

REVIEW

Sudden unexpected death in infancy and socioeconomic status: a systematic review

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This paper aimed to systematically review observational studies documenting the relation between sudden unexpected death in infancy and socioeconomic status. A search of two electronic databases (Medline 1966 to November 2002; Embase 1981 to November 2002) yielded 52 case-control or cohort studies meeting the inclusion criteria. An increased risk of sudden unexpected death in infancy was reported in 51 studies and 32 of 33 studies reporting graded measures of socioeconomic status showed a dose-response relation of sudden death with socioeconomic status. Of the 10 studies in which adjustment was made for maternal smoking, socioeconomic status retained an independent effect on infant death in nine. The effect of socioeconomic status was also independent of birth weight in 10 of 11 studies and independent of sleeping position in two. The included studies reported a significant association of socioeconomic status with sudden unexpected death in infancy with risk of infant death increasing with greater exposure to adverse social circumstances. The findings support a significant role for adverse social circumstances in the pathways to sudden unexpected death in infancy.

A link between low socioeconomic status and SUDI has been noted in much of the literature.^{4–5} Socioeconomic status represents a constellation of factors reflecting social position and social circumstances including income, occupation, education, and ownership of resources such as housing. For the purposes of this study, we have included marital status and maternal age that are not strictly socioeconomic status variables but have been consistently shown to be strongly associated with measures of social status especially in studies of pregnancy and infant outcome.

The relation of low socioeconomic status and SUDI is important in that aetiological hypotheses need to be consistent with the observed social patterns. It has been suggested that smoking “accounts for” the socioeconomic differences in risk of SUDI.^{6,7} It is well reported that smoking patterns by social class vary between countries and, over time, within countries.⁸ Other independent risk factors for sudden unexpected infant death, such as birth weight and sleeping position,¹ are also socially patterned. It seems probable that socioeconomic status rather than being a direct, proximal cause of sudden infant death exerts its effect through mediating variables such as smoking, birth weight, and sleeping position. This study provides an opportunity to examine the links between socioeconomic status and SUDI between countries and over time and contribute to a better understanding of the nature of the relation.

Despite recent changes in the epidemiology of sudden unexpected death in infancy,¹ it remains the most significant cause of infant death in developed countries. The term sudden unexpected death in infancy (SUDI) is used in this study in preference to the more commonly used sudden infant death syndrome (SIDS). Firstly, SUDI incorporates all cases of SIDS, defined as the sudden death of an infant under the age of 1 year that remains unexplained after thorough case investigation including performance of a complete necropsy, examination of the death scene, and review of the clinical history,² while allowing for inclusion of unexpected deaths not fully complying with this strict definition but having common associations and risk factors.³ Secondly, many of the studies included in this review predated the adoption of a strict definition for SIDS and few would have had systems in place to ensure the thorough case investigation required by the definition. For these reasons, we have adopted a similar approach to that used by the UK Confidential Enquiry into Stillbirths and Deaths in Infancy (CESDI).³

METHODS

A systematic search was undertaken to identify case-control and cohort studies in which the relation between socioeconomic status and SUDI was examined.

Inclusion criteria

Case-control and cohort studies of SUDI or SIDS that included author defined useable relative risks or odds ratios associated with measures of socioeconomic status and met methodological criteria.

Methodological criteria

For case-control studies

(a) selection of an appropriate control group—that is, controls from the same population, selected with minimal bias and of similar age

(b) the same method of ascertainment of exposure data for cases and controls

Abbreviations: SIDS, sudden infant death syndrome; SUDI, sudden unexpected death in infancy

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Key points

- The association of sudden unexpected death in infancy with social disadvantage was demonstrated in 51 of 52 case-control and cohort studies published since 1965.
- The association was independent of maternal smoking in 9 of 10 studies.
- Social disadvantage is important to an understanding of the epidemiology of sudden unexpected infant death and should not be dismissed as an unmodifiable variable.

(c) analysis took account of matching where appropriate

(d) exposure data were available for >80% of both cases and controls

For cohort studies

(a) no evidence of biased case ascertainment by exposure status—only studies in which cases were ascertained from whole populations and not selected sources such as specialist hospitals were included

Socioeconomic status measures

Measures of socioeconomic status were included whether measured at the individual or area level. These were: social class (registrar general's social class in UK studies), occupation, income, deprivation (as measured by deprivation indices), housing tenure, overcrowding, maternal education, marital status, and maternal age.

