Socioeconomic Differences in Stillbirths and Infant Mortality in Finland 1976—82

VEIJO NOTKOLA
Chief of Bureau, Docent
Insititute of Occupational Health, Department of Kuopio

TAPANI VALKONEN
Professor
Department of Sociology
University of Helsinki

Introduction

The recent development of infant mortality has been favorable in Finland. The infant mortality rate (deaths during the first year of life per 1000 live births) was 9.9 in 1976, but as low as 6.0 in 1982 (Statistical Yearbook of Finland, 1983). According to an earlier study, social class differences in childhood mortality in a birth cohort of 12,000 children born in 1966 were clear in Finland (Rantakallio, 1986). Social class differences were most marked in mortality from infectious and perinatal diseases.

The main purpose of this article is to find out to what extent there still are socioeconomic differences in stillbirth rate and infant mortality in Finland, and in what way these possible differences have developed during 1976—82.

Antonowsky and Bernstein (1977) reviewed studies on the relationship between infant mortality and social class, published in Western Europe and the United States before the mid-1960s. They came to the following conclusion (p. 453):

> ...although infant mortality has declined dramatically in the past century, the inverse relationship between social class and perinatal, neonatal and postneonatal mortality has not narrowed, in spite of the advances in medicine and surgery, sanitation and housing conditions, and the overall rise in living standards which were presumed to be of special benefit to the lower classes.

More research has been carried out since the studies reviewed by Antonowsky and Bernstein. Table 1 is a crude summary of the results of some recent studies (see Valkonen, 1987, 230—235). Marked socioeconomic and educational differences were found in perinatal mortality and components of infant mortality in England and Wales, Hungary, Italy and California. The differences had diminished in England and Wales during the 1970s, but in Hungary they seemed to have increased.

The results of neonatal mortality for Denmark and of perinatal mortality in Sweden showed only negligible differences. As Finland resembles Sweden and Denmark in many respects, one would expect the differences in perinatal and neonatal mortality to be small in Finland too.

Table 1. Socioeconomic differences in perinatal mortality and components of infant mortality in selected countries

The ratio of the mortality in the lowest socioeconomic category to that in the highest socioeconomic category

England and Wales (occupational classes)	1970—70	1980
Perinatal mortality	2.0	1.8
Neonatal mortality (0—28 days)	2.0	1.7
Postneonatal mortality (29—365 days)	4.5	1.9
(OPCS 1978, 157; Macfarlane and Mugford 1984, 123)		
Hungary (educational categories)	1972—74	1978—80
Perinatal mortality	1.7	2.1
(Klinger, 1982, Table 39)		
Italy (educational categories)		1975
Stillbirths		1.7
Early neonatal (0—7 days)		1.5
Post-hebdomanal (8—365 days)		2.2
(Pinnelli, 1984, 233)		
Denmark (occupational classes)	1970	1977
Neonatal 0—28 days	1.36	1.06
(Holstein, 1986, 32)		
Sweden (a combined socioeconomic index)		1976—77
Perinatal mortality		1.17
(Ericson et al., 1984)		
California (non-Hispanic white population, educational categories)		1978
Early neonatal (0—7 days)		1.4
Post-hebdomanal (8—365 days)		2.4
Total infant mortality		1.9
(Cramer, 1987, 304 and 311)		

Data and methods

The data for this study have been obtained by linking records on individuals from three sources. The computerized linkage was possible because a personal identification number for individuals is used in most statistical files in Finland. The linkage of records was carried out by the Social Insurance Institution of Finland and the Central Statistical Office of Finland on the basis of the necessary permits.

The material consists of all live births and stillbirths during the period 1976—82 by women aged 23—40 years at the birth of the child. The births to mothers younger than 23 years were not included in order to improve the comparability of the data for the beginning and the end of the study period. The births to mothers older than 40 were excluded because the necessary data were not available for the whole period. 17.4 percent of all live births in 1976—82 were to mothers younger than 23 and 0.8 percent to mothers older than 40. The study thus covers 81.2 percent of live births, and probably a slightly lower percentage of all stillbirths in Finland during 1976—82.

