

REGULAR ARTICLE

Sudden unexpected infant death in Auckland: a retrospective case review

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ABSTRACT

Aim: To review autopsy reports of all SUDI deaths in the Auckland region, New Zealand, from October 2000 to December 2009.

Methods: Information on all SUDI cases from 2000 to 2009 was extracted from autopsy and police reports from the National Forensic Pathology Service at Auckland Hospital.

Results: Of the 332 post-mortems in this period, 221 were classified as SUDI. Of these, 83% were Māori or Pacific infants. The median age at death was 11 weeks and 11% occurred in 7- to 28-day-olds. At the time of death, 64% overall were bedsharing; this was more common in 7–28 day olds (92%). Bedsharing infants were significantly younger at death than non-bedsharing infants ($p = 0.008$). Where sleep position was known, 57% were placed in non-supine at the last sleep. There was no evidence of diagnostic shift and the prevalence of bedsharing did not change over the decade.

Conclusions: Bedsharing was associated with a high proportion of SUDI cases, especially in the youngest infants, and non-supine sleep positions were common. There is a need to enhance SUDI prevention messages and consider innovative ways of promoting safe sleeping environment and supine sleep position in Māori and Pacific communities.

INTRODUCTION

In New Zealand, sudden infant death syndrome (SIDS) remains the major cause of infant death in the post-neonatal period (1). SIDS, a diagnosis of exclusion, has been defined as ‘the sudden death of an infant under 1 year of age which remains unexplained after a thorough case investigation, including performance of a complete autopsy, examination of the death scene and review of the clinical history’ (2). Modifiable risk factors for SIDS have been clearly identified and include the following: sleeping in the side or prone position, maternal smoking in pregnancy, absence of breastfeeding and bedsharing where the mother smoked in pregnancy (3). Whilst SIDS mortality has fallen dramatically with the recommendation of the supine sleep position, among Māori infants SIDS has decreased more moderately (4). In 2006, the SIDS rate among Māori was 1.6 per 1000 live births, compared to 0.4 per 1000 in non-Māori, non-Pacific infants (1).

Increasingly, the term sudden unexpected death in infancy (SUDI) is being used. For the purposes of this study, this term includes SIDS, probable SIDS, unclassified SIDS

(where some aspect of the investigation has not been completed) (5), deaths where the autopsy diagnosis is ‘unascertained’ or ‘obscure’ and deaths where the infant is found in an unsafe sleeping environment and a mechanical cause is not proven. The SUDI rate among Māori is 2.34 deaths per 1000 live births, compared to 0.52 deaths per 1000 in non-Māori, non-Pacific infants (1). The Child and Youth Mortality Review Committee (CYMRC) in New Zealand has been collecting national data on SUDI since 2002 (6), but data are incomplete in many instances. More recently, Escott et al. (7) have examined SUDI deaths in the Wellington region. This study examines SUDI deaths in the Auckland region by a retrospective case review of deaths of infants aged 7–364 days referred for coronial investigation and undergoing autopsy from October 2000 through December 2009.

Key notes

- Over the 10-year period studied, bed sharing was associated with 64% of all sudden unexpected deaths in infants.
- Eleven percent of SUDIs occurred at ages 7–28 days; of these, 92% were bed sharing at time of death.
- Infants of Maori ethnicity are over-represented in SUDI deaths in New Zealand.

Abbreviations

SIDS, Sudden Infant Death Syndrome; SUDI, Sudden unexpected death in infancy; CYMRC, Child and Youth Mortality Review Committee.

METHODS

Computerized data were obtained from the National Forensic Pathology Service's autopsy and police (P47 and P47a) reports, on all infant deaths referred for autopsy by the coroner from October 2000 to December 2009, where the infant was aged between 7 and 364 days inclusive and was a permanent resident in the Auckland region. Coroners' reports were not accessed.

Data were collected on infant, socio-economic and child care practice variables. Death scene information was also collected and this included the following: time of death, position infant was placed to sleep, position infant was found, location found, bedsharing, number of people in bed with infant, maternal sleeping whilst breastfeeding, alcohol/drug-use by co-sleeper, covering of infant head/face and death weight. The diagnostic cause of death as determined by the pathologist was used to categorize the infant deaths. All infants given the diagnosis of SIDS or probable SIDS, SUDI, unascertained or obscure, accidental smothering or overlaying or accidental asphyxiation in an unsafe sleeping environment were grouped into the SUDI study group. There was no differentiation in the available data between bedsharing (where an infant is on a sleeping surface with another person who may or may not be sleeping) and co-sleeping (where the infant and other person/s are sleeping together); therefore, in this study, we have used the term 'bedsharing'. The study received ethical approval from the Auckland Regional Ethics Committee and the Auckland District Health Board Ethics Committee.