Search strategy

Two electronic databases (Medline 1966–2002; Embase 1981–2002) were searched for studies of the outcome of interest (search terms included: SIDS; sudden infant death syndrome; sudden unexpected death in infancy; postneonatal mortality; cot death; crib death) and the exposure of interest (search terms included: social class; occupation; maternal age; maternal education; marital status; socioeconomic status; income; poverty; deprivation usually represented by area based deprivation indices based on census data; overcrowding; social factors; risk factors) with appropriate truncations and mis-spellings. A citation search was undertaken for identified studies in the Science Citation Index. Additional socioeconomic status measures were included in studies identified using the above list of measures. They included: parental education; economy of the home, house repair, housing density, cohabitation, and social disadvantage. A secondary search using these terms yielded 34 abstracts and produced no new studies.

Secondary search of the bibliographies of the papers identified by the electronic search was undertaken. Where

gaps in data were identified, authors were asked to provide supplementary data. Titles and abstracts of studies identified by electronic searches were examined for possible relevance and those that might meet the inclusion criteria retrieved. The full papers were read by both reviewers (NJS and SL) independently to determine whether they met the inclusion criteria. Disagreements were resolved by consensus.

Analysis

Each of the studies identified was classified according to whether an increased risk of SUDI was reported to be associated with each measure of socioeconomic status studied. In addition, studies that reported graded measures of socioeconomic status were examined for the presence of a gradient or trend. To further explore the debate on the relation between socioeconomic status and SUDI, the results of studies that attempted to control for potential confounding of the effect of socioeconomic status on SUDI were included in a separate table (table 3). Smoking in pregnancy, birth weight, and sleeping position are socially patterned and also important risk factors for sudden infant death. Studies that adjusted for these variables were included in table 3.

RESULTS

The titles and abstracts of 380 studies identified by the search strategy were examined. A total of 110 published papers and abstracts potentially meeting the inclusion criteria were reviewed. Sixty discrete studies, fulfilling the inclusion criteria, were identified with publication dates from 1966 to December 2002 reporting data on infants born between 1956 and 1998. Eight studies were excluded as they failed to meet methodological criteria (table 1).

Fifty two studies were included in the review (table 2). The studies were conducted in 16 countries, 15 in developed countries and one in a developing country (Brazil). Most of the studies were conducted in the USA and the UK. Thirty were case-control studies and 22 cohort studies.

Only 2 of the 52 studies failed to show a statistically significant relation between sudden unexpected death and at least one measure of socioeconomic status. In one of these studies, the results suggested an association with low social class but failed to reach conventional levels of statistical significance. Six of the remaining 50 studies reported a positive relation between low socioeconomic status and sudden unexpected death for all socioeconomic status measures used. No studies reported an increased risk with any measure of higher socioeconomic status. Thirty three studies reported graded measures of socioeconomic status. Thirty two of these showed a significant gradient for at least one socioeconomic status measure and the remaining study showed a trend but failed to reach conventional levels of statistical significance.

Table 1 Excluded studies

Author/year of publication	Country	Study type	Reason for exclusion
Bergman <i>et al</i> '72 ⁹	USA	Cohort	No denominator data available
Mason <i>et al</i> '80 ¹⁰	UK	Cohort	No denominator data given
Anderson <i>et al</i> '93 ¹¹	Australia	Cohort	Data for OR estimation not available
Kohlendorfer <i>et al</i> ¹²	Austria	Case-control	<80% of cases followed up
Cooke '98 ¹³	UK	Case-control	Data for OR estimation not available
Arnestad <i>et al</i> 2001 ^{13a}	Norway	Case-control	<80% of cases/controls followed up

