



Sudden unexpected infant death and bedsharing: referrals to the Wellington Coroner 1997–2006

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Abstract

Aims To describe the factors associated with sudden unexpected infant deaths, for which there was no clear medical diagnosis, referred to the Wellington-based coronial paediatric pathology service over the decade from 1997 to 2006.

Methods The postmortem report, Police 47 file, Coroner's findings and deceased infant's medical records were used to create a profile for each sudden and unexpected infant death.

Results There were 64 deaths in the period: 54 of these occurred during sleep and did not have a clear medical diagnosis. Māori and Pacific infants and infants from low decile areas were over-represented in the group. The majority (88.7%) of infants were <6 months of age at death. Overall, 50% of infants had been placed to sleep in a non-recommended sleep position and 38% usually slept in a non-recommended location. Bedsharing was associated with 53.7% of deaths. There was a significant association between bedsharing and being found dead on a Sunday morning ($p=0.04$).

Conclusion Sudden unexpected death in infancy is associated with unsafe sleep environments and sleep positions. Every effort should be made to ensure that information about safe infant sleep practices reaches the caregivers of those particularly at risk.

Sudden infant death syndrome (SIDS) is 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".¹

Over recent decades SIDS rates have fallen in New Zealand and internationally.^{2–6} For many infants who die suddenly and unexpectedly and do not fulfil diagnostic criteria for SIDS, a final diagnosis may not be possible because of failure to undertake a complete examination of the death scene and lack of documentation of the full clinical history. This has led to the more general term Sudden Unexpected Death in Infancy (SUDI) being used to describe this group of infants and to the final cause of death increasingly being labelled as undetermined.⁷

Attention has increasingly focused on the infant sleeping environment. Asphyxia, overlaying, and strangulation have been noted as causes of SUDI due to unsafe sleeping environments.^{8–10} Reviews of coronial SUDI death investigations have been reported internationally but not previously in the New Zealand context.^{11–13} This study aimed to review cases of SUDI, referred by the Coroner to the Wellington Hospital Mortuary for autopsy from 1997 to 2006, to describe their demographic characteristics and assess the sleep situation at time of death.

Methods

Cases were sourced from the Wellington Hospital Mortuary records. Infants who died suddenly and unexpectedly who were more than 28 days of age and less than 1 year old were included. Documents used to source information about the cases were; the autopsy report, the Police 47 form (P47), and the Coroner's Inquest findings.

Details for hospital-based records lacking a copy of the Coroner's findings or an autopsy report were accessed through the Ministry of Justice Archives. The predetermined hierarchy of evidence was the Coroner's Inquest, followed by the autopsy report with the least weight placed on the P47. Some files contained copies of the complete Police file and a clinical history taken by a paediatrician. This information was given more weight than the P47.

The verdict from the Coroner's findings as to cause of death was also recorded. All subjects were included in the initial database and cases were subsequently excluded if a specific cause of death was determined at autopsy. Information gathered for the remaining infants included the following: the position the infant was found in, the position the infant was placed to sleep, the sleep surface the infant was found on, the usual sleep surface, whether the infant shared a room, details of bedsharing, and whether the infant was placed on a soft surface (defined as either a pillow, sheepskin or duvet).

Hospital records were reviewed where possible. Data collected included: age, sex, gestation, birth weight, and ethnicity. Socioeconomic status was assessed using the home address as reported on the P47 form. Addresses were geo-coded by Statistics New Zealand into New Zealand Deprivation Index 2001 mesh-blocks and then converted to 2001 decile scores.¹⁴

Data were entered in an excel spreadsheet and pivot tables used to facilitate analysis. Data for sex, birth weight, ethnicity and gestation were compared with regional data from the Ministry of Health Report on Maternity for 2002 and Chi-squared analysis was used to compare variables where comparable data were available.¹⁵

Binary logistic regression was applied to determine whether any of the variables increased the risk of bedsharing. Incomplete data prevented a correlation between decile and bedsharing being calculated. A p value <0.5 was considered significant. Ethical approval for the study was granted by the Central Regional Ethics Committee. Approval for the study was given by the Wellington Coroner.