RESULTS

Ninety-five per cent of the autopsies were performed by six pathologists. Of the 332 post-mortems in this study, 111 did not have a diagnosis of SUDI as defined above and are not reported on in this paper. Two-thirds (221) were classified as SUDI (Table 1). We also report on a subset of 25 SUDI deaths that occurred from 7 to 28 days of age.

There is a considerable amount of data missing from the National Forensic Pathology Service records, for example, birth weight data are 90% incomplete, and similarly, maternal smoking (89%), gestation (76%), breastfeeding (51%) and position placed to sleep (42%) are incomplete. The data for most of the sleeping environment variables, however, are between 84% and 88% complete.

Sleep position

The position the infant was placed for the last sleep was known for 129 (58%) of the SUDI cases (Table 2). Of these, 57% were placed in a non-recommended sleeping position. There was no difference in ethnicity of infant for being placed in a non-recommended position.

Sleep environment

Only 28% of infants were in an infant bed, with the majority of the remainder in an adult-sized bed or on a mattress on the floor (Table 3). Eight infants were found on a couch or

Table 1 Diagnosis and demography

	n (%)
Diagnosis	
SIDS, probable SIDS	113 (51)
Unascertained, obscure	68 (31)
SUDI	24 (11)
Accidental smothering/asphyxiation	16 (7)
Gender (missing = 0)	
Male	116 (53)
Female	105 (47)
Ethnicity* (missing = 4)	
NZ European	31 (14)
Māori	129 (60)
Pacific Island	50 (23)
Other	7 (3)
Age (missing = 0)	
<1 month	25 (11)
1–2 months	98 (44)
3–5 months	66 (30)
6–8 months	21 (9)
9–11 months	11 (5)

*In comparison, ethnicity of all infants born in Auckland region 2000–2008 was as follows: European, 38%; Māori, 22%; Pacific, 22%; other, 18% (Source: Birth Registration Dataset from NZ Ministry of Health via New Zealand Child and Youth Epidemiology Service).

Table 2 Sleep position

Sleep position	Position put down for sleep n (%) (missing = 92)	Position found at death n (%) (missing = 81)
Supine	56 (43)	45 (32)*
Prone	30 (23)	65 (46) [†]
Side	43 (34)	30 (21) [‡]

*Of these, one was found lying under a sibling.

[†]Of these, 62 were found face down, 2 were found wedged and 1 was prone, face to side.

[‡]Of these, 3 were wedged in the sleeping environment, 2 were lying in mother's arms and 1 was on the side with the face into a pillow.

Table 3 Sleep environment

Variable	n (%)
Location found (missing = 27)	
Cot or bassinette	54 (28)
Double/queen/king bed	77 (40)
Mattress on floor	35 (18)
Single bed	16 (8)
Couch or chair	8 (4)
Airbed	1 (0.5)
Other (infant car seat, back seat of car, on parent's chest)	3 (2)

chair, half of whom were sharing the couch with another person. Of the 16 cases of accidental asphyxiation, smothering or overlaying, only one was in a cot. The others were on a double bed (n = 7), single bed (n = 3), couch (n = 2), mattress on the floor (n = 2) or an airbed (n = 1).

Bedsharing

Overall, 64% of SUDI deaths occurred in a bedsharing situation (Table 4). In infants <3 months, 72% were bedsharing. Fifteen per cent of cases were sharing the bed with three or more other people. Eighty per cent of Pacific infants and 72% of Māori infants were bedsharing at the time of death, compared with 16% of NZ European infants. Of all infants who died in a shared bed, 97% were of Māori or Pacific ethnicity. Bedsharing infants were significantly younger at death than non-bedsharing infants (14 weeks vs. 19 weeks, $p = 0.008$).

Other variables in the sleep environment

There were considerable missing data for alcohol/drug-use, soft sleeping surface and the face being covered at death, but the following were documented. Eighteen infants were found dead with an individual under the influence of alcohol or drugs. There were 20 documented cases where the infant's mother had fallen asleep whilst breastfeeding and woke to find the infant deceased. Sleeping on a non-recommended soft surface was reported for 56 infants; these included pillows, duvets, fleecy blankets, soft mattresses and sheepskins. The head or face was found covered by bedding in 26 infants.