Table 2 Studies included in the review

Author/country/year of publication	Study type	Main SES measure/s (number of categories)	Unadjusted RR/OR (95% CI)*	Gradient/trend	
				Estimated	Present
Carpenter and Shaddick, UK, '65 ¹⁴	Case-control	Marital status (2)	2.49 (1.01 to 6.27)	N/A	N/A
Steele and Langworth, Canada, '66 ¹⁵	Case-control	Maternal age (2)	8.53 (1.80 to 55.5)	N/A	N/A
Valdes-Dapena <i>et al</i> , USA, '68 ¹⁶		Maternal age (5)	4.75 (1.34 to 18.4)	Yes	Yes
Strimer <i>et al</i> , USA, '69 ¹⁷	Cohort	Socioeconomic level (3)†	4.59 (3.06 to 6.88)	Yes	Yes
Froggatt <i>et al</i> , N Ireland (UK), '71 ¹⁸	Case-control	Median income of census tracts (9)	5.96 (3.81 to 9.36)	Yes	Yes
		Social class (5)	2.20(0.96 to 5.11)	Yes	Yes
		Unemployed (2)	2.99(1.39 to 6.53)	N/A	N/A
		Persons/room (3)	2.40(1.23 to 4.72)	Yes	Yes
Kraus <i>et al</i> , Canada, '71 ¹⁹	Case-control	SES (2)‡	2.93 (1.31 to 6.65)	N/A	N/A
		Maternal age (2)	5.00 (1.64 to 16.30)	N/A	N/A
Protestos <i>et al</i> , UK, '73 ²⁰	Case-control	Social class (2)	4.79 (1.37 to 6.65)	N/A	N/A
		Marital status (2)	1.17 (0.48 to 2.82)	N/A	N/A
Fedrick, UK, '74 ²¹	Cohort	Social class (5)	3.35 (1.62 to 7.03)	Yes	Yes
		Maternal age (2)	4.27 (2.25 to 8.14)	N/A	N/A
Newcastle Working Party, UK, '77 ²²	Case-control	Unemployed (2)	3.45 (0.71 to 18.89)	N/A	N/A
		Maternal age (2)	4.47 (1.07 to 20.15)	N/A	N/A
Biering-Sorensen <i>et al</i> , Denmark, '79 ²³	Case-control	Marital status (2)	4.20 (2.40 to 7.32)	N/A	N/A
		Father's occupation (2)	2.39 (1.47 to 4.27)	N/A	N/A
		Economy of home (3)	11.17 (3.4 to 39.10)	Yes	Yes
		Persons/room (3)	4.11 (1.50 to 11.28)	Yes	Yes
		Housing quality (3)	5.85 (2.99 to 11.75)	Yes	Yes
Lewak <i>et al</i> , USA, '79 ²⁴	Cohort	Father's occupation (2)	2.76 (1.37 to 5.66)	N/A	N/A
		Maternal age (2)	2.97 (1.59 to 5.53)	N/A	N/A
Bartholomew and MacArthur, Scotland, UK, '88 ²⁵	Case-control	Social class (not stated)	No significant difference (no figures given)	N/A	N/A
		Maternal age (2)	3.67 (0.88 to 17.60)	N/A	N/A
Murphy <i>et al</i> , Wales, UK, '82 ²⁶	Cohort	Social class (3)	13.42 (3.01 to 83.60)	Yes	Yes
		Unemployed (2)	2.78 (1.09 to 6.60)	Yes	Yes
		Maternal age (3)	6.36 (3.00 to 13.30)	Yes	Yes
		Area of residence (3)	14.34 (2.16 to >200)	Yes	Yes
Standfast <i>et al</i> , USA, '80 ²⁷	Cohort	Maternal age (6)	1.98 (1.31 to 2.97)	Yes	Yes
		Marital status (2)	2.3 (CI not given)	N/A	N/A
		Maternal education (3)	3.39 (CI not given)	Yes	Yes
Knowleden <i>et al</i> , UK, '85 ²⁸	Case-control	Social class (5)	3.27 (1.51 to 7.10)	Yes	Yes
		Overcrowding (3)	1.83 (1.13 to 2.95)	Yes	Yes
		House repair (3)	3.22 (1.77 to 5.86)	Yes	Yes
Igrens and Skjaeren, '86 ²⁹ +Oyen <i>et al</i> '94 ³⁰ +Daltvi <i>et al</i> '97 ³¹ Norway	Cohort(s) (1967–1981 and 1967–1988, and 1967–1993)	Marital status (2)	(1967–1981): 1.89 (1.59 to 2.24)	N/A	N/A
			(1990–1993): 1.57 (1.17 to 2.10)	N/A	N/A
		Maternal age (4)	'67–'81: 2.54 (2.04 to 3.17)	Yes	Yes
			'90–'93: 7.03 (4.17 to 11.90)	Yes	Yes
Rintahaka and Hirvonen, Finland, '86 ³²	Case-control	Father's occupation (5)	2.68 (1.34 to 5.37)	Yes	Yes
		Marital status (2)	2.26 (1.34 to 3.82)	N/A	N/A
		Maternal age (2)	1.75 (1.25 to 2.45)	N/A	N/A
Victoria <i>et al</i> , Brazil, '87 ³³	Case-control	Maternal education (4)	8.57 (2.40 to 30.80)	Yes	Yes
		Family income (5)	2.49 (0.85 to 7.25)	Yes	Yes
Kraus <i>et al</i> ³⁴ +Hoffman <i>et al</i> ³⁵ , USA, '88	Case-control	Income (3)	3.9 (2.68 to 5.80)	Yes	Yes
		Maternal education (2)	2.7 (CI not given)	N/A	N/A
		Overcrowding (2)	2.7 (CI not given)	N/A	N/A
		Marital status (2)	3.7 (CI no given)	N/A	N/A
		Maternal age (2)	2.3 (CI not given)	N/A	N/A
Norvenius, Sweden, '88 ³⁶	Cohort	Marital status (2)	1.57 (1.22 to 2.03)	N/A	N/A
Newman, Australia, '88 ³⁷	Cohort	Father's occupation (2)	1.45 (1.08 to 1.94)	N/A	N/A
		Marital status (2)	2.11 (1.48 to 2.99)	N/A	N/A
		Maternal age (5)	1.76 (1.01 to 3.07)	Yes	Yes
Kraus <i>et al</i> , USA, '89 ³⁸	Case-control	Income (4)	2.5 (1.6 to 4.0)	Yes	Yes
		Maternal age (6)	2.8 (1.0 to 6.7)	Yes	Yes
		Maternal education (6)	2.6 (1.3 to 5.3)	Yes	Yes
		Housing density (4)	1.6 (1.0 to 2.5)	Yes	Yes

