

secretions, symptom severity, symptom duration, functional status, and similar clinically important markers. It remains to be seen if the diagnosis sinusitis, however defined, is that important for determining treatment and prognosis.

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Social class differences in infant mortality in Sweden: comparison with England and Wales

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Abstract

Objectives—To investigate social class differences in infant mortality in Sweden in the mid-1980s and to compare their magnitude with that of those found in England and Wales.

Design—Analysis of risk of infant death by social class in aggregated routine data for the mid-1980s, which included the linkage of Swedish births to the 1985 census.

Setting—Sweden and England and Wales.

Subjects—All live births in Sweden (1985-6) and England and Wales (1983-5) and corresponding infant deaths were analysed. The Swedish data were coded to the British registrar general's social class schema.

Main outcome measures—Risk of death in the neonatal and postneonatal period.

Results—Taking the non-manual classes as the reference group, in the neonatal period in Sweden the manual social classes had a relative risk for mortality of 1.20 (95% confidence interval 1.02 to 1.43) and those not classified into a social class a relative risk of 1.08 (0.88 to 1.33). In the postneonatal period the equivalent relative risks were 1.38 (1.08 to 1.77) for manual classes and 2.14 (1.65 to 2.79) for the residual; these are similar to those for England and Wales (1.43 (1.36 to 1.51) for manual classes, 2.62 (2.45 to 2.81) for the residual).

Conclusions—The existence of an equitable health care system and a strong social welfare policy in Sweden has not eliminated inequalities in postneonatal mortality. Furthermore, the very low risk of infant death in the Swedish non-manual group (4.8/1000 live births) represents a target towards which public health interventions should aim. If this rate prevailed in England and Wales, 63% of postneonatal deaths would be avoided.

Introduction

Sweden's record on infant mortality is remarkable. Between 1920 and 1981 it had the lowest reported infant mortality of any country in the world. Between 1982 and 1986 it moved to second or third place behind either Japan or Finland.¹ This pre-eminent position has been maintained in the face of a continuous decline in infant mortality throughout the developed world, including Sweden itself.²⁻⁵

Sweden is often regarded as setting a standard to which other countries aspire, as shown by the many studies that have compared rates and trends in other countries with those in Sweden.⁵⁻⁹ In addition, the Swedish welfare and health care systems have been scrutinised to glean ideas as to how other countries might reduce infant mortality.¹⁰

There has been less awareness internationally of the existence of socioeconomic differences in infant mortality within Sweden. Regional differences in infant mortality were large in the early parts of this century but have since declined substantially.^{2,4} Socioeconomic differences, unlike regional ones, have not been routinely monitored. The paucity of information on this subject has encouraged the assumption that, today, socioeconomic differences in infant mortality do not exist in Sweden or other Scandinavian countries.^{11,12}

A recent, widely read review of inequalities in health stated that "the conclusion, expressed by many [is] that social inequalities in health in early life are negligible in Sweden, at least in those areas where information is available."¹³

Several studies of socioeconomic differences in birth outcome in Sweden have been published¹⁴⁻¹⁸ but, as discussed below, they have several limitations. Our study focuses on inequalities in infant mortality in Sweden, placing them in the context of Britain, a

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country with well recognised socioeconomic differences in infant mortality.

Methods

To compare socioeconomic differences in Sweden with those in England and Wales the Swedish data were coded to the British registrar general's social class schema. As discussed later this creates some problems, but it is clearly preferable to using a different classification for each country as has mostly been the case in other comparative studies.^{13 19}

SWEDEN

All live births registered in Sweden in 1985 and 1986 and all deaths occurring to these infants within one year of their birth as collated by the Swedish medical birth register were analysed. This register routinely links information collected at antenatal visits, delivery, and death and is regarded as being virtually complete.²⁰ Selected information on individuals and households from the 1985 Swedish census relating to mothers who gave birth in the period 1985-6 was linked to routine information from the medical birth register.

