

Social and Environmental Risk Factors for Unintentional Suffocation Among Infants in China

Xue Yu

West China Women's and Children's Hospital: Sichuan University West China Second University Hospital

Leni Kang (✉ kangleni@126.com)

Sichuan University West China Second University Hospital <https://orcid.org/0000-0002-2763-296X>

Lei Miao

Sichuan University West China Hospital of Stomatology: Sichuan University West China College of Stomatology

Jun Zhu

Sichuan University West China Hospital

Juan Liang

Sichuan University West China Hospital

Li Dai

Sichuan University West China Hospital

Li Xiaohong

West China Women's and Children's Hospital: Sichuan University West China Second University Hospital

Qi Li

Sichuan University West China Hospital

Rui Rao

People's Hospital of Leshan

Yanping Wang

Sichuan University West China Hospital

Chunhua Yuan

Renshou Maternity and Child Health Care Hospital

Chunhua He

Sichuan University West China Hospital

Research article

Keywords: unintentional suffocation, risk factors, infants, China

Posted Date: April 15th, 2021

DOI: <https://doi.org/10.21203/rs.3.rs-408743/v1>

License:  This work is licensed under a Creative Commons Attribution 4.0 International License.

[Read Full License](#)

Abstract

Background: This retrospective study aims to determine the epidemiological features of deaths caused by unintentional suffocation among infants in China, with a focus on environmental and sociodemographic factors may contribute to these deaths.

Methods: Data were obtained from China's under 5 Child Mortality Surveillance System (U5CMSS) from October 1, 2015 to September 30, 2016. A total of 377 children under 1 year of age who died from unintentional suffocation were included in the survey. Primary caregivers were interviewed individually using the Unintentional Suffocation Mortality among Children under 5 Questionnaire. EpiData was used to establish the database, and the results were analysed using SPSS 22.0.

Results: Most (85.9%) unintentional infant suffocations occurred in rural areas, and 67.5% occurred in infants 0 to 3 months old. Among the primary caregivers of the infants, most (82.7%) had a junior middle school education or below, and 83.1% of them lacked unintentional suffocation first aid skills. Of the 377 unintentional suffocated-infant deaths, the causes of death were unintentional suffocation and strangulation in bed (ASSB) (193, 51.2%), inhalation suffocation (154, 40.8%), other unintentional suffocation (6, 1.6%), and unknown (24, 6.4%). Among the infant deaths due to ASSB, overlaying (88.6%) was the frequently reported circumstance. A total of 93.8% of cases were reported to occur during co-sleeping/bed sharing with parents, and in 72.8% of the cases, the infants were covered with the same quilt as their parents. In our study, most inhalation suffocation deaths (88.3%) involved liquid food (such as breast milk and formula milk). A total of 80.5% of infant deaths were reported to occur after eating; in 28.2% of those cases, the infants were held upright and patted by their caregivers, and in 57.2% of them, were laid down to sleep immediately after eating.

Conclusions: To reduce the occurrence of unintentional suffocation, local government should strengthen knowledge and awareness of unintentional suffocation prevention and safety among parents and caregivers, healthcare providers should educate parents and caregivers about safety issues of unintentional suffocation and relevant policies should be introduced to provide environments and activities that reduce the risk of suffocation such as promoting the Safe to Sleep Campaign. It is important to enhance the focus on infant unintentional suffocation as a health issue.

Background

Suffocation is a general term that includes many forms of asphyxia due to a scarcity of oxygen. It can happen when there is a lack of oxygen to breathe, or it can be due to an interruption of breathing due to obstructions of the external airways (smothering) or the internal airways (choking)[1]. Unintentional suffocation, including unintentional suffocation and strangulation in bed and choking on food or other objects, causes serious injuries in children and is the leading cause of unintentional death in infants and toddlers[2]. Globally, there were more than 11 400 deaths in infants and toddlers aged 1–59 months reportedly due to unintentional suffocation in 2016[3], causing great losses to families and society.

Accidental suffocation and strangulation in bed (ASSB) is a subset of sudden unexpected infant deaths (SUID); the mechanisms of ASSB are diverse and include the wedging of the child between objects, strangulation from cords or ties, suffocation by soft bedding, or overlaying by an adult or child[4-6]. A substantial proportion of these causes of death are related to the presence of objects in the sleep environment, suggesting that ASSB deaths could be prevented through the promotion of safe sleeping environments[7]. Inhalation suffocation, which is caused by choking on food or other objects, is the interruption of respiration by internal obstruction of the airway usually by food or small toys in young children[8]. The consequences of foreign body aspiration such as asphyxia and cardiopulmonary arrest are very serious and can lead to death or sequelae, which are mostly neurological[9].