Table 2 Continued

Author/country/year of publication	Study type	Main SES measure/s (number of categories)	Unadjusted RR/OR (95% CI)*	Gradient/trend	
				Estimated	Present
McGlashan, Australia, '89 ³⁹	Case-control	Unemployed (2)	3.08 (CI not given)	N/A	N/A
Kyle <i>et al</i> , UK, '90 ⁴⁰	Cohort	Housing tenure (2)	2.64 (CI not given)	N/A	N/A
		Social class (4)	4.68 (1.97 to 11.11)	Yes	Yes
		Maternal age (3)	2.43 (1.54 to 3.83)	Yes	Yes
Li and Darling, USA, '91 ⁴¹ +Irwin <i>et al</i> '92 ⁴²	Cohort	Maternal age (5)	3.4 (2.6 to 4.5)	Yes	Yes
		Marital status (2)	2.4 (2.0 to 2.8)	N/A	N/A
Mitchell <i>et al</i> , New Zealand, '91 ⁴³ +Williams <i>et al</i> , '95 ⁴⁴	Case-control	Unemployed (2)	3.05 (2.89 to 3.21)	N/A	N/A
		Occupational class (3)	3.70 (2.66 to 5.15)	Yes	Yes
		Marital status (2)	2.81 (1.84 to 4.29)	N/A	N/A
Gilbert <i>et al</i> , UK, '92 ⁴⁵	Case-control	Maternal education (3)	3.00 (0.92 to 9.84)	Yes	Yes
		Social class (2)	3.3 (1.6 to 7.0)	N/A	N/A
Haglund and Cnattingius, Sweden, '90 ⁶ + Nordstrom <i>et al</i> , '93 ⁴⁶	Cohort	Cohabitation (2)	1.82 (1.07 to 3.07)	N/A	N/A
		Maternal education (5)	2.88 (1.71 to 4.59)	N/A	N/A
		Maternal age (4)	4.98 (2.76 to 9.02)	Yes	Yes
Millar and Hill, Canada, '93 ⁴⁷	Case-control	Maternal age (5)	4.61 (3.43 to 6.22)	Yes	Yes
Fujita and Kato, Japan, '94 ⁴⁸	Cohort	Marital status (2)	3.48 (2.94 to 4.11)	N/A	N/A
		Marital status (2)	5.86 (2.37 to 14.10)	N/A	N/A
Jorch <i>et al</i> , Germany, '94 ⁴⁹	Cohort	Maternal age (6)	4.82 (1.09 to 20.6)	Yes	Yes
		Maternal age (4)	4.20 (1.70 to 10.40)	Yes	Yes
		Maternal education (3)	2.60 (1.50 to 4.60)	Yes	Yes
Kilkenny and Lumley, Australia, '94 ⁵⁰	Cohort	Maternal age (2)	6.24 (3.47 to 11.28)	N/A	N/A
		Marital status (3)	3.42 (2.61 to 4.48)	Yes	Yes
Arntzen <i>et al</i> , Norway, '95 ⁵¹	Cohort	Maternal education (3)	1.35 (1.0 to 1.82)	Yes	Yes
		Maternal age (3)	2.18 (1.32 to 3.60)	Yes	Yes
		Marital status (2)	1.47 (0.87 to 5.90)	N/A	N/A
Klonoff-Cohen <i>et al</i> , USA, '95 ⁵²	Case-control	Marital status (2)	1.97 (1.43 to 2.71)	N/A	N/A
		Marital status (2)	1.97 (1.43 to 2.71)	N/A	N/A
