

Paper

Sudden Unexpected Death in Infancy: place and time of death

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SUMMARY

In recent years, many babies who die of Sudden Unexpected Death in Infancy (SUDI) in Northern Ireland are found dead in bed – i.e. co-sleeping – with an adult. In order to assess its frequency autopsy reports between April 1996 and August 2001 were reviewed and linked to temporal factors. The day and month of death, and the place where the baby was found were compared to a reference population of infant deaths between one week of age and the second birthday.

Although the rate of SUDI was lower than the UK average, 43 cases of SUDI were identified, and two additional deaths with virtually identical autopsy findings that were attributed to asphyxia caused by suffocation due to overlaying. Thirty-two of the 45 (71%) were less than four months of age. In 30 of the 45 cases (67%) the history stated that the baby was bed sharing with others; 19 died sleeping in an adult bed, and 11 on a sofa or armchair. In 16 of the 30 (53%) there were at least two other people sharing the sleeping surface, and in one case, three. SUDI was twice as frequent at weekends (found dead Saturday – Monday mornings) compared to weekdays ($p<0.02$), and significantly more common compared to reference deaths ($p<0.002$). Co-sleeping deaths were also more frequent at weekends. Almost half of all SUDI (49%) occurred in the summer months – more than twice the frequency of reference deaths.

While sharing a place of sleep per se may not increase the risk of death, our findings may be linked to factors such as habitual smoking, consumption of alcohol or illicit drugs as reported in case-control studies. In advising parents on safer childcare practices, health professionals must be knowledgeable of current research and when, for example, giving advice on co-sleeping this needs to be person-specific cognisant of the risks within a household. New and better means of targeting such information needs to be researched if those with higher risk life-styles are to be positively influenced.

INTRODUCTION

Epidemiological studies have identified several risk factors associated with Sudden Unexpected Deaths in Infancy (SUDI), also known as the Sudden Infant Death Syndrome (SIDS),* which is said to be the cause of death once other identifiable disorders have been excluded. Modification of these factors

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* An unexpected death in infancy (after one week of age) where a thorough paediatric autopsy fails to find an adequate explanation for death.

– including the prone sleeping position, smoking before, during and after (passive) pregnancy, or allowing babies to become over heated - has been associated with a marked reduction in this form of mortality world wide.¹

In recent years, several large studies have examined the more emotive issue of co-sleeping and concluded that under certain circumstances it is inadvisable to share a bed or sofa (place of sleep or sleeping surface) with babies – generally up to three – four months of age.²⁻⁴ Concomitantly in Northern Ireland, most SUDI occurred in infants co-sleeping with adults or older children, many during the warmer months of the year. Accordingly we undertook a retrospective review of all SUDI over a five-year period to assess both place and time of such deaths.

METHODS

The Department of Forensic Medicine, Queen's University of Belfast holds computerised records on autopsy examinations carried out at the request of a coroner. From these we identified all reports on children less than the second birthday, where the cause of death between April 1996 and August 2001 was recorded as SUDI, or as Undetermined. The history provided for the pathologist, usually obtained by a police officer included data on age and sex, where the baby was found, sleeping position, and whether at the time of death the infant was co-sleeping and, if so, with how many others.

In order to ensure that all relevant deaths were included, we also recovered data on all deaths in infants of the same age where the cause had been recorded as “interstitial pneumonitis”. Within the time frame of study, this outmoded term was still in use where there was microscopic evidence within lung parenchyma of a scanty, but, in the view of some pathologists, a significant inflammatory cell response that was thought sufficient to cause death. Although such findings are no longer considered a separate cause of death or a distinct clinical entity,⁵ in 14 cases this diagnosis had been used. In order to distinguish those with a genuine cause of death, a forensic pathologist (PI) who was “blind” to all historical or other information reviewed histological material. In nine, lung histo-pathology showed sufficient inflammatory change that the possibility of an infective process to account for death could not be discounted with reasonable certainty. These nine, five of whom were co-sleeping, were excluded

TABLE I

<i>Generation of the reference population of infants deaths January 1997 – August 2001</i>	
Infant deaths in N Ireland < 2 years of age	657
Deaths excluded from Reference Group:	475
– consisting of those that occurred < 7 days of age	368
– those attributed to – prematurity	72
– SUDI	25
– “interstitial pneumonitis”	9
– Overlaying	1
Remaining deaths included in Reference Group	182

from the SUDI group, nor were they included in the reference or comparison population that will be referred to (*Table I*). In the remaining five, no such histo-pathological ambiguity was present and they were reassigned as SUDI.