In China, there were nearly 3200 deaths in infants and toddlers aged 1–59 months reportedly due to unintentional suffocation, accounting for 28% of unintentional suffocation deaths worldwide in 2016. The relative mortality among young children in China (5.33 per 100 000) is far higher than that in developed countries, such as the US (3.31 per 100 000), Canada (1.2 per 100 000), and Australia (0.8 per 100 000)[3]. Additionally, 83.8% of suffocation-related deaths among children younger than 5 years occur in infancy, and suffocation accounts for 83.0% of injury-related infant deaths[10]. Therefore, the prevention of unintentional suffocation deaths can have an important effect on reducing the overall infant mortality rate. Most unintentional suffocation-related deaths can be prevented by well-known preventive strategies[2]. China released the ‘Healthy China 2030 Planning Outline’ in 2016 with a goal of establishing a comprehensive injury monitoring system and developing guidelines and standards for strengthening the prevention and intervention of injuries. Prevention should be based on clear epidemiologic evidence of the behaviour and factors increasing the probability of suffocation[11]. However, previous resources have been limited by their lack of specific information, with the injury described only as the cause of death. In our study, given the absence of national-level data, we conducted one-to-one interviews with primary caregivers of infants who suffered from unintentional suffocation from various parts of the country (registered in the National Maternal and Child Health Surveillance System) to elucidate characteristics and risk factors of unintentional suffocation deaths among infants. Our analysis focused on improving the epidemiological understanding of these deaths and thereby strengthening our ability to design more effective prevention strategies.

Methods

Study Subjects

This study used data were obtained from the U5CMSS, a population-based surveillance system for monitoring the death of children younger than 5 years, which covered a total population of approximately 44–47 million individuals across 334 representative districts, of which 124 are urban and 210 are rural, in 31 provinces in mainland China. It follows stringent procedures for data collection, reporting, auditing and quality control, helping to reduce the risk of under-reporting, further details about the U5CMSS are described elsewhere[12]. Causes of death were classified according to the World Health Organization International Classification of Diseases, Tenth Revision (ICD-10)

The survey time period was October 1, 2015, to September 30, 2016, and the parents of 377 children under 1 year of age in surveillance districts who died from unintentional suffocation were included in the survey. The unintentional suffocation in the study including W75–W76, W78–W80, W83–W84. The research team participated in the research design, questionnaire design, data collection and also responsible for descriptive analysis and reporting.

Questionnaire

We collected information about the unintentional suffocation deaths from the Unintentional Suffocation Mortality among Children under 5 Questionnaire, which was designed by the Chinese National Health Commission and UNICEF to gain information on children under five who died due to unintentional suffocating. The questionnaire contains two parts: basic information about children and their families (information of children, families and the care-giving situation); the basic conditions of the injuries (factors of unintentional suffocation, care-giving situation when the injury occurred and rescue condition of the injury). All respondents provided oral informed consent for their anonymized responses to be analysed and published.

Data collection and Quality control

Local health workers from each district branch of China's under 5 Child Mortality Surveillance System (U5CMSS) were responsible for the organization, implementation, and conduct of the survey, as well as for quality control of the data and reporting of the results. The investigators were trained to ensure that they fully understood the survey instructions and corresponding notes. During the interview, one trained investigator was paired with one respondent; the investigator read the questionnaire description and corresponding notes aloud to the respondent before filling in the questionnaire with information dictated by the respondent. The same investigator checked the completeness and reliability of the data after the interview. Finally, the completed questionnaires were submitted stepwise via district-level, county, prefecture, city and provincial-level maternal and child health care centres to the National Office of Maternal and Child Health Surveillance. To ensure the quality of the investigation, the interviews with respondents were conducted within three months of the child's death, and the maternal and child health care institutions at every level reviewed the data in a timely manner.

Statistical analysis

The questionnaires were double entered with logic and consistency checks. The cases were analyzed and categorized according to sociodemographic characteristics associated with infants, basic characteristics of primary caregivers and environmental risk factors. Proportions were calculated to describe the main results. EpiData (version 3.1, The EpiData Association, Odense, Denmark) was used to establish the database and the results were analysed using SPSS 22.0 (IBM, Armonk, NY, USA).

Results

1. Epidemiology of infants who died due to unintentional suffocation in China

Of the 377 unintentional suffocated-infant deaths, the causes of death were unintentional suffocation and strangulation in bed (ASSB) (193, 51.2%), inhalation suffocation (154, 40.8%), other unintentional suffocation (6, 1.6%), and unknown (24, 6.4%) (Figure 1). Among these deaths, infants ≤ 3 months of age accounted for 67.5% of the cases; the 1-month-old group had the highest proportion of deaths, with 30.3% of deaths, and the 1-2-month-old group had the next highest proportion, with 24.8% of cases. The proportion of infant death decreased with age; only 13.2% of deaths occurred in the 6-to-12-month-old group. Among the unintentional suffocated-infant deaths, 56.8% of cases occurred in boys, 43.2% in girls, 13.3% in urban areas, and 86.2% in rural areas (Table 1).

2. Basic information of primary caregivers of infants who died due to unintentional suffocation

2.1 Social features of primary caregivers

Most infants (84.7%) received full-time care (which is defined as the caregiver having no permanent job and only looking after one child) from their primary caregivers. The primary caregiver (which is defined as the caregiver who provided at least 6 hours of caring per day) was only the mother in 37.5% of cases, and in 46.4% of cases, both parents were primary caregivers; grandparents took care of children in 4.0% of the cases. Among the primary caregivers, we found that most (82.7%) of them had a junior middle school education or below, and only 2.3% had acquired some form of a bachelor's degree.