Births were allocated to a social class on the basis of census information on the occupation and employment status of the mother's cohabitant, irrespective of marital status. This exercise drew on the experience of the Swedish Institute for Social Research, which conducted earlier comparative studies of social class differences in mortality and morbidity in Sweden and Britain.^{21 22} As described elsewhere,²³ each combination of occupation and employment status in the data set was reviewed and assigned to a social class using the 1980 registrar general's classification of occupations.²⁴ In addition to social classes I to V, two further categories were defined. An "other" category comprised births to women whose cohabitant at census was a student, unemployed, or in the armed services; did not state an occupation; or whose occupation was inadequately described. Births to women who did not have a cohabitant at census, or for whom the cohabitant's details could not be linked, were assigned to a separate category.

ENGLAND AND WALES

All live births and infant deaths registered in England and Wales in the years 1983-5 were analysed. Counts of these births and deaths by social class were obtained from published and unpublished tabulations produced routinely by the Office of Population Censuses and Surveys.

Social class was routinely coded for 10% of all live births according to the 1980 classification of occupations,²⁴ based on parental occupation given at birth registration. All infant deaths (under 1 year) occurring in 1983-5 were included. Only 10% of the deaths could be allocated to a class from the birth registration, so each death was allocated to a social class

according to occupation stated on the death certificate.²⁵

For this analysis births were categorised by social class of father only for those registered within marriage or registered outside marriage by the father and mother jointly. An "other" category was defined for births registered within marriage or jointly registered outside of marriage when on the birth registration the father was a student, unemployed, or in the armed services; did not state an occupation; or his occupation was inadequately described. Births registered by the mother alone (sole registrations) were allocated to a separate category as the father's occupational details were not available.

INFANT MORTALITY

For both Sweden and England and Wales, infant mortality was divided into neonatal mortality and postneonatal mortality. Neonatal mortality relates to deaths occurring within the first 28 days of life, postneonatal mortality to subsequent deaths within the first year. The risk of neonatal and postneonatal death was calculated by dividing the numbers of deaths by the total number of live births in corresponding social class categories.

The effects of social class on mortality within each country are expressed as a series of ratios in which the risk in each category is related to that seen in the non-manual classes. The 95% confidence intervals were calculated on the assumption that the observed number of deaths were drawn from a Poisson distribution.²⁶ The public health significance of the differences in risk was examined by calculating the proportion of observed deaths that would have been avoided in each country under three assumptions: firstly, that the risks within each country were reduced to those of the non-manual group in that country; secondly, that the risks in England and Wales were reduced to those observed in Sweden as a whole; and, thirdly, that the risks in each country were reduced to the level of the Swedish non-manual group. Confidence intervals for the proportions of avoidable deaths were calculated using estimates of the variance of the logarithm of the avoidable proportion.²⁷

Results

Table I shows the distributions of live births by social class in Sweden and in England and Wales. The proportion of live births within the non-manual classes (I-III non-manual) was very similar. The residual categories of "other" and "sole registration or no cohabitant" made up a fifth of the Swedish live births but only a tenth of those in England and Wales.

Mortality by social class and country, and the corresponding risks, are shown in tables II and III for the neonatal and postneonatal periods. Overall, in the neonatal period the risks for England and Wales were 1.5 times those in Sweden, while in the postneonatal period they were 1.9 times greater. Within each social class category the risks in England and Wales were greater than those in Sweden. In England and Wales the neonatal and postneonatal mortality risks rise smoothly from class I to class V. For Sweden there is no such regular pattern.