Sanghavi, USA, '95 ⁵³	Cohort	Maternal age (2)	1.73 (CI not given)	N/A	N/A
Poets <i>et al</i> , Germany, '95 ^{54**}	Case-control	Socioeconomic status (3)††	1.65 (0.85 to 3.25)	Yes	Non-significant Trend
Taylor and Sanderson, USA, '95 ⁵⁵	Case-control	Maternal age (2)	1.92 (1.54 to 2.38)	N/A	N/A
Alessandri <i>et al</i> , Australia (Aborigines only), '96 ⁵⁶	Case-control	Maternal education (2)	2.29 (1.89 to 2.79)	N/A	N/A
		Maternal age (4)	2.89 (1.05 to 8.00)	Yes	Yes
Taylor <i>et al</i> , USA, '96 ⁵⁷	Case-control	Marital status (2)	8.02 (3.55 to 18.28)	N/A	N/A
CESDI, UK, '96 ³ + Blair <i>et al</i> '96 ⁵⁸	Case-control	Social class (7)	6.95 (4.09 to 11.87)	Yes	Yes
		Income (8)	11.66 (3.57 to 40.6)	Yes	Yes
		Parental education (6)	2.47 (1.67 to 3.73)	Yes	Yes
		Housing tenure (3)	3.81 (2.66 to 5.50)	Yes	Yes
		Overcrowding (4)	31.3 (10.1 to 105.01)	Yes	Yes
		Marital status (2)	5.57 (2.89 to 10.83)	N/A	N/A
		Receipt of income support (2)	6.27 (4.15 to 9.47)	N/A	N/A
		Maternal education (4)	2.27 (1.84 to 2.79)	Yes	Yes
Kytir and Paky, Austria, '97 ⁵⁹	Cohort	Maternal age (5)	3.01 (1.94 to 4.44)	Yes	Yes
		Marital status (2)	1.41 (1.24 to 1.61)	Yes	Yes
Brooke <i>et al</i> , UK (Scotland), '97 ⁶⁰	Case-control	Social class (7)	2.55 (1.66 to 3.93)	Yes	Yes
		Deprivation index (7)	9.59 (3.32 to 27.68)	Yes	Yes
		Marital status (2)	4.22 (2.90 to 6.13)	N/A	N/A
		Maternal age (2)	2.87 (1.85 to 4.45)	N/A	N/A
		Maternal education (2)	4.28 (2.41 to 7.62)	N/A	N/A
Dalviet <i>et al</i> , Nordic countries (Denmark, Norway, and Sweden), '98 ⁶¹	Case-control	Marital status (2)	2.9 (1.7 to 5.0)	N/A	N/A
		Paternal employment (2)	4.0 (2.7 to 5.9)	N/A	N/A
		Maternal age (5)	7.8 (2.8 to 21.5)	Yes	Yes
l'Hoir <i>et al</i> , Netherlands, '98 ⁶²	Case-control	Maternal education (4)	4.5 (2.8 to 7.1)	Yes	Yes
		Maternal age (2)	1.18 (1.01 to 1.39)	N/A	N/A
Wisborg <i>et al</i> , Denmark, 2000 ⁶³	Cohort	Socioeconomic status (2)‡‡	1.79 (1.01 to 3.18)	N/A	N/A
		Maternal age (2)	4.39 (1.83 to 10.55)	N/A	N/A
Beal, Australia, 2000 ⁶⁴	Cohort	Maternal education (2)	2.23 (0.73 to 6.82)	N/A	N/A
		Private/public patient (2)	2.12 (1.62 to 2.77)	N/A	N/A