The data on live births were obtained from the Social Insurance Institution and on stillbirths from the Central Statistical Office. The data included information about the sex of the child, the parity of the child (only for live births) and the age of the mother at birth. The information on the level of education and the socioeconomic position of the mothers were obtained by linking the records on births to the records of the census of 1975 on the basis of the identification numbers of the mothers.

The records on births and the characteristics of the mothers were finally linked with the records of the register for causes of death. Through this linkage it was possible to identify children who died during their first year of life. The data consisted of 361 049 births, 1 977 of which were stillbirths. There were 2 492 deaths during the first year of life.

Four types of variables are used in the analysis:

1) Demographic variables: parity of child, age of the mother and sex of the child. These variables are included in the analysis mainly to control for the possible differences in their distribution in the socioeconomic categories.

2) Socioeconomic variables: level of education and occupational class. These variables are used as two parallel indicators of socioeconomic status. The variable occupational class is based on the »social group» classification used by the Central Statistical Office of Finland (Official Statistics of Finland VIC: 104, IX, 1974). Mothers who were economically active in 1975 or had formerly been economically active were classified by their own occupation. Mothers who were economically dependent in 1975 were classified by the occupation of the supporter or the household (usually husband or father).

3) Time: the study period is divided into three subperiods (1976—77, 1978—79, 1980—82) to study changes in death rates.

4) Six partly overlapping components of mortality:

a) stillbirths
b) early neonatal mortality (0—7 days)
c) perinatal mortality (stillbirths + early neonatal deaths)
d) late neonatal and post-neonatal mortality (8—365 days)
e) total infant mortality (0—365 days)
f) total infant loss (stillbirths + infant deaths)

Statistical analysis was carried out by using logit models (Murrells et al., 1985). The estimation of odds ratios was made by using the binominal model in the GLIM program package (Baker and Nelder, 1978; Holford, 1980).

Results

Crude rates

There were differences in the crude stillbirth and infant mortality rates by parity, by age of mother, by sex of child and also by the socioeconomic variables (Table 2). Both stillbirth and infant mortality rate decreased during the period covered by the study. The infant mortality rate was 8.2 per thousand during 1976—1977 but 5.9 per thousand during 1980—1982. These rates were slightly lower than the rates for all births in the same period as published in the official statistics of Finland. This was due to the fact that births to mothers younger than 23 years and older than 40 years were excluded in this study to improve the comparability of the data for the beginning and the end of the study period.

Table 2. Stillbirth and infant death rate (‰) by parity, age of mother at birth, sex of child, level of education of mother, occupational class and period in Finland. (Number of stillbirths or deaths in parentheses).