To provide more stability in estimates, tables II and III also show risks for the non-manual and manual class aggregates. There is an additional reason for aggregating the data in this way. In the Swedish data there was sometimes doubt as to which of the two adjacent classes at either end of the schema (I or II, IV or V) an individual should be allocated to; the aggregates minimise misclassification.²³

The risk ratios for the manual, non-manual, and residual categories are also shown in tables II and III. In the neonatal period the relative risks for England

TABLE I—Live births by social class and country

Social class	England and Wales		Sweden	
	No of live births	Percentage	No of live births	Percentage
I	122 676	6.4	11 161	5.7
II	374 697	19.5	39 472	20.0
III Non-manual	184 241	9.6	15 929	8.1
III Manual	647 317	33.7	59 269	30.2
IV	268 261	14.0	22 911	11.7
V	123 473	6.4	5 645	2.9
Other	76 486	4.0	18 405	9.4
"Sole"*	123 468	6.4	23 761	12.1
Total	1 920 619	100	196 553	100

*In England and Wales this category comprised births registered by the mother only. In Sweden it comprised principally births to mothers for whom no cohabitant could be identified.

TABLE II—Neonatal mortality risks by social class and country

Social class	England and Wales			Sweden		
	No of deaths	Risk/100 000 live births	Relative risk (95% confidence interval)	No of deaths	Risk/100 000 live births	Relative risk (95% confidence interval)
I	530	432	1.00	43	385	1.00
II	1 700	454		131	332	
III Non-manual	892	484	1.27 (1.22 to 1.33)	47	295	1.20 (1.02 to 1.43)
III Manual	3 477	537		245	413	
IV	1 748	652		86	375	
V	819	663	1.59 (1.49 to 1.69)	20	354	1.08 (0.88 to 1.33)
Other "Sole"*	582	761		65	353	
	872	706		87	366	
Total	10 620	553		724	368	

*In England and Wales this category comprised births registered by the mother only. In Sweden it comprised principally births to mothers for whom no cohabitant could be identified.

TABLE III—Postneonatal mortality risks by social class and country

Social class	England and Wales			Sweden		
	No of deaths	Risk/100 000 live births	Relative risk (95% confidence interval)	No of deaths	Risk/100 000 live births	Relative risk (95% confidence interval)
I	296	241	1.00	17	152	1.00
II	1 080	288		66	167	
III Non-manual	544	295	1.43 (1.36 to 1.51)	14	88	1.38 (1.08 to 1.77)
III Manual	2 282	353		116	196	
IV	1 192	444		51	223	
V	721	584	2.62 (2.45 to 2.81)	9	159	2.14 (1.65 to 2.79)
Other "Sole"*	588	769		55	299	
	891	722		77	324	
Total	7 594	395		405	206	

*In England and Wales this category comprised births registered by the mother only. In Sweden it comprised principally births to mothers for whom no cohabitant could be identified.

TABLE IV—Percentage of observed deaths (95% confidence interval) that would be avoided if mortality in each country was reduced

Hypothetical level of reduced mortality	Neonatal mortality		Postneonatal mortality	
	England and Wales	Sweden	England and Wales	Sweden
Non-manual classes within country	17 (16-18)	10 (4-26)	29 (26-31)	29 (20-42)
Total Swedish population	33 (27-41)		48 (43-53)	
Swedish non-manual classes	40 (33-49)	10 (4-26)	63 (56-71)	29 (20-42)

and Wales are somewhat larger than in Sweden. The increase in risk from non-manual through manual to residual categories seen in the neonatal period in England and Wales is not found in Sweden. However, relative risks for the postneonatal period are much more similar in the two countries and show a systematic pattern of increase.

Relative to the Swedish non-manual category, the neonatal risks in England and Wales are 1.38 (95% confidence interval 1.20 to 1.58) for the non-manual, 1.75 (1.53 to 2.00) for the manual, and 2.19 (1.90 to 2.52) for the residual categories. In the postneonatal period the corresponding relative risks are 1.93 (1.58 to 2.37), 2.77 (2.26 to 3.38), and 5.07 (4.13 to 6.22).

Table IV shows the percentage of neonatal and postneonatal deaths that would have been avoided in each country under various assumptions. If both countries had risks equal to that of the Swedish non-manual group, then the percentage reductions in mortality shown in table IV, when applied to observed mortality in 1988 (the latest year for which figures are jointly available), would have resulted in the avoidance of 1350 neonatal and 1760 postneonatal deaths in England and Wales, and 40 neonatal and 70 postneonatal deaths in Sweden.