As can be seen from Table II the trend by pathologists to record an undetermined cause of death rather than SUDI has increased over the years of the study. This decision can be rather subjective, however, bearing in mind that both autopsy and histo-pathological findings in the two are indistinguishable and that abnormality likely to have caused death are absent. Moreover, pathologists are reluctant to use the term SUDI where, for example, the history tends to implicate circumstantial factors, as when a baby is found face down on soft furnishings. Hence we contend that in the context of a review that focuses on the place where a baby was found dead, it is reasonable also to include these among the index group. Death due to suffocation or overlaying also has identical post-mortem findings to those in the other two groups.⁶ Therefore when analysing the data, undetermined deaths and two babies thought to have died of overlaying, were amalgamated with those referred to as SUDI, and the group as a whole was referred to by this term. Indeed the detailed work of Kemp and colleagues in the US in the mid-1990s would also encourage this approach as a public health measure.⁷

We were aware that this was a retrospective, uncontrolled analysis. A comparison or reference group of deaths was generated by the Registrar General's office in the first two years of life during a similar period of time (January 1997 - August

TABLE II

<i>Trend in attribution of cause of death during the study period</i>		
<i>Year</i>	<i>SUDI</i>	<i>Undetermined</i>
1996	8	–
1997	8	1
1998	4	5
1999	1	6
2000	–	5
2001	–	5

[In addition 2 cases of overlaying/ suffocation]

Chi-square for trend = 24, $p < 0.001$

2001). There were 657 deaths in toto, but we excluded deaths that occurred in the first seven days of life (368 in all) as this is outwith the time frame for a diagnosis of SUDI. We also removed 72 that were directly attributable to prematurity, and 35 SUDI and other deaths (*Table I*). The remaining 182 reference, or comparison, deaths were therefore entirely distinct from those due to SUDI. Causes of death in the reference group were multiple congenital anomalies including chromosomal abnormalities in 37, deaths due to major cardiovascular anomalies 37, respiratory disorders 32, sepsis 25, major CNS or muscle disorders 24, injuries 11, GI or urinary conditions 9, and deaths from neoplasm 7.

Statistical analysis was by χ^2 or Fisher's exact tests and non-parametric tests.

RESULTS

During the study period there were 45 infant deaths, 18 of which were in males. This figure includes two attributed to suffocation due to overlaying, each of whom was found dead on a sofa or armchair and at autopsy facial pressure marks were obvious. Throughout the study period, the overall rate of SUDI in Northern Ireland was 0.32/1000 live births. This compares to an overall rate of 1.71 in 1990, 0.74 in 1992, 0.37 in 1994, 0.21 in 1995 and 0.45/1000 live births in 1996.

Thirty-two of the 45 (71%) infants who died were less than four months of age, the mean age being 90 days; the range was large (13 – 390 days). The reference group was collected between the ages of 7

days and 2 years of age – mean 137 days – and was therefore higher than that of the SUDI ($p=0.043$).

The history given clearly indicated the last place of sleep in all 45. In 30 (67%), the baby was found dead having been sleeping with a carer; 15 were found in their cots. Of the 30, 19 (63%) died in an adult bed, and 11 (37%) on a sofa or armchair. Three infants who were not co-sleeping were not recorded as having died in their cots: one was “in bed”, one “on a cushion” and one “in mother's arms”. In 16 of the 30 (53%) co-sleepers there were at least two other people sharing the sleeping surface – and in one case three. Although those who died while co-sleeping were younger than those who were not, this difference was not significant (median age: 91 vs 113 days, $p = 0.9$ by Mann-Whitney test). Hence twelve (27%) died in their cots.