Diagnostic shift

Although it has been suggested that diagnostic shift has occurred in recent years (8), this was not seen in this study ($\chi^2 = 5.0$, 9 df, $p = 0.84$). There was also no trend for the practice of bedsharing to either increase or decrease over the decade.

Table 4 Bedsharing

Variable	n (%)
Bedsharing (missing = 33)	
Yes	121 (64)
No	67 (36)
Percentage bedsharing by age of infant (missing = 33)	
<1 month (n = 25; missing = 1)	92
1–2 months (n = 98; missing = 18)	68
3–5 months (n = 66; missing = 9)	56
6–11 months (n = 32; missing = 5)	48
Percentage bedsharing in each ethnic group (missing = 33)	
NZ European (n = 4; missing = 6)	16
Māori (n = 82; missing = 15)	72
Pacific (n = 35; missing = 6)	80
Other (n = 0; missing = 4)	0
Ethnicity not stated (n = 2)	
Number of people in shared bed, including infant (missing = 0)	
2	51 (42)
3	52 (43)
4	14 (12)
5	4 (3)
Shared room (missing = 42)	
Yes, bedsharing	121 (68)
Yes, not bedsharing	22 (13)
Yes, bedsharing not stated	4 (2)
No	32 (18)

SUDI deaths in 7- to 28-day-olds

Within the SUDI study group, there were 25 infants who died between the ages of 7 and 28 days inclusive. Together, Māori and Pacific children accounted for 96% of these deaths compared to 81% of deaths from 29 to 364 days ($p = 0.08$, Fisher's exact test) (Table S1). The position the infant was placed for the last sleep was known for only 12 of the 25 cases. Of these, 58% were placed in a non-supine sleeping position. Ninety-two per cent were bedsharing at the time of death compared to 60% of those aged 29–364 days ($p = 0.002$, Fisher's exact test) (Table S2). Of the 17 infants known to be breastfed, the mothers of seven fell asleep whilst breastfeeding the infant and woke to find the infant deceased. There were four cases where it was recorded that the mother was intoxicated whilst bedsharing.

DISCUSSION

Sudden unexpected death in infancy, the leading cause of postneonatal death in New Zealand, accounts for 67% of diagnoses made at the autopsies of infants dying aged 7–364 days in the Auckland region over the 2000–2009 decade. We have also provided a profile of associated risk factors for SUDI referred to the coroner. Although hampered by missing information, there are several important aspects that stand out.

This study shows that SUDI in Auckland is largely, but not entirely, a problem for Māori and Pacific infants, with 83% of deaths occurring in these ethnic groups. Notably, 60% of the SUDI were in Māori infants, although they comprised only 22% of all births in the Auckland region from 2000 to 2008.

Bedsharing, when associated with maternal smoking, is a known risk factor for SIDS (9–12); similarly, increased duration of sharing (11), alcohol consumption by the bed sharer (9), co-sleeping on a couch (13–15) and infants <3 months of age (16) also increase the risk. We demonstrated the high percentage of deaths occurring in a bedsharing situation, particularly in younger infants. Bedsharing infants in this study were significantly younger at death than non-bedsharing infants, a factor that has also been reported elsewhere (17). Almost all the 7- to 28-day-old infants were bedsharing at the time of death, and almost three-quarters of infants aged less than 3 months were bedsharing – a known risk even if the mother is a non-smoker (15). Overall, the rate of bedsharing in our study (64%) was higher than in Wellington (54%) (7) or the national rate (43%) reported by CYMRC (6); Auckland is known to have a higher proportion of Māori and Pacific Island people. Bedsharing in this study is very much higher than that found in a survey of mainly European mothers in 2005 (16%) (18) or in a similar study reporting habitual bedsharing (18%) by Māori mothers, although, when asked about bedsharing the previous night, 65% of these Māori mothers reported a period of bedsharing of greater than 2 h (19), compared with 28% in the earlier mainly European survey (18).

Previous work by our group has shown a maternal smoking rate of 52% in Māori mothers in Auckland (19), and

in a similar study, 29% of Pacific mothers smoked (20). Although we were limited by missing data for smoking and other relevant risk factors, it seems reasonable to assume that smoking in pregnancy by the mothers in this study might have been at least equal to that in the above surveys, and with the high prevalence of bedsharing that we have demonstrated here, the smoking/bedsharing scenario seems to be the leading explanation of the high Māori, and moderately higher Pacific SUDI rates.