Discussion

The existence of socioeconomic differences in infant mortality in Sweden in the early decades of this century was shown by Rietz in an analysis of mortality in

Stockholm by family income.²⁸ Twofold differences were observed between the highest and lowest of four income categories for deaths in the first month of life, while much greater differences were seen in the remaining period up to one year. The data presented here suggest that differences of this magnitude no longer exist in Sweden. Nevertheless, our analyses indicate that in the mid-1980s social class differences in postneonatal mortality in Sweden were still fairly pronounced and were of roughly the same magnitude as seen in England and Wales. Social class differences in neonatal mortality in Sweden are small and are even less than in England and Wales.

These findings are consistent with the results of the other studies published over the past decade that have attempted to quantify socioeconomic differences in adverse birth outcome in Sweden,¹⁴⁻¹⁸ all of which used data from the Swedish Medical Birth Register.²⁰ In the period 1976-7 the perinatal mortality rate for babies born to women classified as most disadvantaged was 1.2 times that for babies born to those least disadvantaged.¹⁴ For the neonatal period slightly larger relative risk of around 1.3 were found.¹⁸ None of these rates was significantly different from 1.0 at the 5% level.

Ericson *et al* reported a postneonatal relative risk of 1.3 (0.8 to 2.2) between the most and least advantaged socioeconomic groups.¹⁸ These groups contained only 18% of live births (most advantaged 11%, least advantaged 7%), and had been constructed to define two groups that differed as much as possible in terms of maternal socioeconomic characteristics such as Swedish citizenship, occupation, cohabitation status, housing conditions, and ownership of place of residence.¹⁷ It is therefore surprising that the differentials in infant mortality seen using this classification are not more substantial than those seen in our analysis between the non-manual and manual classes (relative risk=1.38), which covered 90% of live births (non-manual 36%, manual 54%).

Chance may explain this apparent anomaly; the 95% confidence interval for the postneonatal relative risk

given by Ericson *et al* suggests that the true risk could be as high as 2.2. However, social class of cohabitant may be a more powerful tool for differentiating between groups with different levels of infant mortality than the socioeconomic classification of maternal characteristics used by Ericson *et al*. This is an issue of considerable sociological interest, touching on the question of how to assign social class to families. We are pursuing this further by investigating the mutually adjusted effects of maternal and paternal socioeconomic characteristics on infant mortality.

A general problem that affects all international comparisons of socioeconomic differences in health^{29 30} is the degree to which the classifications used are truly comparable. Our approach has been to use the same classification for both countries. We recognise that the registrar general's social classes were devised to reflect the general standing in Britain of people according to their occupation. Although the Swedish data do not show the same smooth gradient over social classes as seen in England and Wales, there is no reason to believe that this invalidates the simple comparison of manual with non-manual that we base our conclusions on. For more detailed comparisons we would want a classification of social class based more on sociological factors than is the registrar general's schema, the theoretical underpinnings of which are questionable.³¹

A further potential problem in comparing the effects of social class in Sweden with those in England and Wales arises because the distribution of live births among the social classes is not the same. The number not assigned to a specific social class is twice as large in Sweden (21%) as it is in England and Wales (10%). Births assigned to the residual categories tend to represent socioeconomically marginal groups. These include single mothers and families where the father or cohabitant is unemployed or ill (only a very small proportion are accounted for by those in the armed forces). However, groups such as single mothers may be less socioeconomically marginalised in Sweden than in England and Wales. This would be consistent with our observation that in the postneonatal period these residual groups have a lower relative risk in Sweden than in England and Wales.