2.2 First aid knowledge of primary caregivers

The definition of unintentional suffocation first aid skills in this investigation was the ability of the primary caregivers to notice signs of suffocation and also complete first aid for children, which included removal of the foreign body in the respiratory system and cardiopulmonary resuscitation. Suffocation first aid skills were mostly lacking; the vast majority (87.3%) of primary caregivers reported having received no training (Table 2).

2.3 Activities of primary caregivers when unintentional suffocating

At the time of unintentional suffocation, 81.0% of infants were with their primary caregivers. Regarding the primary caregivers who were with their infant at the time of suffocation, only 10.4% were supervising the infants, smaller proportions (1.7%) were using their phone or socializing, and the majority (57.9%) were sleeping. It is worth noting that 70.0% and 42.2% of those primary caregivers were sleeping during the infant deaths due to ASSB and inhalation suffocation, respectively, and 21.4% were taking care of the infants during the inhalation suffocation (Table 3).

3. Environmental features of infants who died due to different types of unintentional suffocation

Infants whose deaths were attributed to ASSB in our study had some noteworthy characteristics. Half (50.8%) of the ASSB cases occurred in winter, and only 7.8% occurred in summer. Overlaying was the

most frequently reported circumstance, contributing to 88.6% of cases; 10.4% of the infants were overlaid by the adult's body, and 1.0% of the cases were due to other causes. Of the 193 ASSB infant deaths, 93.8% were reported to occur from co-sleeping/bed sharing with parents, and 72.8% of the infants who were co-sleeping/bed sharing with their parent were covered with the same quilt as their parent.

We found that breast milk was the main cause of inhalation suffocation in the infant deaths (54.5%), followed by a liquid substance (33.8%) and another semisolid or solid substance (11.7%). In our study, 80.5% of infant deaths due to inhalation suffocation were reported to occur after eating; in 28.2% of these cases, the infants were held upright and patted by their caregivers, while 57.2% were put to sleep immediately after eating.

Discussion

In the study, we focused on unintentional suffocation among infants using data from the survey about the children's characteristics, primary caregivers, and the mechanism of unintentional suffocation deaths leads to the following findings. First, infants 0 to 3 months old (especially those 1 month old) who were living in rural areas had the highest mortality attributable to unintentional suffocations. Second, most primary caregivers (87.3%) had not received first aid training in suffocating and most suffocated infants had caregivers who were less educated. Third, among infants died due to ASSB, overlaying was the most frequently reported contributing factor, and most cases featured bed sharing, even sharing a quilt with the caregiver. Fourth, the most common substance of inhalation suffocation was breast milk and other liquid substances, and most infants who died due to inhalation suffocation did not receive protective measures such as being held upright and patted by their caregivers and not being put to sleep immediately after eating. Therefore, our analysis suggests that several external factors influence the risk of infants dying due to unintentional suffocation: residence, age, unintentional suffocation safety training, and risky behaviours.

We found that the majority of infant deaths occurred in rural areas, consistent with the previous studies[13]. The possible explanations include a lack of adequate care from caregivers due to farming duties or other tasks, low safety awareness and less knowledge among rural caretakers of children[14, 15]. Relatively weak prehospital aid and hospital treatment for the children suffering from unintentional suffocation also increased the risk that injuries will result in mortality[16]. Therefore, the government should pay more attention to rural areas by strongly publicizing the importance of knowledge and awareness of unintentional suffocation prevention and safety measures, and more budget resources should be allocated to improve the construction of medical facilities and improve the medical treatment level.

The results showed that the highest percentage of cases occurring among infants who were 0 to 3 months old (especially 1 month old); these findings were consistent with a previous study in USA[17]. Regarding ASSB, the most likely explanation is that many parents and adult caretakers prefer to sleep with their children in a single bed in China, especially when the children are infants[18]. Regarding

inhalation suffocation, the factors that predispose infants to these risks are often the habit of bringing objects to their mouths, inadequate chewing of food before swallowing (due to immature neuromuscular mechanisms of deglutition and airway protection) and incomplete development of posterior dentition with an absence of molars [9, 19]. Local communities could promote safety awareness regarding unintentional suffocation according to health education programmes and could send related suffocation knowledge via SMS or voice messages to parents' mobile phones, which has effectively raised awareness and reduced the risk of drowning in many countries[20, 21] .

Professional knowledge of suffocation first aid can greatly improve the prognosis, especially for inhalation suffocation which prevents oxygen from getting to the lungs and brain, leading to brain damage or even death within four minutes[22]. However, we found that the majority (87.3%) of primary caregivers of the infants did not have knowledge of first aid. Therefore, it is important to educate caregivers about suffocation first aid. Paediatric health care providers should encourage parents and other caregivers to learn cardiopulmonary resuscitation (CPR) and choking first aid, and they should offer anticipatory, age-appropriate guidance to prevent unintentional injuries[2].