	A. Stillbirths	B. Deaths in 0—7 days	C. Perinatal mortality	D. Deaths in 8—365 days	E. Total infant mortality	F. Total infant loss = Stillbirths + infant deaths
Parity						
First child	n.a.	4.4. (595)	n.a.	2.1 (283)	6.5 (878)	n.a.
Second or third child	n.a.	4.3 (869)	n.a.	2.6 (523)	6.9 (1392)	n.a.
Fourth or more child	n.a.	6.0 (144)	n.a.	3.3 (78)	9.4 (222)	n.a.
Age of mother at birth						
23—28	4.9 (934)	4.3 (823)	9.1 (1757)	2.3 (449)	6.6 (1272)	11.4 (2206)
29—33	5.6 (667)	4.4 (521)	9.9 (1188)	2.5 (302)	6.9 (823)	12.4 (1490)
34—40	7.4 (376)	5.3 (264)	12.7 (640)	2.7 (133)	7.9 (397)	15.4 (773)
Sex						
Male	5.6 (1034)	5.1 (934)	10.6 (1968)	2.6 (485)	7.7 (1419)	13.2 (2453)
Female	5.3 (943)	3.8 (674)	9.1 (1617)	2.3 (399)	6.1 (1073)	11.4 (2016)
Level of education 1975						
—9 years	5.8 (885)	4.7 (706)	10.5 (1591)	2.7 (414)	7.4 (1120)	13.2 (2005)
10—12 years	5.6 (543)	4.8 (459)	10.3 (1002)	2.3 (222)	7.0 (681)	12.6 1224)
13 + years	4.6 (524)	3.8 (429)	8.4 (953)	2.2 (245)	6.0 (674)	10.6 (1198)
No information[1]	20.9 (25)	11.8 (14)	32.5 (39)	2.5 (3)	14.4 (17)	35.0 (42)
Occupational class						
Upper white-collar w.	4.4 (192)	4.0 (175)	8.5 (367)	2.2 (95)	6.3 (270)	10.6 (462)
Lower white-collar w.	5.1 (767)	4.3 (634)	9.4 (1401)	2.3 (344)	6.6 (978)	11.7 (1745)
Manual workers	5.8 (641)	4.8 (527)	10.5 (1168)	2.5 (280)	7.3 (807)	13.0 (1448)
Farmers	6.4 (161)	4.6 (114)	11.0 (275)	3.0 (75)	7.6 (189)	14.0 (350)
Others	6.4 (216)	4.7 (158)	11.0 (374)	2.7 (90)	7.4 (248)	13.7 (464)
Period						
1976—77	6.1 (630)	5.5 (561)	11.6 (1191)	2.7 (273)	8.2 (834)	14.3 (1464)
1978—79	5.5 (564)	4.7 (475)	10.1 (1039)	2.5 (254)	7.2 (729)	12.6 (1293)
1980—82	5.0 (783)	3.6 (572)	8.6 (1355)	2.3 (357)	5.9 (929)	10.8 (1712)
All	5.4 (1977)	4.5 (1608)	9.9 (3585)	2.5 (884)	7.0 (2492)	12.3 (4469)

A) Stillbirths × 1000/(stillbirths + live births)
B) Deaths in 0—7 days × 1000/live births
C) (Stillbirths + deaths 0—7 days) × 1000/(stillbirths + live births)
D) Deaths in 8—365 days × 1000/live births
E) Deaths in 0—365 days × 1000/live births
F) Stillbirths + deaths in 0—365 × 1000/(stillbirths + live births)
n.a. = not available
[1] Results for this catogory will not be included in the tables of this article because of the small number of stillbirths and infant deaths.

Infant mortality was slightly higher among women having higher parity than three. Among older women both the stillbirth rate and infant mortality rate were increased. The relative differences between age groups were more marked for stillbirths than infant deaths. The effect of sex of child was negligible for stillbirths, but infant mortality was higher among male children.

The infant mortality rate was 6.0 per thousand among mothers with 13 years of education or more and 7.4 per thousand among those with 9 years or less. The stillbirth rate and infant mortality rate were highest in the small group with unknown level of education. The stillbirth and infant death rate were higher also among farmers and among manual workers than in the non-manual classes. This difference was more marked in the stillbirth rate than in the components of infant mortality.

Simultaneous effects of demographic variables

The logit analysis showed that all three demographic variables (parity, age of mother and sex of child) had statistically significant effects on at least some components of infant loss (Table 3).

After adjustment for age of mother and sex of child infant mortality was about 35 percent higher for the fourth or higher parity children compared to the first children. The mother's age had no effect on infant mortality in the age bracket covered, but the stillbirth rate was clearly increased in the oldest age group after adjustment for sex of child. The child's sex was an important variable for infant mortality but not for stillbirths.

Because all three demographic variables had effects on some of the components of infant loss, these variables were included in the analysis when the effects of the two socioeconomic variables were studied.

Table 3. Logit analysis (odds ratios) of stillbirths and infant deaths by parity, age of mother and sex of child).