LEVELS OF INEQUALITY

Although relative risks in the postneonatal period in Sweden are similar to those in England and Wales, the absolute level of inequality is substantially less. In England and Wales the difference in postneonatal risk between the manual and non-manual classes is 122 deaths per 100 000 live births; between the aggregate residual category and the non-manual classes it is 458 deaths per 100 000 live births. In contrast, the equivalent risk differences in Sweden are 54 and 167 deaths per 100 000 live births. Nevertheless, eliminating social class differences in Sweden (if all groups had the risk of the non-manual classes) would reduce postneonatal deaths by 29%. The same percentage reduction would occur if social class differences in postneonatal mortality were eliminated within England and Wales. However, if postneonatal risks in England and Wales were reduced to the level of those in non-manual classes in Sweden then nearly two thirds of postneonatal deaths would be avoided.

Risks in Swedish non-manual classes are lower than in any social class in England and Wales. In the postneonatal period these differences are substantial, with the non-manual category having almost twice the risk of its Swedish counterpart. The reasons for this substantial difference between countries is not fully understood, although it is consistent with the hypothesis that total mortality and infant mortality in a country are inversely related to the degree of equity in income distribution within it.^{32 33} However, despite the

greater equity of income distribution in Sweden than in England and Wales, we have observed similar levels of inequality in postneonatal mortality within each country. Regardless of the role of income inequity in explaining differences between countries in infant mortality it does not seem readily to explain the size of the differences within countries emphasised here.

The risks in the Swedish non-manual classes are lower than those seen in Japan, which now has the lowest level of infant mortality of any country. In 1985-7 Japanese infant mortality stood at 5.3 per 1000 live births,³⁴ compared with 4.8 per 1000 for Swedish non-manual classes (1985-6). The contrast is even more pronounced postneonatically where the corresponding figures for Japanese and Swedish non-manual classes were 2.10 and 1.46 per 1000 live births. In the absence of information on subgroups of the Japanese population with even lower risks, the rates in Swedish non-manual classes may be regarded as a new standard towards which all countries, including Sweden as a whole, should aim.

The consistent long term investment in social welfare and health care provision in Sweden over the past decades has gone alongside a substantial reduction in infant mortality. Despite this, inequalities in infant death seem to persist, particularly in the postneonatal period. We conclude that socioeconomic differences in the home environments of infants, which are likely to be important in determining levels of postneonatal mortality,³⁵ may have been more difficult to reduce than inequities in health care.

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How safe is Scottish hot air?

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Modern hot air balloons consist of a gondola, containing the pilot, passengers, and propane fuel tanks, suspended beneath a powerful gas burner that intermittently heats air within a nylon canopy overhead. Since the first flight by a British aeronaut (a former Edinburgh medical student) in 1784 ballooning accidents have continued to make front page news.¹ However, the accurate documentation of ballooning injuries remains sparse.^{2,3} Theoretical risks include thermal burns from propane; trauma on falling from the gondola (particularly on take off or landing); hypoxia; and unintentional contact with trees, buildings or overhead electricity wires. This paper records a prospective study of injuries to balloonists based in Scotland to find improvements for safer flying.

Methods and results

Over an eight year period (1983 to 1991) accidents were documented from the 10 pilots, 100 crew, and 15 hot air balloons based annually in Scotland. Minor injuries (such as abrasions, small haematomas, or facial hair loss) are commonplace³ and were excluded.

Twelve people were seriously injured on nine flights over the eight years and estimated 2000 hours of flying time (table). Limb and facial injuries were most common. Eight of the injured required hospital treatment, nine were unable to return to work immediately, but all 12 made an eventual recovery and eight flew again.

Eight subjects were injured on landing, and two of the aircraft were destroyed. Six cases (1, 2, 3, 7, 11, and 12) occurred on landing in mountainous terrain and (like case 10) involved the emergency services. Cases 5 and 6 necessitated enforced landings. All the pilots had less than 500 hours of flying experience, and seven of the nine accidents involved private pilots rather than commercial pilots. In five accidents pilot error and changing weather conditions were considered the major causes of the accident. There were no thermal injuries from the propane fuel.