Table 2 Continued

Author/country/year of publication	Study type	Main SES measure/s (number of categories)	Unadjusted RR/OR (95% CI)*	Gradient/trend	
				Estimated	Present
Mehanni <i>et al</i> , Ireland, 2000 ⁶⁵	Cohort	Maternal age (2)	1.78 (1.48 to 2.15)	N/A	N/A
		Marital status (2)	1.67 (1.40 to 2.15)	N/A	N/A
		Father unemployed (2)	2.15 (1.72 to 2.69)	N/A	N/A
		Socioeconomic group (2)§§	1.26 (1.18 to 1.35)	N/A	N/A
Toro and Sotonyi, Hungary, 2001 ⁶⁶	Case-control	Social disadvantage (2)	6.7 (1.3 to 35.7)	N/A	N/A
Arayev <i>et al</i> , 17 European countries participating in the European Concerted Action on Sudden Infant Death, 2001 ⁶⁷	Case-control	Maternal age (3)	9.81 (5.94 to 16.20)	Yes	Yes
Paris <i>et al</i> , USA, 2001 ⁶⁸	Case-control*** (1992–1995 only)	Marital status (2)	2.0 (1.6 to 2.5)¶¶	N/A	N/A
		Maternal age (4)	3.4 (2.3 to 4.8)¶¶	Yes	Yes
Sanderson <i>et al</i> , UK, 2002 ⁶⁹		Residence in area of poverty (2)	2.33 (1.06 to 5.11)§	N/A	N/A

*For studies in which SES measures have more than two categories, RR/OR refers to the risk for the most versus the least disadvantaged (reference group).

Additional data obtained from authors. *Paper includes data on study already included in papers³⁹ and⁴⁰. †OR adjusted for pre-natal smoking. ‡OR adjusted for smoking and maternal depression. †Census tracts categorised on three characteristics: educational level; crowding; housing condition. ‡Two groups: low—father unemployed or unskilled and unmarried mothers versus rest. ††Categorised into three groups (low; middle; high) based on mother's education and occupation. ‡‡Three categories (below average; average; above average) based on housing and education. §§Two categories (low; high) based on paternal occupation.

Sixteen studies reported odds ratios associated with measures of socioeconomic status after adjustment for the main socially patterned risk factors, smoking, birth weight, and sleeping position. Maternal smoking during and/or after pregnancy was adjusted for in 10 studies (table 3). In 8 of these 10 studies, the 95% confidence intervals for at least one socioeconomic status measure excluded one. One study⁷¹ did not report 95% confidence intervals but p values indicate that maternal education remained significant after adjustment. Birth weight was adjusted for in 11 studies and sleeping position in two studies. Socioeconomic status measures remained independently associated with sudden unexpected infant death in all but one of the studies adjusting for birth weight and in both studies adjusting for sleeping position.

DISCUSSION

Methods for the systematic review of observational studies are less well defined than for randomised control trials. Meta-analysis of observational data poses particular problems related to heterogeneity between populations and in measures used. None the less, the principles of systematic reviews, an exhaustive search for primary studies and clear, pre-defined inclusion criteria, seem to offer an approach to minimising bias in the review of observational data. In this review no attempt was made to combine data statistically but rather to examine whether a consistent relation was found between social factors and sudden unexpected infant death over time and between countries. The range of countries and populations studied, the 42 year period over which the studies were conducted, and the wide range of socioeconomic status measured used would have made combined statistics difficult to interpret and potentially misleading.

Policy implications

Preventive programmes should address the social circumstances of families with young infants in addition to promoting parental behaviour change

Fifty two studies, undertaken in 16 countries and including over 10 000 sudden unexpected infant deaths during the period 1956 to 1998, were included in this systematic review. A broad definition of sudden unexpected infant death was used to take account of the changing definition of sudden unexpected death over the period studied. The results show an increased risk of sudden unexpected infant death associated with low socioeconomic status, measured by a range of indicators, which is consistent over time and between countries. These findings suggest that socioeconomic factors have an important role in the pathways leading to SUDI. Smoking is known to be strongly correlated to SIDS⁷⁰ and it has been suggested that it “accounts for” the social gradient.

The changing social pattern of women's smoking in developed countries over the 40 year period covered by these studies, the finding that in 10 studies socioeconomic status measures retained statistical significance after adjustment for maternal smoking (see table 3) and the variation in smoking patterns between countries⁸ makes it unlikely that smoking “accounts for” all the effects of socioeconomic factors in sudden infant death.^{6,7}

Socioeconomic status is not a discrete variable that can be said to “cause” sudden unexpected infant death. It is likely to act, as it does in relation to mortality throughout the life course,⁷¹ as a distal determinant exerting its influence through a range of variables including low birth weight,⁷² smoking,⁷³ overwrapping,⁷⁴ and prone sleeping⁷⁵ all of which have been shown to have a social gradient in the same direction as sudden infant death. These risk factors are likely to be on the pathway from socioeconomic status to sudden infant death. As table 3 shows, socioeconomic status exerts an effect on sudden infant death independent of these major risk factors and it is possible that other socially patterned variables are mediating this independent effect.