In our study, there were 194 infant deaths due to accidental suffocation and strangulation in bed, accounting for 44.1% of all deaths, including some cases of sudden infant death syndrome. ASSB deaths share many of the same characteristics of sudden infant death syndrome (SIDS) and cause unknown deaths[23], and there are no criteria to distinguish an ASSB death from a SIDS death, not even pathophysiological findings[24, 25]. Among the infant deaths due to accidental suffocation and strangulation, most occurred during sleeping, and risky infant behaviours are affected by unsafe sleeping environments. In our study, 50.8% of injuries occurred in winter, because parents in China are fond of using thick quilts and bed sharing with infants in cold winters. We also found that 93.8% were reported to occur while the infants were sleeping with their parents in the same bed, with 72.8% of the infants being covered with the same quilt as their caregivers. Bed sharing and the use of adult beds is a modifiable risk factor for sudden infant death syndrome and unintentional sleep-related suffocation because adults may lie on or roll over on top of or against an infant while sleeping and may wedge and trap an infant between two objects[26, 27][28]. A study in the United State showed that the risk for suffocation among infants in adult beds was 40 times higher than the risk for suffocation among infants sleeping on surfaces designed for infants[29]. We also found that overlaying was the most frequently reported contributing factor, which is similar to findings from other countries[17]. Preventative efforts should target those at highest risk and focus on helping caregivers provide safer sleep environments.

In our study, inhalation suffocation was not a negligible phenomenon. It contributed to 40.3% of the deaths, and most of those deaths (88.3%) were due to liquid food, such as breast milk and formula milk. In addition to immature neuromuscular mechanisms of deglutition and airway protection, swallowing liquid food often contributes to choking during babyhood[19, 30]. There are many other risk factors. We found that 80.5% of inhalation suffocation cases occurred after eating, and half of the infants were put to sleep immediately after eating. A small proportion of caregivers held the infants upright and patted them. Therefore, proper feeding practices, including appropriate feeding time, correct feeding position,

careful observation during the feeding process and the expulsion of gastric gas after feeding, are critical for preventing infant inhalation suffocation. Governments and medical institutions should strengthen training on proper feeding for new mothers.

In view of the results of our study, it is important to enhance the focus on infant unintentional suffocation as a health issue and to integrate injury prevention efforts with a combination of education and policy. First, the government should strengthen publicity and education by disseminating unintentional suffocation prevention messages through channels such as TV, posters, parent and caregiver learning experiences for increasing knowledge, attitudes, and behaviour change conducive to preventing injuries. Second, healthcare systems should play a critical role in educating parents and caregivers about safety issues of unintentional suffocation and encourage widespread CPR training among them. Last, the government should enforce policies to provide environments and activities that reduce the risk of suffocation such as promoting the Safe to Sleep Campaign. Moreover, more attention should be given to injury prevention in rural areas.

Conclusions

This cross-sectional study is the most extensive survey to examine the characteristics of unintentional suffocation deaths in infants in China recently. The risk factors for unintentional suffocations include a lack of comprehensive understanding of safety, poor awareness of prevention and a lack of related policy. To reduce the occurrence of unintentional suffocations, local government should strengthen knowledge and awareness of unintentional suffocation prevention and safety among parents and caregivers, healthcare providers should educate parents and caregivers about safety issues of unintentional suffocation, and relevant policies should be introduced to provide environments and activities that reduce the risk of suffocation such as promoting the Safe to Sleep Campaign.

Declarations

Ethics approval and consent to participate

The Ethics Committee of West China Second University Hospital, Sichuan University, China, approved this study.(we have obtained the participants' verbal consent. Before starting the survey, the trained investigators would ask the participants' verbal consent whether he/she were willing to participate the survey. The ethics committee approved this method of obtaining verbal consent, because we will not collect participants' any biological samples, and the study will not reveal participants' individual identifiable information.)

Consent to publish

Not applicable.

Availability of data and materials

This study used data from the NMCHSS. This system was coestablished by the National Health and Family Planning Commission of the People Republic of China and Sichuan University, and it is owned by the National Health and Family Planning Commission of the People Republic of China. The researchers did not obtain consent to publicly share the data. The deidentified data set is available upon request to interested researchers. For data requests, please contact the Department of Science and Technology of West China Second University Hospital, Sichuan University, at: fu2yuankjb@163.com. This department is in charge of all programs in the hospital, including data management. One staff member from the department (named Xian He) monitors this email address.

Competing interests

The authors declare that they have no competing interests.

Funding

This work was funded by the Department of Women and Children of the National Health Commission of China, UNICEF, and the Sichuan Science and Technology Department Project (No.2018ZR0334). The funders were involved in designing the study but were not involved in the collection, analysis, or interpretation of the data, or writing of the manuscript.

Authors' contributions

XY, RR, CY, LM, JZ was involved in study design, led data collection, analysis and writing of the manuscript. CH, LK was involved in study design, data collection, and data analysis. JL, LD, YW were involved in study design. All authors read and approved the final manuscript.

Acknowledgements

We thank the institutions and staff of the National Maternal and Child Health Surveillance System for the data collection.

