to mothers who do not have incident or mothers who do not breastfeed in the side-lying position. It can be inferred that mothers who have incidents during breastfeeding in the side-lying position may also be in close contact with the infant during co-sleeping; however, further investigations are required to address this point as no clear reasons could be identified in this study.

The incidence of infant ASSB in Japan was 2.5 per 100,000 births in 2016 (Ministry of Internal Affairs and
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SUID, sudden unexpected infant death; ASSB, accidental suffocation and strangulation in bed.

Table 6. Reports of infant suffocation death/accident associated with co-sleeping in the side-lying position in Japan and foreign countries.

| Reference (country) | Year         | Year of research (Investigation period) | Infants age       | Sample size(n) | Infant suffocation death/accident associated with co-sleeping |
|--------------------|--------------|-----------------------------------------|-------------------|---------------|-------------------------------------------------------------|
| Abramson (The U.S.)| 1944         | 1939-1943 (10 years)                    | < 1 year of age   | Suffocation deaths (139) | 19 cases (15%) had a cover over as a result of sleeping after breastfeeding in bed. All 19 patients were < 4 months old. |
| Byard (Australia)  | 1998         | 1996 (1 year)                           | < 1 year of age   | SUII (3)      | 3 cases (10.7%) of SUID occurred during breast feeding in parents' bed. Both mothers were tired and slept while breastfeeding in both cases causing airway obstruction in the infants. |
| Shigeta (Japan)    | 2005         | 1982-2004 (23 years)                    | < 1 year of age   | Suffocation deaths (44) | 7 cases (15.9%) of death were caused when the infant was lying with their mothers; of which, 4 (57.1%) mothers fell asleep while breastfeeding. 13 cases (86.7%) had the mother everlasting the infants. |
| Hutchinson et al.  | 2011         | 2006-2009 (10 years)                    | Aged 7-365 days   | SUID (221)    | SUID with co-sleeping occurred in 121 cases (64%). 12 cases (9%) were caused by falling asleep while breastfeeding in the side-lying position. |
| Feldman and White  | 2013         | Unknown                                 | < 1 month of age  | SUID (1)      | 2 cases mothers fell asleep while breastfeeding in the side-lying position. |
| Hoffend and Sperhake (Germany) | 2014 | 1996-2011 (16 years) | < 7 days age      | SUID (46)     | 22 cases (48%) were co-sleeping on the bed with parents. 15 cases (32.6%), mothers fell asleep while breastfeeding in the side-lying position. |
| Thach (UK)         | 2014         | 1995-2013 (14 years)                    | < 7 days age      | SUID (16)     | The average monthly age of SUID was 3.8 ± 2.5 months. 1,168 of 1,736 (67.3%) patients were < 5 months old. |

SUID, sudden unexpected infant death; ASSB, accidental suffocation and strangulation in bed; CP, cerebral palsy.

Communications Statistics Bureau 2016). Rates in other countries, such as, 23.0 in the United States in 2015 (Lambert et al. 2018) and 29.0 in New Zealand (The New Zealand Matotality Review Group 2016), were higher than the rate in Japan, while the 1.9 in Canada (Gilbert et al. 2012) was similar to Japan. The incidence of ASSB in Japan is lower than in other countries, despite the fact, that co-sleeping is commonly practiced. We believe that this
may be attributed to the use of wide and relatively hard bedding (futon) used in Japan. With traditional Japanese bedding, mothers rarely place themselves over infants, while co-sleeping is often performed in a sofa or soft bedding in other countries (Tackett et al. 2010).

As deaths caused by co-sleeping/breastfeeding in the side-lying position are preventable, we believe they should not occur. While the incidence of ASSB is low in Japan, complete awareness of factors that lead to infant suffocation incidents associated with co-sleeping/breastfeeding in the side-lying position and increasing attention for the prevention of infant suffocation among mothers are crucial for preventing infant deaths as mothers customarily co-sleep/breastfeed in the side-lying position.

Conclusions

In this study, we investigated the frequency of occurrence and factors related to infant suffocation associated with co-sleeping/breastfeeding in the side-lying position. Our conclusions are as follows:

1. Of the 895 survey responses, 28.3% (253) of mothers were co-sleeping only and 56.0% (501) of the mothers were breastfeeding in the side-lying position. In total, 84.3% were co-sleeping with the infant.

2. Of the mothers who had received specific guidance on co-sleeping as well as the risks of co-sleeping from medical professionals, 36.3% received guidance on co-sleeping and 60.1% on breastfeeding in the side-lying position.

3. Of the mothers surveyed, 10.6% and 13.2%, respectively, had infant suffocation incidents during co-sleeping and breastfeeding in the side-lying position.

4. Factors related to incident experiences during co-sleeping were significantly more for mothers with 1- or 4-month-old infants compared with mothers of 10-month-old infants. Regarding incidents experienced during breastfeeding in the side-lying position, no significant differences were found for all variables.

5. Of mothers who experienced incidents during breastfeeding in the side-lying position, 45.5% also faced similar incidents during co-sleeping. This frequency was significantly higher than that for mothers who had no incidents experience during breastfeeding in the side-lying position or mothers who did not breastfeed in the side-lying position.

These results indicate the importance of making mothers aware of the risk for infant suffocation before beginning the practice of co-sleeping, since co-sleeping with children in early infancy, such as at 1 month or 4 months of age, is a risk factor for infant suffocation incidents.

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