Further work is required to elucidate the mechanisms by which socioeconomic factors influence sudden infant death. However, this study shows that the search for possible proximal causes of sudden infant death must be consistent with observed social patterns.

It has been suggested that the socioeconomic status of families with young children is “immutable”⁶² and

Table 3 Studies reporting odds ratios/relative risks for socioeconomic factors adjusted for maternal smoking during or after pregnancy

Studies in order of year of publication	Adjusted OR/RR for SES (95% CI)	Variables adjusted for
Victoria <i>et al</i> '87 ³³	Maternal education (per year of schooling) 0.73 (0.59 to 0.91)	Birth weight; number of children <5 years; breast feeding; smoking in pregnancy
Kyle <i>et al</i> '90 ⁴⁰	Maternal age (per year) 0.91 (0.84 to 1.00)	Birth weight; ethnicity; infant sex
	Maternal age (<20) 1.31 (0.77 to 2.21)	
Nordstrom <i>et al</i> '93 ⁴⁶	Social class (IV/V) 1.50 (0.84 to 2.67)	Maternal age; parity, smoking in pregnancy
Millar and Hill '93 ⁴⁷	No employed parent 2.34 (1.41 to 3.89)	
Fujita and Kato '94 ⁴⁸	Maternal education (<10 years) 1.3 (0.8 to 2.2)	Birth weight; parity; pregnancy duration; infant sex
Kilkenny and Lumley '94 ⁵⁰	Maternal age (<20) p<0.001 (OR not given)	
Sanghavi '95 ⁵³	Marital status (unmarried) p<0.001 (OR not given)	Birth weight; region; birth order; infant sex
	Marital status (unmarried) p<0.001 (OR not given)	
Alessandri <i>et al</i> '96 ⁵⁶	Maternal age (<20) 1.62 (1.13 to 2.35)	Birth weight; parity; plurality; gestation; mother's birthplace; infant sex
	Marital status (unmarried) 2.81 (2.21 to 3.57)	
Blair <i>et al</i> '96 (CESDI study) ⁵⁸	Maternal age (<20) 1.73 (CIs not given) p<0.08	Birth weight; cigarette and alcohol use in pregnancy; prenatal care; race; method of delivery; gestation; multiple births
	Maternal education (per year of schooling) 0.80 (CIs not given) p<0.01	
Kytir and Paky '97 ⁵⁹	Marital status (single) 0.92 (0.52 to 1.61)	Birth weight; parity; gestation; infant sex
	Maternal age (<20) 2.42 (0.89 to 6.56)	
Brooke <i>et al</i> '97 ⁶⁰	Receipt of income support (UK safety net benefit) 2.81 (1.60 to 4.95)	Smoking in pregnancy; parity; marital status; income; alcohol consumption in pregnancy; thermal environment; maternal education; bed/room sharing
	Maternal education (low) 1.45 (1.16 to 1.81)	
Dalviet <i>et al</i> '98 ⁶¹	Maternal age (<27) 2.37 (1.23 to 4.58)	Birth weight; birth order; birth interval
	Deprivation score (high) 2.56 (1.20 to 5.49)	
l'Hoir <i>et al</i> '98 ⁶²	Marital status (unmarried) 1.87 (1.00 to 3.48)	Maternal smoking at time of death; sleeping position; bed sharing; social class; infant sex; gestation; birth weight; breast feeding; thermal environment
	Maternal age (<20) 29.4 (9.0 to 96.5)	
Toro and Sotonyi 2001 ⁶⁶	Maternal age (<20) 2.3 (1.2 to 4.5)	Smoking in pregnancy; birth order
	Paternal unemployment 3.7 (2.3 to 6.0)	
Paris <i>et al</i> 2001 ⁶⁸	Maternal age 1.32 (1.09 to 1.60)	Smoking in pregnancy; smoking after pregnancy; paternal smoking; marital status; breast feeding; bed sharing; birth weight; alcohol use since infant's birth
	Socioeconomic status 2.00 (1.01 to 4.00)	
Sanderson <i>et al</i> 2002 ⁶⁹	Social disadvantage 6.7 (1.3 to 35.7)	Smoking in pregnancy; birth weight; breast feeding; sleeping position; pregnancy interval
	Marital status (unmarried) 2.0 (1.6 to 2.5)	
	Maternal age (<20) 3.4 (2.3 to 4.8)	Smoking in pregnancy; year of birth
	Residence in area of poverty 2.33 (1.06 to 5.11)	
		Maternal smoking status (not stated if in pregnancy or after); maternal depression; gestation