Results

Case selection—There were 99 Coroner's case records that met inclusion criteria. The most complete information was available for infants referred to the Wellington Coroner so only these were included in the study. Other cases had been referred to Dr Zuccollo for forensic postmortem from Coroner's outside of the Wellington region. Final causes of death are listed in Table 1.

There were 64 postneonatal deaths between 1997 and 2006. Some cases were labelled as SUDI as a final diagnosis. To ensure all possible SUDI deaths were included in the analysis the following classifications were also included in the SUDI group: accidental asphyxia, SIDS and undetermined with possible and probable classifications of these diagnostic labels also included. There were 54 (84.4%) SUDI cases, and 10 (15.6%) non-SUDI cases.

Table 1. Final cause of death for cases referred to the Wellington Coroner 1997–2006

Final cause of death	No of cases
Determined causes of deaths	
Inflicted injury – child abuse	1
Infection	4
Congenital anomaly	3
Acquired cardiac disease	1
Acute gastrointestinal	1
All SUDI deaths	
SUDI	20
SIDS	14
Possible / probable accidental asphyxia	4
Possible / probable SIDS	3
Undetermined	5
Accidental asphyxia	8
Total	64

SUDI infants—The demographic details of the SUDI infants are listed in Table 2. Two sets of twins were found dead together. For SUDI infants, 75.0% (95%CI: 61.1–85.2) were full term compared with 92.6% (95%CI: 91.8–93.2) from the local population as reported in the 2002 National Maternity Report (Chi squared 20.91, $p < 0.0001$).¹⁵

The median birth weight was 2880g compared with the national mean birth weight of 3400g documented in the 2002 National Maternity Report. Māori (Chi squared 40.1, $p < 0.001$) and Pacific (Chi squared 6.5, $p = 0.01$) infants were over-represented in the sample compared with ethnicity reported for Wellington infants in the 2002 Maternity Report. New Zealand European infants were under-represented (chi square 30.3, $p < 0.001$)

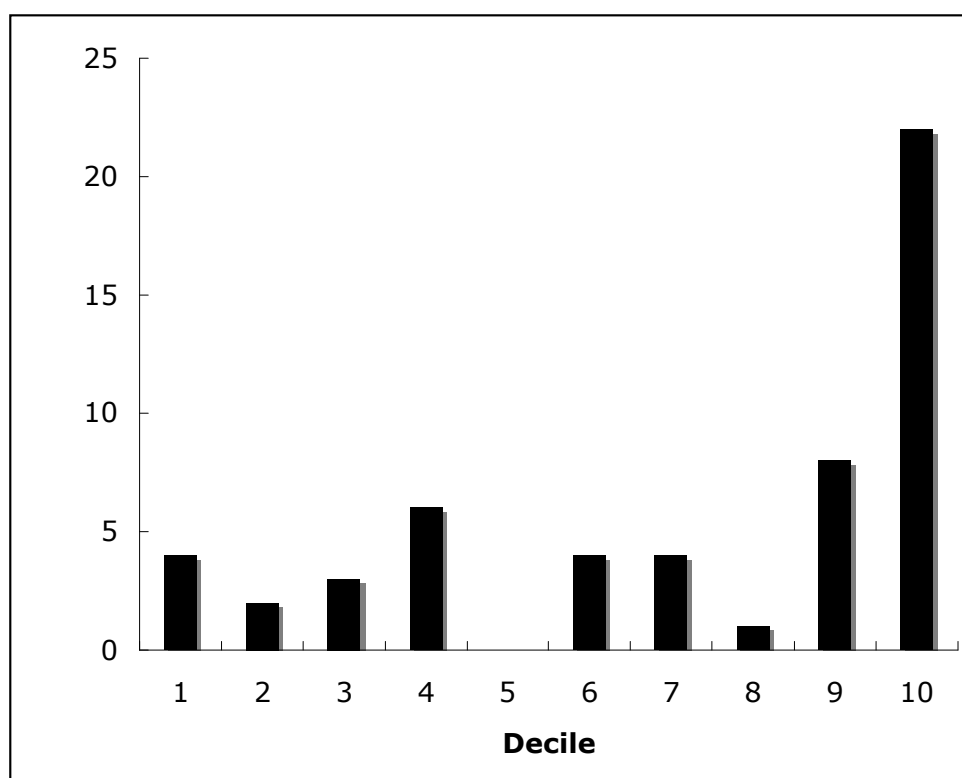
Mothers of SUDI infants—Maternal age was known for 49 cases. The median maternal age was 24 years (range 17–40 years). Body mass index (BMI) values were only available for 18 mothers so could not be reported on. NZ Deprivation Index decile ratings are illustrated for mother and infant pairs in Figure 1. For 30 (55.5%) infants, the decile rating was 9 or 10 whereas only 6 (11.1%) infants were in decile 1 or 2.