During the study period, 30 infants (67%) were found dead between Saturday morning and Monday morning (i.e. following a weekend night) and 15 infants (33%) between Tuesday morning and Friday morning (after a weekday night) [$\chi^2=9.6$, $p<0.02$]. Half the weekend deaths (one-third of all deaths) took place over Saturday night to Sunday morning (*Table III*). In regard to co-sleeping deaths of which there were 30, 11 (37%) occurred during the week compared to 19 (63%) at the weekend. Focusing on weekend deaths (30), there was no significant difference between the proportion found co-sleeping (19) and those who were not (11). We also compared the number of daily deaths from SUDI with those in the reference group. Numbers in the latter were fairly consistent throughout the week, however, SUDI was significantly more common at weekends ($p < 0.02$) (*Table III*).

Similarly, seasonal variation was examined (*Table IV*). Twenty-two SUDI (47%) occurred in summer compared to winter when there were eight (18%); similar numbers were recorded in spring and autumn. The proportions in the reference group were higher in winter and spring and were lower in summer and autumn as might be expected, whereas the SUDI distribution was strikingly different. There were similar proportions in all seasons except in summer when almost half the total SUDI (49%) occurred, and this was significantly more than the proportion of reference deaths (22 or 49% vs 43 or 24%, respectively; $\chi^2 = 8.8$, $p=0.02$). Eleven (24%) SUDI occurred in July and August compared to 12.6%.

TABLE III

<i>Comparison of SUDI and reference deaths by day of the week</i>							
	Weekend				Weekdays		
SUDI	30 (67%)				15 (33%)		
Reference deaths*	72 (40%)				110 (60%)		
	Saturday	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday
SUDI	8	15	7	3	5	4	3
Reference deaths	25	26	21	24	27	33	26

*difference between SUDI and other deaths by Chi-square test, $p < 0.002$

TABLE IV

<i>Comparison of SUDI and reference deaths by month of the year</i>												
	Winter				Spring			Summer			Autumn	
SUDI	8 (18%)				8 (18%)			22 (49%)			7 (16%)	
Reference deaths*	55 (30%)				59 (32%)			43 (24%)			25 (14%)	
	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
SUDI	3	2	3	4	3	1	11	5	6	2	3	2
Reference deaths	13	23	19	18	19	22	20	11	12	15	4	6

*difference between SUDI and other deaths by Chi-square test, $p < 0.02$

Although specific information was not prospectively sought, in three cases the police history given to the pathologist stated that one or both parents had taken alcohol on the night of the child's death, each of whom was co-sleeping with the baby.

DISCUSSION

Our data reflect the low incidence of SUDI in recent years in Northern Ireland. The death rate (0.32/1000 live births) is lower than that reported nationally in a similar time period – in 1995 to 2000 this was 0.54 – 0.7/1000. It is also considerably lower than that recently reported from the Wirral (population 350,000; 1.2/1000 live births).⁸ In common with that in other UK regions, the rate here has declined considerably from that in the early 1990s (see above).

On the other hand, there seems little doubt both in local experience and in the literature that co-sleeping has increased in the past two decades. For example, a Norwegian study found among control (normal) families (1993-98) that 15% of parents routinely bed-shared with their baby compared to half this proportion in 1990-92, but only 4% in 1984-89.⁹ Such practice has been shown to have some benefits and, for example, is known to promote breastfeeding.¹⁰ However, the trend has been accompanied by a 17-fold increase in the proportion of babies found dead while bed sharing.⁹

In our five-year study of 45 SUDI, more than two-thirds died while co-sleeping which is in contrast to data reported by the CESDI Research Group for five English Regions [respectively, 30/ 45 (67%)

vs. 126/ 321 (39%); $p=0.001$].² That in the Wirral study was 36%.⁸ The rate we report is also high when compared to other western countries, such as Norway (1993–1998, 34 %) and the USA (47% sleeping on a shared surface).^{7,9} Moreover, more than 70% of SUDI occurred at less than four months of age, which is broadly similar to that in larger studies,^{1,2,7,9} and confirms that the greatest risks is to younger babies. The European Concerted Action on SIDS (ECAS) which was a large case control study from 20 European regions found that the risk to babies who bed-shared all night with an adult was inversely related to a baby's age – declining by 5% each week.¹¹ Although our work sheds no light on this trend, we believe that the age-related risk has not been stressed sufficiently.

