

- 15 Wilson JMG, Jungner G. *Principles and practice of screening for disease*. Geneva: World Health Organisation, 1968. (WHO public health paper 34.)
- 16 Day NE. Screening for cancer of the cervix. *J Epidemiol Comm Health* 1989;43:103-6.
- 17 Raffle AE, Alden B, Mackenzie EFD. Detection rates for abnormal cervical smears: what are we screening for? *Lancet* 1995;345:1469-73.
- 18 Johnson J. Media focus on failures of screening programme. *BMJ* 1997;314:1630.
- 19 Moss S. Screening for cancer of the cervix. In: Chamberlain J, Moss S, eds. *Evaluation of cancer screening*. London: Springer, 1996:15-32.
- 20 Miller AB, Chamberlain J, Day NE, Hakama M, Prorok PC. Report on a workshop of the UICC project on evaluation of screening for cancer. *Int J Cancer* 1990;46:761-9.
- 21 Van Wijngaarden WJ, Duncan ID. Rationale for stopping cervical screening in women over 50. *BMJ* 1993;306:967-71.
- 22 Chamberlain J. Screening for early detection of cancer. In: Tiffany R, Pritchard AP, eds. *Oncology for nurses and health care professionals*. Vol 1. London: Harper and Row, 1988:155-73.
- 23 Cook GA, Draper GJ. Trends in cervical cancer and carcinoma in situ in Great Britain. *Br J Cancer* 1984;50:367-75.
- 24 Parkin DM, Nguyen-Dinh X, Day NE. The impact of screening on the incidence of cervical cancer in England and Wales. *Br J Obstet Gynaecol* 1985;92:150-7.
- 25 Murphy MFG, Campbell MJ, Goldblatt PO. Twenty years' screening for cancer of the uterine cervix in Great Britain 1964-84: further evidence for its ineffectiveness. *J Epidemiol Comm Health* 1987;42:49-53.
- 26 Austoker J. Screening for cervical cancer. *BMJ* 1994;309:241-7.
- 27 Lancaster G, Moran T, Woodman C. Towards achieving the health of the nation target for cervical cancer: accuracy of cancer registration. *J Pub Health Med* 1992;16:50-2.
- 28 Coleman MP, Estève J, Damiacki P, Arslan A, Renard H. *Trends in cancer incidence and mortality*. Lyons: International Agency for Research on Cancer, 1993. (IARC scientific publications No 121.)
- 29 Herbert A, Breen C, Bryant TN, Hitchcock A, Macdonald H, Millward-Sadler GH, et al. Invasive cervical cancer in Southampton and south west Hampshire: effect of introducing a comprehensive screening programme. *J Med Screening* 1996;3:23-8.
- 30 Sasieni PD, Cuzick J, Lynch-Farmery E and the National Coordinating Network for Cervical Screening Working Group. Estimating the efficacy of screening by auditing smear histories of women with and without cervical cancer. *Br J Cancer* 1996;73:1001-5.
- 31 Raffle AE. Deaths from cervical cancer began falling before screening programmes were established. *BMJ* 1997;315:953-4.

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Short version 1

Narrowing social inequalities in health? Analysis of trends in mortality among babies of lone mothers

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Editorial
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Abstract

Objectives To examine trends in mortality among babies registered solely by their mother (lone mothers) and to compare these with trends in infant mortality for couple registrations overall and couple registrations subdivided by social class of father.

Design Analysis of trends in infant death rates from 1975 to 1996 for the three groups. The data source was the national linked infant mortality file, containing all records of infant death in England and Wales linked to the respective birth records.

Setting England and Wales.

Participants All live births (n = 14.3 million) from 1975 to 1996; all deaths of infants from birth to 12 months of age over the same period (n = 135 800).

Main outcome measures Death rates in the perinatal, neonatal, and postneonatal periods and for infancy overall.