Timing of deaths—The number of deaths varied from one to nine per year with no trend to an increase or decrease in deaths over the time period. There was a slight majority (59.3%) of deaths in winter and autumn. Deaths occurred on the weekend (Friday, Saturday, Sunday) in 46.2% of cases. Sunday was the commonest day for death to occur (18.5% cases). The majority of infants (57.4%) were found dead between 0601 and 1200h. There were 11 (20.4%) infants found between 0001–0600h, 9 (16.7%) infants between 1201–1800h, and 3 (5.6%) infants between 1801–2400 hours.

Table 2. Demographic variables for 54 SUDI cases referred to the Wellington Coroner 1997-2006 and for some variables for infants born in the Hutt Valley and Capital and Coast DHBs in 2002

Demographic variable	No of cases (%) or Median (range)	HVDHB and CCDHB 2002 Maternity report
Male sex	30/54 (55.6%)	
Age at death (days)	95 (30–358)	
Age <3 months	25/54 (47.2%)	
Age 3–5 months	22/54 (41.5%)	
Age >5 months	7/54 (13.2%)	
Gestation at birth		
≥ 37 weeks	36/48 (75%)	4867/5258 (92.6%)
32-36 weeks	8/48 (16.6%)	347/5258 (6.6%)
28-31 weeks	4/48 (8.3%)	44/5258 (0.8%)
Birthweight (gms)	2880 (1128–4380)	
Birthweight ≤ 2500g	14/48 (29%)	348/5402 (6.4%)
Ethnicity		
NZ European	15/54 (27.8%)	3406/5324 (64.0%)
Māori	25/54 (46.3%)	801/5324(15.0%)
Pacific	12/54 (22.2%)	596/5324 (11.2%)
Other	2/54 (3.7%)	519/5324 (9.8%)
Maternal age (years)	24 (17–40)	

Figure 1. NZ Deprivation index 2001 classification based on maternal address for SUDI infants referred to the Wellington Coroner 1997–2006



Sleep environment at death—Overall, 50% of infants for whom the information was known were placed to sleep in a non-recommended sleep position and 38% usually slept in a non-recommended location. Table 3 lists the position the infants were placed for the last sleep, the position found and the usual sleep position.

Table 3. Usual sleep position, position placed at last sleep and position found, for SUDI deaths referred to the Wellington Coroner 1997–2006

Position	Usual position	Position placed	Position found
Prone	6 (11.1%)	7 (13%)	14 (25.9%)
Supine	15 (27.8%)	24 (44.4%)	23 (42.6%)
Side	3 (5.6%)	17 (31.5%)	11 (20.4%)
Side/supine	1 (1.9%)	0	0
Entrapped	0	0	3 (5.6%)
Unknown	29 (53.7%)	6 (11.1%)	3 (5.6%)

Table 4 lists the usual location for sleep and location found. Although only 12 of the cases usually slept in a double bed, 24 cases were found dead in a double bed. There were 29 (53.7%) babies bedsharing at the time of death. For one infant no information was available about bedsharing. Of the infants in the bedsharing group 16 (55%) were <3 months of age compared with 9 (37.5%) of the non-bedsharing infants. Of those placed supine, 17 were found supine and 13 of those were bedsharing.