Parity[1]	Still-births	0—7 days	Perinatal mortality	8—365 days	Infant mortality	Total infant loss
First child*	n.a.	1.00	n.a.	1.00	1.00	n.a.
Second or third	n.a.	.95	n.a.	1.22	1.04	n.a.
Fourth or more	n.a.	1.28	n.a.	1.54	1.36	n.a.
		P<0.01		P<0.01	P<0.001	
Age of mother						
23—28*	1.00[4]	1.00[2]	1.00[4]	1.00[2]	1.00[2]	1.00[4]
29—33	1.15	1.00	1.09	1.02	1.01	1.09
34—40	1.54	1.17	1.40	1.01	1.11	1.34
	P<0.001	P=NS	P<0.001	P=NS	P=NS	P<0.001
Sex of child						
Male*	1.00[5]	1.00[3]	1.00[5]	1.00[3]	1.00[3]	1.00[5]
Female	.96	.76	.86	.86	.79	.86
	P=NS	P<0.001	P<0.001	P<0.001	P<0.05	P<0.001

[1] Adjusted for age of mother and sex of child
[2] Adjusted for parity and sex of child
[3] Adjusted for age of mother and parity
[4] Adjusted for sex of child
[5] Adjusted for age of mother
n.a. = not available
* = reference group

Effects of socioeconomic variables

Adjustment for the demographic variables and period did not change the differences between educational categories presented in unadjusted form in Table 2 (Table 4). The stillbirth rate as well as the rates for all components of infant mortality were about 20 percent higher for the mothers in the highest educational category compared to those in the lowest category. The middle category differed only slightly from the lowest educational category.

The relative differences between the occupational classes in stillbirths and infant mortality were somewhat larger after adjustment for the demographic variables and period than without adjustment (Table 5 compared with Table 2). This was due to the fact that the upper white-collar workers were older than the other occupational classes. The pattern of the differences was, however, the same in both Table 5 and Table 2. The stillbirth rate and the death rates for all components of infant mortality were systematically lowest in the upper white-collar class, somewhat higher in the lower white-collar class and still higher in the manual class. The highest rates were, however, found among the farmers, except for early neonatal mortality.

The differences between occupational classes were clearly more marked for stillbirths and, consequently, for perinatal mortality than for infant mortality and its components. The differences in the infant mortality rates were, in fact, not even statistically significant. The statistical test used here does not, however, take into account the rank order of the two white-collar classes and the manual class which corresponded systematically to the order of the mortality levels.

Table 4. Logit analysis (odds ratios) of stillbirths and infant deaths by level of education in Finland 1976—1982.

Level of education	Still-births[1]	0—7 days[2]	Perinatal mortality[1]	8—365 days[2]	Infant mortality[2]	Total infant loss[1]
—9 years(*)	1.00	1.00	1.00	1.00	1.00	1.00
10—12 years	.96	1.02	.98	.85	.95	.95
13+years	.78	.81	.79	.81	.80	.79
	P<0.001	P<0.001	P<0.001	P=NS	P<0.001	P<0.001

[1] Adjusted for age of mother, sex of child and time period
[2] Adjusted for parity, age of mother, sex of child and time period
(*) = reference group

Table 5. Logit analysis (odds ratios) of stillbirths and infant deaths by occupational class in Finland 1976—1982.

Upper white-collar w.(*)	Still-births[1]	0—7 days[2]	Perinatal mortality[1]	8—365 days[2]	Infant mortality[2]	Total infant loss[1]
	1.00	1.00	1.00	1.00	1.00	1.00
Lower white-collar w.	1.23	1.10	1.16	1.09	1.09	1.14
Manual worker	1.44	1.25	1.35	1.18	1.23	1.32
Farmers	1.45	1.18	1.39	1.39	1.26	1.40
Others	1.63	1.26	1.46	1.29	1.27	1.42
	P<0.001	P=NS	P<0.001	P=NS	P=NS	P<0.001

[1] Adjusted for age of mother, sex of child and time period
[2] Adjusted for parity, age of mother, sex of child and time period
(*) = reference group

Table 6. Crude stillbirth and infant death rate by period and level of education and by period and occupational class (Number of stillbirths or deaths in parentheses).