Results For the babies of lone mothers infant mortality has fallen to less than a third of the 1975 level, with a clear reduction in the gap between the mortality in these babies compared with all couple registrations: the excess mortality in solely registered births was 79% in 1975 reducing to 33% in 1996. Most of the narrowing of the sole-couple differential was associated with the neonatal period, for which there is now no appreciable gap. For couple registrations analysed by social class of father, infant death rates have more than halved in each social class from 1975 to 1996. The reductions in mortality were greater in the late 1970s and early 1990s. Infant death rates in classes IV-V remained between 50% and 65% higher than in classes I-II. Differentials between social classes were largest in the postneonatal period and smallest in the perinatal and neonatal periods. The gap in perinatal and neonatal mortality between the

babies of lone mothers and couple parents in social classes IV-V has disappeared.

Conclusions The differential in infant mortality between social classes still exists, whereas the differential between sole and couple registrations has decreased, showing positive progress in the reduction of inequalities. As the reduction in the differential was confined to the neonatal period these improvements may be more a reflection of healthcare factors than of factors associated with lone mothers' social and economic circumstances.

Introduction

Infant mortality has long been accepted as an important indicator of a population's health, with evidence of any social differentials in this indicator regarded as particularly unacceptable and a spur to action. The traditional way of analysing social trends in infant mortality, often limited to births inside marriage by social class of father, has, however, become increasingly problematic as growing numbers of infants are excluded from such an analysis, not least the babies of lone mothers.

Over the past 20 years there has been a clear reduction in the proportion of births registered within marriage in England and Wales,¹ and this trend has been accentuated in manual social classes (table A on the *BMJ's* website, www.bmj.com).

A second distinct group commonly excluded from the traditional analyses of social trends in mortality consists of babies registered outside marriage solely by their mothers. The size of this group has increased from 5% of births in 1975 to 8% in 1996 (table B on the *BMJ's* website, www.bmj.com). The social class of the father is not available from these records, and it has not been possible to assign a social class on the basis of the mother's occupation to most births until the last few years as

occupation of the mother has only been recorded at registration since 1986 and then only on a voluntary basis, with slow take up of this option in the early years. We believe, however, that this category consists largely of the babies born outside marriage to lone mothers and that they form a potentially vulnerable group in society. In Britain, a high proportion of lone mothers live in poverty,^{2,3} and their children not only face socio-economic disadvantage but are known to have higher risks of health problems such as accidents and infections.^{4,5} It is therefore important to include this previously excluded group in any consideration of socioeconomic trends in infant mortality in this country.

We analysed trends in mortality in babies of lone mothers and compared these with mortality trends in babies of couple parents from different social classes, including all births registered by both parents, whether married or not.

Methods

Tabulations of the numbers of live births, stillbirths, and early neonatal, late neonatal, and postneonatal deaths for each year from 1975 to 1996 were obtained from the Office for National Statistics for babies born inside marriage, babies born outside marriage but jointly registered by both parents, and babies born outside marriage registered solely by the mother.

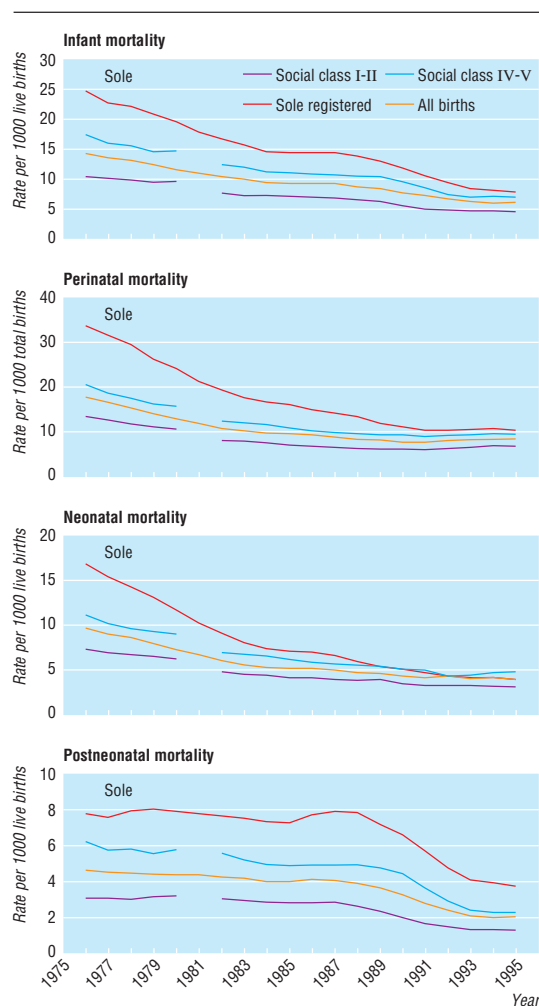
Since 1975 registrations of infant deaths in England and Wales have been linked to birth records; a high linkage rate of over 98% has been achieved in each year.⁶ This linkage means that the more detailed information collected at birth on a range of sociodemographic factors can be used in the analyses of deaths.