Table 4. Normal sleep location and location found for SUDI deaths referred to the Wellington Coroner 1997–2006

Sleep location	Normal location	Location found
Cot	23 (42.6%)	19 (35.2%)
Double Bed	12 (22.2%)	24 (44.4%)
Couch	3 (5.6%)	4 (7.4%)
Basinette	2 (3.7%)	0
Own Mattress	1 (1.9%)	1 (1.9%)
Single Bed	1 (1.9%)	4 (7.4%)
Car seat	0	1 (1.9%)
Unknown	12 (22.2%)	1 (1.9%)

Of the 17 infants placed on the side, 8 remained on the side but 6 of these were bedsharing. Four infants moved from side to prone, four infants moved from side to supine (three were bedsharing) and one infant was found entrapped. Two of the bedsharing infants were twins sharing a cot. Of the others, 23 (79.3%) were sharing a double bed, two (6.9%) a couch and two (6.9%) a single bed. For 12 of the infants bedsharing there was one other person in the bed, for another 12 there were two other persons in the bed, for four there were three others and for one there were four others. Of the 10 infants found dead on a Sunday, 9 (90%) were bedsharing. The time found was between midnight Saturday and lunchtime on Sunday for eight of these infants.

Breast-feeding was the main reason for 14 of the infants sharing a bed during the last sleep (48.3%). Of those 14 infants, 13 (92.8%) of their mothers fell asleep before the infant was removed from the breast. Insufficient information was available to comment on specific bedding characteristics.

Risk factors for death in a bedsharing situation—Infants found dead on Sunday were more likely to be bedsharing than infants who died on other week days (OR 15.0, 95%CI: 1.2–185.2, p=0.04). Diagnosis at postmortem, age, sex, time of day, ethnicity, position put down, weekend death or death in the second half of the study were not significant risk factors for death in a bedsharing situation.

Change in diagnoses—There were 27 deaths in the first half of the decade and 27 in the second. Bedsharing was a factor in 12 (44.4%) of the deaths in the first 5 years and in 17 (63%) of the deaths in the second. This difference was not significant (Chi squared 1.51, p=0.22).

For 44 (80.5%) Wellington SUDI cases the Coroner had released a verdict as to cause of death. Of these verdicts 36 (81.8%) were in agreement with the pathologist’s findings at postmortem. Of the eight cases that were changed, seven received the verdict “Undetermined” by the Coroner. A Coroner’s verdict of SIDS or possible SIDS was given for 12 (44.4%) cases in the first half of the decade but for no cases in the second half of the decade.

The most common final Coroner’s verdict in the second half of the decade was SUDI. Information presented at inquest lead to a confirmed diagnosis in only one of these cases which was to confirm a case of presumed accidental asphyxia.

Accidental asphyxia—To identify the reasons for accidental asphyxia as a cause for SUDI, all cases of suspected or presumed accidental asphyxia, as determined after autopsy, were grouped together. This resulted in 12 cases of accidental asphyxia when possible and probable cases were included (Table 5).

Table 5. Suspected mechanism for SUDI deaths concluded to be due to presumed or possible accidental asphyxia

Suspected mechanism	No cases
Breast smothering infant	2
Cot accident	2
Entrapment	2
Adult overlying infant	1
Pillow	2
Unknown	2
Plastic mattress cover	1
Total	12

Discussion

This study provides a profile of factors associated with post-neonatal SUDI deaths referred to the Wellington-based coronial paediatric pathology service. In this cohort of infants, 88.7% were less than 6 months old and 24.9% were preterm.

Māori and Pacific infants were over-represented in the cohort and just over half the infants were from a decile 9 or 10 area. Half had been placed to sleep in a non-recommended sleep position and just over half were found dead in a bedsharing situation. For 38% the usual place of sleep was a non-recommended sleep location.

There was a strong association between being found dead on a Sunday morning and bedsharing at the time of death. While the rate of SIDS has decreased, worldwide, deaths listed as accidental asphyxia or undetermined have increased.¹⁶ This trend is reflected in the current study, which showed a significant decrease in the proportion of SIDS cases and an increase in cases labelled SUDI between the first and second five-year periods.