Authors' information

¹National Office for Maternal and Child Health Surveillance of China, West China Second University Hospital, Sichuan University, Chengdu, Sichuan, China;

²Key Laboratory of Birth Defects and Related Diseases of Women and Children of the Ministry of Education, West China Second University Hospital, Sichuan University, Chengdu, China;

³Department of Pediatrics, the people's hospital of Leshan, Leshan, Sichuan, China; ⁴Department of gynaecology and obstetrics, Renshou Maternity and Child Health Care Hospital, Meishan, Sichuan, China.

References

1. Boghossian E, Tambuscio S, Sauvageau A: Nonchemical suffocation deaths in forensic setting: a 6-year retrospective study of environmental suffocation, smothering, choking, and traumatic/positional asphyxia. *J forensic sci* 2010, 55(3):646-651.
2. Cyr C: Preventing choking and suffocation in children. *Paediatr Child Health* 2012, 17(2):91-94.
3. Rubin, Rita: Profile: Institute for Health Metrics and Evaluation, WA, USA. *Lancet* 2017, 389(10068):493.
4. Drago, Dorothy, A, Dannenberg, Andrew, L: Infant Mechanical Suffocation Deaths in the United States, 1980-1997. *Pediatrics* 1999.
5. Byard RW: Hazardous infant and early childhood sleeping environments and death scene examination. *Journal of Clinical Forensic Medicine* 1996, 3(3):115.
6. Nakamura S, Wind M, Danello MA: Review of Hazards Associated With Children Placed in Adult Beds. *Arch Pediatr Adolesc Med* 1999, 153(10):1019-1023.
7. Gaw CE, Chounthirath T, Midgett J, Quinlan K, Smith GA: Types of Objects in the Sleep Environment Associated With Infant Suffocation and Strangulation. *Acad pediatr* 2017, 17(8).
8. Vincenten, J: European Child Safety Alliance. *Injury prev* 2001, 7(2):166.
9. Pan H, Lu Y, Shi L, Pan X, Li L, Wu Z: Similarities and differences in aspirated tracheobronchial foreign bodies in patients under the age of 3 years. *Int J Pediatr Otorhinolaryngol* 2012, 76(6):911-914.
10. Xiang L, Wang K, Miao L, Kang L, Li X, Zhu J, Liang J, Li Q, He C, Wang Y: Injury-related mortality among children younger than 5 years in China during 2009-2016: an analysis from national surveillance system. *Inj Prev* 2019, 25(1):60-66.
11. Nakamura SW, Pollack-Nelson C, Chidekel AS: Suction-type suffocation incidents in infants and toddlers. *Pediatrics* 2003, 111(1):e12-e16.
12. He C, Liu L, Chu Y, Perin J, Dai L, Li X, Miao L, Kang L, Li Q, Scherpbier R *et al*: National and subnational all-cause and cause-specific child mortality in China, 1996-2015: a systematic analysis with implications for the Sustainable Development Goals. *Lancet glob health* 2017, 5(2):e186-e197.
13. Wang L, Gao Y, Yin P, Cheng P, Liu Y, Schwebel DC, Liu J, Qi J, Zhou M, Hu G: Under-five mortality from unintentional suffocation in China, 2006-2016. *J glob health* 2019, 9(1):10602.
14. Yin Z, Wu J, Luo J, Pak AW, Choi BC, Liang X: Burden and trend analysis of injury mortality in China among children aged 0-14 years from 2004 to 2011. *Bmj open* 2015, 5(7):e7307.
15. Schwebel DC, Gaines J: Pediatric unintentional injury: behavioral risk factors and implications for prevention. *J Dev Behav Pediatr* 2007, 28(3):245-254.
16. Hu G, Baker SP, Baker TD: Urban-rural disparities in injury mortality in China, 2006. *J rural health* 2010, 26(1):73-77.
17. Shapiro-Mendoza CK, Kimball M, Tomashek KM, Anderson RN, Blanding S: US infant mortality trends attributable to accidental suffocation and strangulation in bed from 1984 through 2004: are rates increasing? *Pediatrics* 2009, 123(2):533.