“unmodifiable”⁵⁸ justifying exclusive concentration on proximal risk factors in the prevention of sudden infant death. However, the proportion of UK children living in poverty (by the EU definition of income below half the average after housing costs) rose from 9% in 1979 to 34% in 1995–6.⁷⁶ These trends can be traced directly to government

policy and could be reversed. If, as the results of this study suggest, socioeconomic factors act as distal determinants of SUDI, preventive programmes need to address the social circumstances into which infants are born as well as the health related behaviours of their parents.

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Speaker's corner

Outsourcing: wagering protection

Outsourcing is a growing trend, relieving business pressure to flex with the erratic work demands of a dynamic market. Practically speaking, when a process is fairly consistent across an industry, outsourcing seems to make sense, as long as one can sufficiently detail the work specifications. To be successfully outsourced, a project must be translated into logical steps, those steps communicated, and executed—it must be well managed.

Not surprising, the emigration of project management to low wage economies has economic motivation. For all the resistance against such business practice, the long term effect of outsourcing on community health is not obvious. While offering flexibility and diversity to workers and employers, its trade off is stability and many times, expertise. Still, outsourcing offers an opportunity to globalise worker standards.

Against this backdrop, the stage is set for the Forum Barcelona (<http://www.barcelona2004.org>). The world Forum is organised around three core themes: (1) cultural diversity, (2) sustainable development, and (3) conditions for peace. In fact, conversation has already begun via the web and pre-forum dialogues.

CULTURAL DIVERSITY

That commerce fosters cultural diversity is undeniable. Outsourcing to the majority of the world brings India and the UK in contact, Brazil and Japan, China and the USA. Within a country, we can see an intersection of cultures. Also undeniable is the conflict concomitant with diversity. It is difficult to understand another who does not speak your language; even for people who speak the same language, a word can connote vastly different meanings. It takes time to develop understanding and trust. We promote effective dialogue by accentuating the beneficial aspects of diversity while acknowledging the inherent conflict in disparity.

SUSTAINABLE DEVELOPMENT

The business practice of contracting workers from low wage economies like the Far East and eastern Europe also frames the question of what kind of growth is sustainable, and how do we sustain healthy communities. The global workforce cries for global standards for health and safety. Whether jobs are local or shipped to far away shores, all workers deserve protection. Smart regulations surely do not hinder profitability—amidst the toughest regulation in industry, we see some of the most profitable companies. The conundrum of economic prosperity as a requisite for community health is based, in part, on the riddle of productivity. Can industry

increase productivity with greater return on investment, and concurrently preserve worker security?

CONDITIONS FOR PEACE

Clearly, the social contract between employers and workers is under revision. Those with the advantage of wealth, power, or prestige may craft policies toward or away from greater social justice. One measure of success will be the degree to which we reconcile the well established links of health with a decent family income, adequate housing, early childhood development, and a good education.

HOW TO CREATE A HEALTHY WORKPLACE

Ours is not a unique situation. Social reformers have helped close sweatshops, end child labour, and give workers a fair wage for a days' work in Western Europe, Scandinavia, and the USA. Today, with many workers in safe jobs, in comfortable offices, with reasonable pay, we are called to extend reform of unsafe working conditions globally. As health professionals, we can take a page from the theory of change management¹:

- Establish a sense of urgency—why is this change needed now?
- Gather a coalition to develop a strategy—for direction and support
- Communicate the strategy—where do we want to go?
- Empower others to act—those closest to the fire must stake it
- Generate short term wins—celebrate successes publicly
- Produce greater change.

While thoughtful discussion is valuable, more important is implementing effective solutions. Companies can harmonise existing health and safety standards or stipulate such practice when outsourcing to escape liability and so all are protected, especially those with low wages. To paraphrase one executive, we have the capacity to do more good, for more people, than any other generation on the planet. The question is: How do we respond?

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