Comment

Control over a hot air balloon in flight is limited, with the aircraft prey to the vagaries of the weather. Until recently modern ballooning injuries were poorly documented^{2,3} and often sensationalised by the media.¹ Six different Scottish hospitals have treated ballooning injuries in the past decade. The casualties in case 2 (subject multiply injured, rescued unconscious from open water) and case 10 (subject grasped 220 kV overhead power wires) clearly benefited from rapid evacuation and hospital attention. The majority of other injuries were to the limbs, sometimes involving considerable force (case 1), and face. Injuries to the face were due to spectacles (which should be removed before landing) or failure to wear crash helmets. It is notable that most accidents occurred during landing. Flights over mountainous territory should not be undertaken lightly (and accounted for half of the casualties), given the unpredictable weather conditions over often hostile landing terrain. The two young crew who experienced vasovagal attacks on unrelated flights were laid prone in the gondola until they recovered. Neither flight went over 2500 feet above mean sea level and the pilot and other crew remained well; thus hypoxia is unlikely to have contributed to their collapse.²

The hot air balloons cited in this series were up to 90 000 cubic feet (2550 m³; up to five persons) in size. These are smaller than most commercial passenger carrying balloons, the pilots of which are required to pass regular flight tests, although accidents still occur.^{4,5} Three private pilots accounted for nine of the 12 cases in this series. Thus potential aeronauts should choose a commercial pilot with a good safety record flying a balloon certified for passenger carrying by the Civil Aviation Authority, wear appropriate safety equipment, and fly in good weather.

- 1 Balloon crashes. *Observer* 1992 Jan 12:1.
- 2 Harding RM, Mills FT. Special forms of flight I: balloons, gliders and hang gliders. *BMJ* 1983;287:277.
- 3 Thompson AM. Aviation medicine: balloons. *BMJ* 1983;287:614.
- 4 Accident incident summary: balloons. *Flight Safety Bulletin* 1991;27(3):44.
- 5 Accident incident summary: balloons. *Flight Safety Bulletin* 1991;27(4):44-5.

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Ballooning injuries to Scottish
based balloonists

Case No	Age range and sex	Injuries	Hospital treatment	Surgery	Time off work	Role	Pilot's capacity*	Phase of flight	Comments
1	20-30 M	Dislocated elbow, facial lacerations	Yes	Yes	Yes	Pilot			
2	10-20 F	Fractured ribs, head injury, facial bruising	Yes	No	No	Crew	PPL	Landing. Balloon destroyed	Pilot error in adverse weather: air-sea rescue (1 other unhurt)
3	10-20 M	Knee haematoma	No	No	No	Crew			
4	50-60 M	Fractured ankle	Yes	No	Yes	Pilot	PPL	Landing	Pilot error
5	10-20 M	Vasovagal attack	No	No	No	Crew	PPL	Mid-flight	Landed immediately
6	10-20 F	Vasovagal attack	No	No	No	Crew	PPL	Mid-flight	Landed immediately
7	50-60 F	Facial lacerations and haematoma	Yes	No	Yes	Passenger	CPL	Landing	Adverse weather. Helicopter rescue (2 others unhurt)
8	30-40 F	Facial lacerations and haematoma	No	No	Yes	Passenger	CPL	Landing	Passenger disobeyed pilot's landing briefing
9	10-20 M	Fractured tibia and fibula	Yes	Yes	Yes	Ground crew	PPL	Mid-flight	Tripped chasing balloon
10	30-40 F	Electrical burns on hands and wrists	Yes	Yes	Yes	Crew	PPL	Take off	Pilot error—flew into power wires (2 others unhurt)
11	30-40 M	Thigh haematomas, laceration	Yes	No	Yes	Pilot	PPL		
12	20-30 M	Severe back muscle spasm (unable to walk)	Yes	No	Yes	Crew	PPL	Landing. Balloon gondola destroyed	Pilot error in adverse weather

*PPL=Private pilot. CPL=Commercial pilot.