18. Lili X, Jian H, Liping L, Zhiyu L, Hua W: Epidemiology of Injury-Related Death in Children under 5 Years of Age in Hunan Province, China, 2009-2014. *Plos one* 2017, 12(1):e168524.
19. Zigon G, Gregori D, Corradetti R, Morra B, Salerni L, Passali FM, Passali D: Child mortality due to suffocation in Europe (1980-1995): a review of official data. *Acta Otorhinolaryngol Ital* 2006, 26(3):154-161.
20. Hossain M, Mani KK, Mohd SS, Kadir SH: The development of an intervention package to prevent children under five years old drowning in rural Bangladesh. *Acta paediatr* 2016, 105(8):e373-e378.
21. Zhang PB, Chen RH, Deng JY, Xu BR, Hu YF: Evaluation on intervening efficacy of health education on accidental suffocation and drowning of children aged 0 - 4 in countryside. *Chinese Journal of Pediatrics* 2003, 41(7):497-500.
22. Hossain M, Mani KK, Mohd SS, Kadir SH: The development of an intervention package to prevent children under five years old drowning in rural Bangladesh. *Acta Paediatr* 2016, 105(8):e373-e378.
23. Shapiro-Mendoza CK, Tomashek KM, Anderson RN, Wingo J: Recent national trends in sudden, unexpected infant deaths: more evidence supporting a change in classification or reporting. *Am j epidemiol* 2006, 163(8):762-769.
24. Bass M, Kravath RE, Glass L: Death-scene investigation in sudden infant death. *N Engl J Med* 1986, 315(2):100-105.
25. Dickinson HO: Sudden Infant Death Syndrome: Problems, Progress and Possibilities. *Pediatric & developmental pathology* 2002, 5(5):508-509.
26. Corey TS, McCloud LC, Nichols GN, Buchino JJ: Infant deaths due to unintentional injury. An 11-year autopsy review. *Am J Dis Child* 1992, 146(8):968-971.
27. Drago DA, Dannenberg AL: Infant mechanical suffocation deaths in the United States, 1980-1997. *Pediatrics* 1999, 103(5):e59.
28. Imamura JH, Troster EJ, Oliveira CA: What types of unintentional injuries kill our children? Do infants die of the same types of injuries? A systematic review. *Clinics (Sao Paulo)* 2012, 67(9):1107-1116.
29. Scheers N: Where should infants sleep? A comparison of risk for suffocation of infants sleeping in cribs, adult beds, and other sleeping locations. *Pediatrics* 2003, 112(4):883-889.
30. Pan H, Lu Y, Shi L, Pan X, Li L, Wu Z: Similarities and differences in aspirated tracheobronchial foreign bodies in patients under the age of 3 years. *Int J Pediatr Otorhinolaryngol* 2012, 76(6):911-914.

Tables

Table1: The descriptive characteristics of unintentional suffocated infants in the study.

Characteristic	ASSB (n, %)	inhalation suffocation (n, %)	Total (n, %)
Age (months)			
~1	46(23.8%)	59(38.2%)	105(30.3%)
~2	52(26.9%)	34(22.1%)	86(24.8%)
~3	29(15.0%)	14(9.1%)	43(12.4%)
~4	17(8.8%)	10(6.5%)	27(7.8%)
~5	14(7.3%)	10(6.5%)	24(6.9%)
~6	7(3.6%)	9(5.7%)	16(4.6%)
6~12	28(14.7%)	18(11.9%)	46(13.2%)
Total	193(100.0%)	154(100.0%)	347(100.0%)
Sex			
Male	98(50.5%)	99(64.3%)	197(56.8%)
Female	95(49.5%)	55(35.7%)	150(43.2%)
Total	193(100.0%)	154(100.0%)	347(100.0%)
Location			
urban	21(10.9%)	28(18.2%)	49(14.1%)
rural	172(89.1%)	126(81.8%)	298(85.9%)
Total	193(100.0%)	154(100.0%)	347(100.0%)

Table2: Characteristics of infants' primary caregivers.

	ASSB (n,%)	inhalation suffocation (n,%)	Total (n,%)
Full-time care			
Yes	160(82.9%)	134(87.0%)	294(84.7%)
No	33(17.1%)	20(13.0%)	53(15.3%)
Total	193(100.0%)	154(100.0%)	347(100.0%)
Relationship to child			
Only father	11(5.7%)	3(2.0%)	14(4.0%)
Only mother	71(36.8%)	59(38.3%)	130(37.5%)
Only parents	92(47.7%)	69(44.8%)	161(46.4%)
Father and grandparents	0(0.0%)	0(0.0%)	0(0.0%)
Mother and grandparents	3(1.6%)	6(3.9%)	9(2.6%)
Parents and grandparents	7(3.6%)	9(5.8%)	16(4.6%)
Only grandparents	7(3.6%)	7(4.5%)	14(4.0%)
Only Nanny	0(0.0%)	0(0.0%)	0(0.0%)
Not answered	2(1.0%)	1(0.7%)	3(0.9%)
Total	193(100.0%)	154(100.0%)	347(100.0%)
Education level			
Unschoolled	13(6.7%)	12(7.8%)	25(7.2%)
Primary schools	35(18.1%)	28(18.2%)	63(18.2%)
Middle schools	116(60.1%)	83(53.9%)	199(57.3%)
High school/technical school	11(5.8%)	14(9.1%)	25(7.2%)
Technical secondary school	6(3.1%)	2(1.3%)	8(2.3%)
Junior college or over	8(4.1%)	15(9.7%)	23(6.6%)
Not Answered	1(0.5%)	0(0.0%)	1(0.3%)
Unknown	3(1.6%)	0(0.0%)	3(0.9%)
Total	193(100.0%)	154(100.0%)	347(100.0%)
Knowledge of first aid			
Yes	22(11.4%)	20(13.0%)	42(12.1%)
No	169(87.6%)	134(87.0%)	303(87.3%)

Not Answered	2(1.0%)	0(0.0)	2(0.6%)
Total	193(100.0%)	154(100.0%)	347(100.0%)

Table3: The behavior of the primary caregiver at the time of unintentional suffocating .