It was a particular worry that 11 of the 30 co-sleepers in our study were found dead on a sofa or armchair. In a large case control study, Blair and colleagues² have highlighted the very high risk (50-fold) that this practice carries; and two babies at death had a clear imprint on the face caused by soft furnishings. These, together with the 19 whose last sleep was in bed with an adult(s), are lying on surfaces that are inherently softer, possibly warmer, and distinctly more unsafe, which, given the age group, exposes them to various risks, such as overlaying and airway obstruction causing accidental asphyxiation, head covering (with overheating), or entrapment either in tight bedding or between the bed and a wall.^{7,12}

However, the position in which a baby is found may not explain fully why death occurred. Carefully matched controlled studies (summarised in CESDI SUDI Studies, 2000¹) have clearly demonstrated that the risks assume statistical validity when the carers are either habitual smokers, or have consumed significant quantities of alcohol (> 2 units) or of illicit or sedative drugs.² The risks appear therefore to relate to life-style issues. For it to be effectual, advice given by doctors, midwives and health visitors needs to be expressed with simplicity and clarity, emphasising both the benefits and risks. We question whether this is currently the case.

It is clear that in Northern Ireland there is an increased risk of SUDI both at weekends and during the warmer months of the year, patterns that differed significantly from those in the reference group.

Although the CESDI Research Group reported that there was no particular day when the number of deaths was significantly different than expected (peak days Thursday and Fridays),¹ Williams and

colleagues in New Zealand reported a similar finding in respect of weekends (and public holidays). One-third of all SIDS died then, the peak day being Sunday.¹³ This work followed an earlier study by the same group, and several other earlier papers both from European countries and Australia.¹³ Although we lack precise data to account for our findings, given what sparse anecdotal information we have (see above) and others' published work^{1,2,11} it is impossible not to speculate that bed sharing combined with a weekend lifestyle that may in some cases have included parental alcohol consumption and/or recreational drug, in habitual smokers, might alter "good enough" child care practices. The New Zealand work also found that the likelihood of SIDS after a party was higher at weekends (odds ratio 2.47) suggesting that alcohol consumption may have a role.¹³ A study from Seattle found an eight-fold increased risk of weekend deaths linked to mothers' educational disadvantage.¹⁴

Why our findings show a very significant increase in SUDI during summer months is also open to conjecture. Is it possible that some of these life-style factors, perhaps allied to civil tension in the Province, which tends to increase at this time of year ("the marching season"), could be an added stress or distraction in some communities. These are tentative rather than judgmental comments and represent an attempt to understand findings that differ markedly from seasonal data in the Republic of Ireland (1993-97), for example, where no seasonal peak has been observed.¹⁵ What seems clear from our work and that of others^{1,2,7,9,13} is that current evidence regarding the increased risks of SUDI that arise with use of shared sleeping surfaces and adverse lifestyles needs to be further emphasised to each emerging group of parents. Much of the increased risk of SUDI relates to smoking in pregnancy;² and the CESDI SUDI Study found that the risk was 1 in 737 where anybody smokes in a household compared to just 1 in 5,041 where nobody smokes.¹ It is known that 28% of women in Northern Ireland are smokers – a slightly greater proportion than men. In the Republic 60% of babies are exposed to one or more adults smoking in the home despite parental awareness of its association with SUDI.¹⁶ However, it is disappointing that a recent study aimed at helping mothers stop smoking in pregnancy was largely ineffective and the rates of validated cessation were substantially lower than self reported rates. The authors conclude that more intensive and complex interventions, appropriately targeted and

tailored, need to be developed and evaluated, which gives some indication of the formidable challenges posed by this factor alone.¹⁷