The prevalence of bedsharing among the SUDI cases in this study at 53.7% is comparable to an international prevalence of between 35-50% in cohorts based on similar criteria.^{3 17 18} In this study 90% of infants who were bedsharing for the purpose of breast-feeding were not removed from the breast before the mother fell asleep. There was a significant association between bedsharing and being found dead on Sunday morning.

Increased risk of death at weekends and in particular on Sunday, was found in the New Zealand Cot Death Study and in the United Kingdom the weekend effect was more marked in younger infants.^{19 20} It was not possible to determine from the current data why this might be so. Mothers in a bedsharing situation appear to usually respond well to an infant's needs during the night.²¹

It is possible that the weekend, and in particular Saturday night, might be a time when parents are more likely to socialise and the combination of staying up later than usual and perhaps consumption of alcohol, even in small amounts, may be enough to affect a mother's ability to respond to her infant's needs while co-sleeping. The increased tiredness may also mean that an infant-mother pair is more likely to fall asleep together after a feed.

Māori and Pacific infants were over-represented in this group of SUDI deaths. For Caucasian infants only 23.5% of infants were in a double bed at the time of death but the corresponding proportion for Māori and Pacific infants was 50% and 66.7% respectively. Of the infants found dead in a double bed, 66.7% lived in a decile 9 or 10 area. Deprivation is a recognised association with sudden infant death in other countries also.²²

We were unable to get accurate data on levels of maternal smoking. This is recognised as being the main associated risk for infants in a bedsharing situation.^{23,24} More recent case-control studies have shown that infants of mothers who do not smoke are also at increased risk when bedsharing in the first 3 months of life.^{18,24,25} Half the bedsharing infants in this study were <3 months of age.

The rate of bedsharing in this cohort (53.7%) compares with a rate of 31.7% reported previously in 1993 from the New Zealand Cot Death study case data and 11.7% from the New Zealand Cot Death study controls.²³ The policy conclusions drawn from these data published in 1995 suggested that stopping bedsharing for all infants would have a minimal effect on the rate of sudden infant death.²⁶ However this analysis did not take into account age at death or maternal weight which have both been shown since to contribute to risk.¹⁷

It is concerning so many infants were placed to sleep in a non-recommended sleep position or location. Recent reviews of infant care practices in New Zealand indicate that prone placement of infants for sleep is now rare.^{27, 28} Of the 17 infants placed to sleep on their side, only 8 were found dead on their side. Of the other 9, 1 was found entrapped, 4 were found prone, and 4 supine. This is not a recommended sleep position because of this recognised instability.

The demographic profile of the cases in this study suggests that some Māori and Pacific parents and parents from more deprived groups of the community may be less likely to either be aware of or adhere to guidelines for safe sleep practice for infants.

This study had three significant limiting factors. Firstly a lack of information in case files and medical records meant that known associations such as maternal smoking, gravida, parity and maternal weight could not be analysed. Secondly the absence of controls meant that relative risks for each risk factor could not be calculated. Thirdly, the change in use of diagnostic categories over time had to be accounted for. This was addressed by combining all unexplained deaths together and including those determined originally as SIDS and accidental asphyxia in with the SUDI deaths.

A major strength of the study is that all the cases were autopsied by one perinatal pathologist. Also the cases derived from the Wellington Coroner's jurisdiction contained all cases referred to the Coroner in the region for the ten year time period and consequently form a complete dataset for the Wellington population.

The overall rate of sudden infant death has not varied between 1997 to 2006 but there has been a significant shift in diagnostic categories from SIDS to SUDI. This trend probably reflects that more information is available to the pathologist to enable cause of death to be determined. An increasing number of deaths appear to be occurring while bedsharing.

Māori and infants from lower socioeconomic deciles appear to be at greater risk from sudden unexpected death in infancy in the Wellington region. Educational messages about safe sleeping practice need to be particularly targeted towards these groups if further improvements are to be seen in decreasing unexpected death in this age group.

Competing interests: None known.

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