	ASSB (n, %)	inhalation suffocation (n, %)	Total (n, %)
Who was with the child when the fatal accident occurred			
Primary caregivers	161(83.4%)	120(77.9%)	281(81.0%)
Other adults	9(4.7%)	5(3.3%)	14(4.0%)
Alone	13(6.7%)	19(12.3%)	32(9.2%)
Other children	2(1.0%)	1(0.7%)	3(0.9%)
Others	8(4.2%)	9(5.8%)	17(4.9%)
Total	193(100.0%)	154(100.0%)	347(100.0%)
What was the primary caregiver doing when the injury occurred			
Doing housework	31(16.1)	31(20.1)	62(17.9)
Watching TV	1(0.6)	5(3.2)	6(1.7)
Sleeping	135(70.0)	65(42.2)	200(57.6)
Eating	2(1.1)	6(3.9)	8(2.3)
Looking after the infant	3(1.6)	33(21.4)	36(10.4)
Others	6(3.2)	2(1.3)	8(2.3)
Unknown	15(7.4)	12(7.9)	27(7.8)
Total	193(100.0%)	154(100.0%)	347(100.0%)

Figures

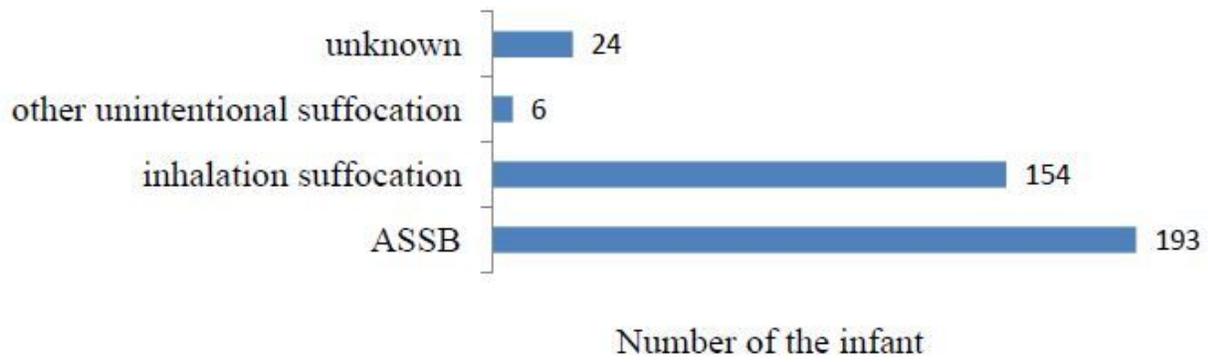


Figure 1

The mechanism of unintentional suffocation among the infant.