	Stillbirth rate (per thousand)		
Education	1976—77	1978—79	1980—82
—9 years	7.0 (294)	5.4 (213)	5.4 (378)
10—12 years	6.0 (166)	6.0 (173)	5.1 (204)
13+years	5.0 (162)	5.1 (169)	4.1 (193)
Occupational class			
Upper white-collar w.	4.4 (60)	5.0 (61)	4.1 (71)
Lower white-collar w.	5.7 (256)	5.4 (236)	4.6 (275)
Manual workers	6.9 (205)	5.2 (157)	5.5 (279)
Farmers	8.0 (48)	6.8 (42)	5.6 (71)
Others	7.9 (61)	7.2 (68)	5.3 (87)
All	6.1 (630)	5.5 (564)	5.0 (783)
	Infant mortality rate (per thousand)		
Education	1976—77	1978—79	1980—82
—9 years	8.8 (365)	8.0 (316)	6.3 (439)
10—12 years	8.2 (225)	7.2 (207)	6.2 (249)
13+years	7.4 (241)	6.1 (201)	5.0 (232)
Occupational class			
Upper white-collar w.	7.2 (99)	6.3 (77)	5.4 (94)
Lower white-collar w.	7.7 (343)	6.7 (291)	5.7 (344)
Manual workers	8.7 (258)	8.2 (247)	6.0 (302)
Farmers	12.2 (73)	7.7 (47)	5.4 (69)
Others	7.9 (61)	7.1 (67)	7.3 (120)
All	8.2 (834)	7.2 (729)	5.9 (929)

The results of an analysis, not presented here, showed that there were no statistically significant interaction effects between level of education and the demographic variables, or between occupational class and the demographic variables. This implies that the relative sosioeconomic differences are equally large for all age groups, all parities and both sexes.

Changes in socioeconomic differences

The stillbirth and infant mortality rates declined in Finland during the study period. According to Table 6 the decline was 18 percent in the stillbirth rate and 28 percent in the infant mortality rate from the period 1976—77 to the period 1980—82. The decline influenced all socioeconomic groups: the stillbirth rate and infant mortality rate was clearly lower in 1980—82 than in 1976—77 in all occupational classes and all educational categories.

The adjusted odds ratios both for stillbirths and for infant deaths show that the relative differences between the educational categories were almost the same in 1980—82 as in 1976—77 (Table 7). No narrowing or widening of the educational differentials had thus occurred. It is interesting, however, that there were no systematic differences between the educational categories in stillbirth rates in 1978—79. This anomaly is due to differences in the timing of the decline as Table 6 shows.

Table 7. Logit analysis (odds ratios) of stillbirths and infant deaths by time period and level of education and by time period and occupational class.

Stillbirths (adjusted for age of mother and sex of child)

	Period		
Education	1976—77	1978—79	1980—82
—9 years(*)	1.00	1.00	1.00
10—12 years	.89	1.14	.91
13+years	.71	.95	.72
	P<0.01	P=NS	P<0.01
Occupational class			
Upper white-collar w.(*)	1.00	1.00	1.00
Lower white-collar w.	1.42	1.14	1.14
Manual workers	1.72	1.12	1.45
Farmers	1.78	1.40	1.48
Others	2.03	1.59	1.39
	P<0.001	P=NS	P<0.01

Infant deaths (adjusted for age of mother, parity and sex of child)

Education	1976—77	1978—79	1980—82
—9 years(*)	1.00	1.00	1.00
10—12 years	.83	.92	.94
13+years	.65	.69	.67
	P<0.001	P<0.001	P<0.001
Occupational class			
Upper white-collar w.(*)	1.00	1.00	1.00
Lower white-collar w.	1.12	1.09	1.08
Manual worker	1.24	1.34	1.12
Farmers	1.64	1.21	1.00
Others	1.16	1.18	1.38
	P<0.001	P=NS	P=NS

(*) = reference group

The most striking feature of the adjusted results for occupational classes is the diminishing of the excessive infant mortality of farmers (Table 7). Their odds ratio of infant mortality was 1.6 times that of the white-collar classes in 1976—77 but at the same level in 1980—82. The excessive stillbirth mortality of farmers had also diminished but not as much as that for infant mortality.

There is also a tendency towards diminishing relative differences between the white-collar and manual classes in the odds ratios for both stillbirths and infant mortality (Table 7). The practical disappearance of this difference in the stillbirth rate in the period 1978—79 is probably related to the similar finding for the educational differences.