Prior to death, 57% of these SUDI infants were put down to sleep in high-risk non-supine positions. In particular, 23% had been placed prone. In a study of usual practice however, only 1% of European mothers (18) and 6% of Māori mothers (19) used the prone position. These high rates of non-recommended sleep positioning are a clear marker of the very high-risk group of infants. Given the promotion of supine sleeping by health services in New Zealand, and noting adherence by the majority, a possible explanation for this high-risk practice is the persisting belief, as shown in our earlier child care practices surveys, that prone position gives a better sleep and reduces aspiration risk (18,19). In addition, 11% of the SUDI cases occurred in 7–28 days olds. CYMRC has announced its future intention to report on SUDI deaths <28 days owing to reports from the Perinatal and Maternal Mortality Review Committee, of almost universal associations with bedsharing in this age group (6).

Although the Ministry of Health has described a diagnostic shift in New Zealand (21), as has occurred in some studies (22–24) but not in others (25), we found no clear evidence of diagnostic shift in the Auckland region over the last decade. This may be because most autopsies were conducted by only six pathologists, and the difficulty in diagnosing SIDS in the absence of all the necessary investigations needed to make such a diagnosis. There can be a lack of consistency in the way pathologists categorize sudden unexpected infant deaths (26). For instance, in comparison with Escott et al. (7) from the Wellington region, this study recorded 51% of deaths diagnosed as SIDS or probable SIDS, whereas in Wellington this was 31%. Unascertained deaths in Auckland were 31% compared to 9% in Wellington; SUDI was 10% (37% in Wellington), and accidental smothering or asphyxiation was 7% (22% in Wellington). Escott et al., however, had the advantage of also accessing coroner's reports.

There were two main limitations to this study. Firstly, we were unable to access coroners' reports for the deaths, which would have perhaps added to the available information. However, it appears from other New Zealand reports (6,7) that even had we been able to use coroners' information, there would probably still be a large gap in data for such factors as smoking and sleep position. A particular problem was the lack of data recorded in the P47 and P47a reports that describe the death scene investigation; consistency in the filling of these forms would provide a clearer picture of circumstances surrounding each of these tragic deaths. This lack of simple data limits comprehension of these sudden and unexpected deaths, and it is imperative

that a consistent SUDI death scene investigation protocol is implemented.

The findings from this study have important implications for health policy workers and professionals. They highlight the need to enhance education around safe and appropriate infant care practices, particularly the development of effective interventions that target unsafe infant sleep positioning and unsafe sleep environments. Nearly, all (97%) of the infants who were bedsharing at death were Māori or Pacific Island infants and so such interventions need to reach these communities in a culturally appropriate manner with some understanding of the adherence to bedsharing in these communities (27,28). Similarly, CYMRC recommendations include 'better safe sleeping messages and better ways of disseminating them to Māori' and that District Health Boards 'ensure safe sleeping arrangements are in place for all babies at every sleep before discharge home' (6). There are currently two interventions aimed at reducing the risk associated with bedsharing, a bassinet loan scheme, and the *wahakura* initiative. The *wahakura* is a flax bassinet modelled on a traditional Māori item, which, if used with a set of simple safe sleeping rules that are consistent with the 2005 American Academy of Paediatrics SIDS prevention recommendations, provides the infant with a separate sleeping space in the parent's bed.

CONCLUSIONS

The consistent collection of appropriate data at the infant death scene requires urgent attention and although this study is limited by such significant missing data, the findings of this study are stark. These SUDI deaths are primarily Māori and Pacific Island infants. The apparent poor penetration of the message that prone sleeping and bedsharing are unsafe demands a re-think of how we promote safe sleeping and safe sleeping environments in New Zealand, particularly to Māori and Pacific Island communities. Solving the problem of the persistent tail end of the SIDS epidemic depends on working intuitively but intelligently in underserved communities.

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SUPPORTING INFORMATION

Additional Supporting Information may be found in the online version of this article:

Figure S1 SUDI Diagnoses by year of death.

Figure S2 Bedsharing by year of death.

Table S1 Characteristics of SUDI, for 7- to 28-day-olds.

Table S2 Sleep position and environment at death, for 7–28 day olds.

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