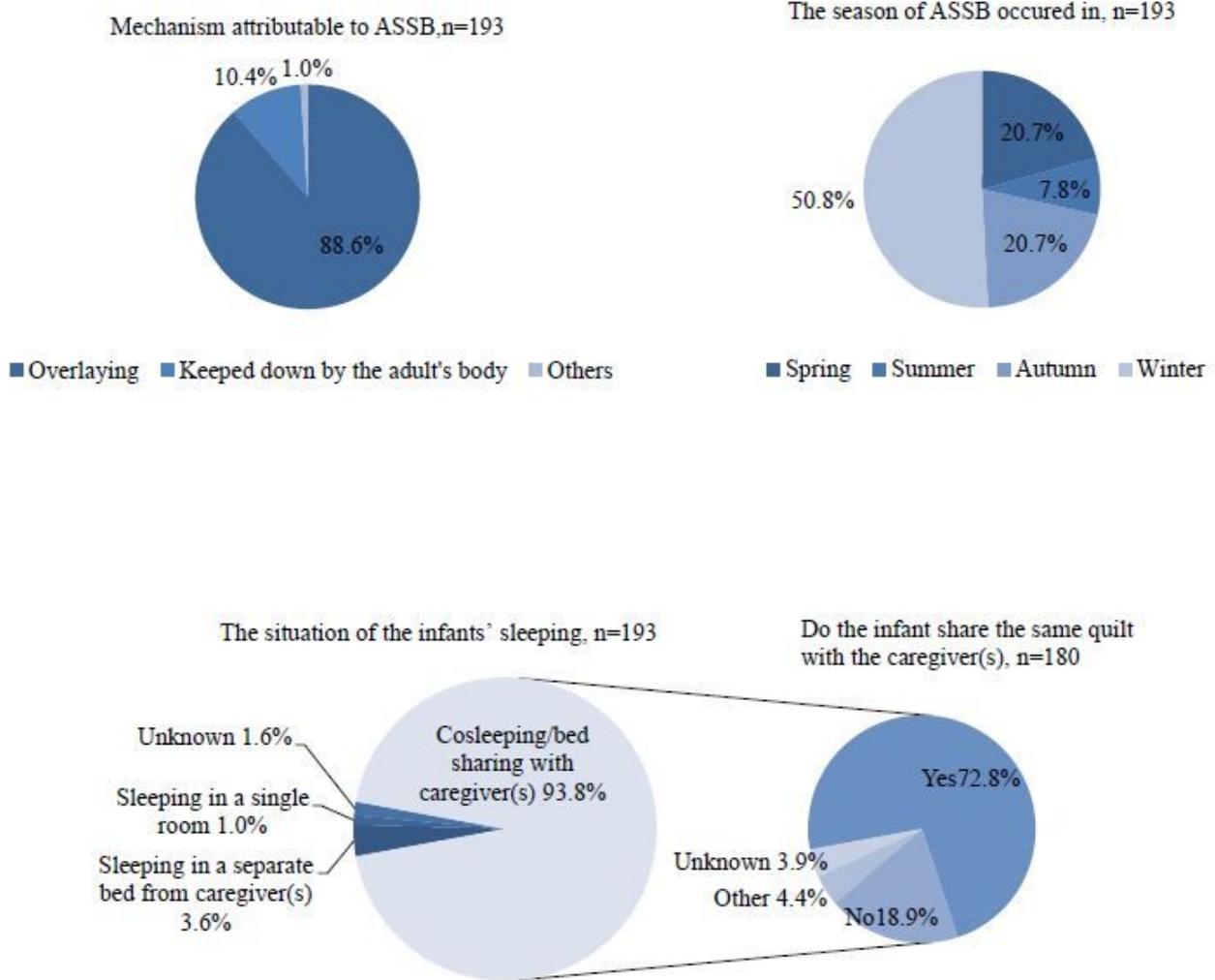


Figure 2

The characteristics of infants who died due to ASSB.

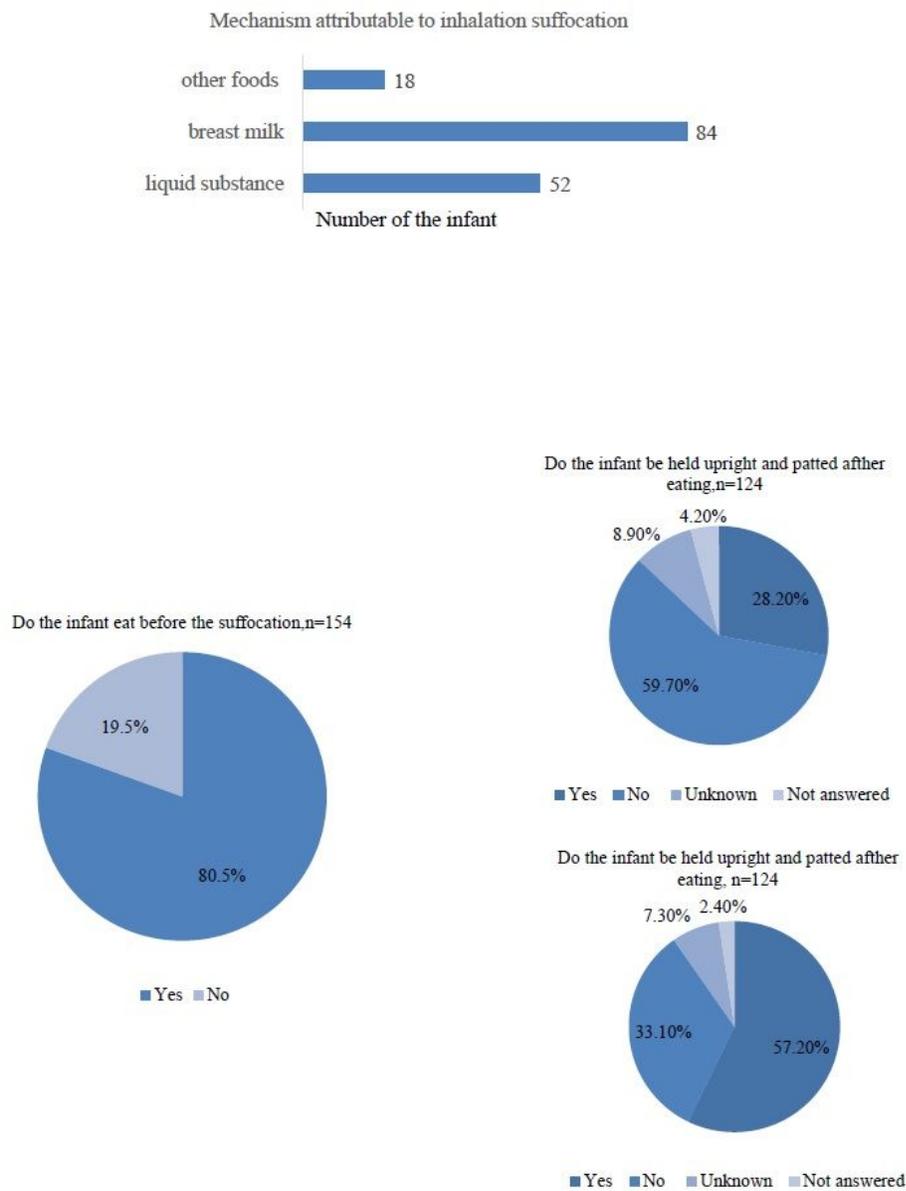


Figure 3

The characteristics of infants who died due to inhalation suffocation.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- questionnaire.docx