Conclusions

Despite the low level of perinatal infant mortality in Finland, socioeconomic differences have not totally disappeared. The results for the whole period 1976—82 indicate that both the perinatal and the infant mortality rates of the lowest educational category were about 20 percent greater than those for the highest educational category. The relative differences between occupational classes were somewhat more

marked. The results are not strictly comparable to those presented for selected populations in Table 1. It may be concluded, however, that socioeconomic differences in perinatal and infant mortality are smaller in Finland than in England and Wales, Hungary, Italy or California, but probably somewhat larger than in Sweden and Denmark.

The increased probability of stillbirth and infant death in the lower educational and occupational classes cannot be explained by differences in maternal age and parity distributions between the classes. The result is the same as in England and Wales in 1975 (Murrells et al., 1985).

The stillbirth rate declined approximately 20 percent from the period 1976—77 to the period 1980—82. The relative decline was equally large in all educational categories and the differences between the categories were thus the same in both periods. The results for occupational classes were different, since the decline was greater than average for farmers and smaller than average for white-collar workers. The differences between occupational classes, consequently, diminished to some extent. In 1980—82 the stillbirth rate of manual workers and farmers was still almost 50 percent higher than that for the upper white-collar workers.

The decline of the infant mortality rate was greater than that of the stillbirth rate. The results of the development of the socioeconomic differences were analogous to those of the stillbirth rate: differences between educational categories remained the same, whereas those between occupational classes diminished. The differences in infant mortality between occupational classes almost vanished.

A partial reason for the smaller differences in infant mortality between the occupational classes in 1980—82 may be a decrease in the accuracy of the measurement of occupational class. The measurement of occupational class was based on the information on the occupation of the mother or the head of household in the 1975 census. This information is more valid for the period 1976—77 than for the later periods. The poorer accuracy of the data on occupational class in 1980—82 compared to 1976—77 does not, however, explain all of the decrease in the occupational class differences in infant mortality, since these differences in the stillbirth rate were quite marked even in 1980—82.

References

Antonovsky, A. and Bernstein, J. (1977) Social class and infant mortality. Social Science and Medicine 2(8—9): 453—470.

Baker, R. J. and Nelder, I. A. (1978) General Linear Interactive Modelling (GLIM), Release 3. Oxford: Numerical Algorithms Group.

Cramer, C. C. (1987) Social factors and infant mortality: identifying high-risk groups and proximate causes. Demography 24(3): 299—322.

Ericson, A. et al. (1984) Pregnancy outcome and social indicators in Sweden. Acta Paediatrica Scandinavica 73(1): 69—74.

Holford, T. R. (1980) The analysis of rates of survivorship using log-linear models. Biometrics 36(2): 299—305.

Holstein, B. E. (1986) Denmark. In: WHO, Regional Office for Europe. The health burden of social inequities, pp. 29—47. Copenhagen.

Klinger, A. (1982) Infant mortality in Eastern Europe, 1950—1980. Budapest: Statistical Publishing House.

Macfarlane, A. and Mugford, M. (1984) Birth Counts. Statistics of Pregnancy and Childbirth. Tables. London: Her Majesty's Stationery Office.

Murrells, T. I., Catford, I. C., Smith, T. M. F. and Machin, D. (1985) The use of logit models to investigate social and biological factors in infant mortality. II: Stillbirths. Statistics in Medicine 4: 189—200.

Pinnelli, A. (1984) Facteurs différentiels de la mortalité feto-infantile en Italie. In: Socio-Economic Differential Mortality in Industrialized Societies, Volume 3, pp. 227—243. Rome: UN, WHO, CICRED, IRP and DSD.

Office of Population Censuses and Surveys (1978) Occupational Mortality. The Register General's Decennial Supplement for England and Wales, 1970—71. Series D5, no. 1. London: Her Majesty's Stationery Office.

Rantakallio, P. (1986) Inequalities in children's deaths in the country with the lowest infant mortality. Publich Health 100(3): 152—155.

Valkonen, T. (1987) Social inequality in the face of death. In: European Population Conference 1987: Issues and Prospects. Plenaries, pp. 201—252. Helsinki: Central Statistical Office of Finland.