We recognise that our study has a number of limitations. The histories recorded were unstandardised, largely anecdotal, and were not recorded by health professionals. Factors related to perinatal health, family size or socio-economic circumstances were mentioned infrequently.¹ The information also often lacked details thought to be linked to SUDI, such as birth weight and gestation, recent symptomatology, parental or passive smoking, infant's body temperature, the nature of bed coverings, tiredness of carers, recent alcohol or recreational drug consumption. James and colleagues have also commented on the difficulties of obtaining accurate information on life-style habits on the night of death and concluded that such data tends to be under-reported.⁸ Moreover, police involvement in some communities can make collection of such information problematic, albeit for public health purposes. Since this study was completed, an inter-collegiate working party of the Royal Colleges of Pathologists and of Paediatrics and Child Health chaired by Baroness Helena Kennedy QC has reported. The resulting Report sets out the necessary collaboration and communications between the police, HM coroner, pathologists, paediatricians, and others and of the need for close dialogue with the parents themselves. Clearly this protocol should result in a more structured and sensitive approach to the various strands of practice necessary in these circumstances.¹⁸

Our study was designed primarily to focus on the place (e.g. co-sleeping) and time of death and SUDI and was therefore largely descriptive and retrospective. Instead of contemporaneous, matched controls we sought the next best alternative – a comparison group of infant deaths that have been described – drawn from the same overall population within a virtually identical time frame (*Table 1*). Although the median age of the SUDI was somewhat younger they constitute a mutually exclusive group from the reference population which we feel broadly reflects the spectrum of infant deaths province-wide.

In the early 1990's, a relatively simple change in parenting practice reduced this form of infant mortality in various countries by almost three-quarters.¹⁹ It now seems that large numbers of parents routinely bed share with a baby. In a recent

US study it was the more vulnerable infants so exposed – 50% at one month of age – reducing to 18% by six months.²⁰ However, to issue blanket advice directed against this practice *per se* seems unwise. The ECAS Study found, for example, that the odds ratio for a non-smoking mother who shared a bed with her baby (modal age of 10 weeks) carries only minimal risk (odds ratio 1.56).¹¹ Hence the approach to a well-educated, non-smoker of moderate habits, who, to facilitate breast feeding,¹⁰ takes a baby into her bed must differ from that of a young, poorly educated woman with an adverse lifestyle living in poverty. Bed-sharing affords a range of positive benefits both to mother and baby, and a recent review concludes that the complexities of this interaction are only just beginning to be unravelled and that health care professionals must avoid over-simplistic advice that bed-sharing behaviour is inherently harmful.²¹

However, a growing body of evidence worldwide suggests that in certain circumstances (i.e. excessive parental tiredness, habitual smoking, or alcohol or drug ingestion), co-sleeping places young infants at significantly increased risk of undetermined death, overlaying or SUDI.⁷ Advice on the risks of co-sleeping in a household with such adverse co-factors has not received the promotion accorded to better publicised risks such as prone sleeping and those just alluded to.^{1-2,8,11}

It is crucial that health promotion agencies and the relevant practising professionals find improved ways of co-ordinating advice to parents so that a more balanced approach is presented. Advice also needs to be well targeted, especially, but not exclusively, at those with adverse or potentially dangerous lifestyles. However, it is salutary to note that the Cardiff audit study of how parents were adhering to the Back to Sleep Guidelines,²² found significant proportions, within quite differing socio-economic communities, who regularly disregarded warnings on risk reduction.²³ A recent Irish study has reported similar findings,¹⁶ as has one from Kentucky.²⁰ This causes one to wonder whether, given the increasingly robust evidence of the risks, novel ways of promoting such public health measures need to be researched jointly by health care policy-makers and the professionals with major responsibility for mother and infant care.

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CONFLICT OF INTEREST

The authors have no conflict of interest

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