Sole registrations: are they the babies of lone mothers?

We assumed that the category containing births outside marriage registered solely by the mother consists largely of the babies of lone mothers on the basis of knowledge of registration procedures and data processing by the Office for National Statistics.

Registration of births is a legal requirement. A baby born to a married couple may be registered by either parent, with both the baby's father and mother entered into the record. For births outside marriage, there are provisions for fathers who wish to register their child jointly with the mother, provided the mother is a party to the registration. Special arrangements can be made by the mother for joint registration outside marriage if the father is absent at the time of registration. These provisions are widely taken up: in 1995, 78% of births outside marriage were registered by both parents, and nearly three quarters of these births were registered by parents living at the same address, presumed to be cohabiting.⁸

For the quarter of joint registrations outside marriage in which the parents were living at different addresses a proportion probably relate to the babies of lone mothers, not cohabiting with a partner, but we have no way of differentiating these births. On the other hand, because the option of joint registration is widely available and used it is unlikely that the sole registration category contains more than a small proportion of couple parents who wished but failed to make a joint registration.



Infant mortality, England and Wales, 1975-96 (3 year moving averages). Registrar general's social class I-II: professional, managerial, and technical occupations; IV-V: partly skilled and unskilled occupations; sole registered: babies whose birth is registered solely by the mother; all births: all births, regardless of type of registration. Data for social class for 1981 are not available because of industrial action by registrars in that year

For births inside marriage and those outside marriage jointly registered by both parents the Office for National Statistics assigns a social class to a 10% sample of records (about 58 000 records each year) on the basis of the occupation of the father stated on the birth record.⁷ Even births to fathers who were currently unemployed could be assigned a social class if the father gave details of his last main occupation. All the social class analyses are based on this 10% sample of coded records.

Data relating to births outside marriage registered solely by the mother were placed in a separate category, which we believe consists largely of the babies of lone mothers and is the best proxy available from the readily published national statistics (see box).

Mortality for various ages within infancy was calculated from 1975 to 1996 for the babies solely registered by the mother and for each social class. Data for births inside marriage were combined with those outside marriage jointly registered by both parents—the combination referred to here as “couple registrations”

Table 1 Trends in infant mortality (95% confidence interval) for sole and couple registrations, England and Wales, 1975 to 1996

| Year | Sole registrations | Couple registrations | Excess mortality sole/couple (%) |
|--|---------------------|----------------------|----------------------------------|
| Perinatal mortality/1000 total births | | | |
| 1975-7 | 34.2 (33.0 to 35.5) | 17.2 (17.0 to 17.3) | 100 |
| 1982-4 | 17.8 (17.1 to 18.6) | 10.1 (9.9 to 10.2) | 77 |
| 1989-91 | 11.5 (11.0 to 12.0) | 7.8 (7.7 to 7.9) | 47 |
| 1994-6 | 10.6 (10.1 to 11.1) | 8.6 (8.4 to 8.7) | 24 |
| Neonatal mortality/1000 live births | | | |
| 1975-7 | 17.1 (16.2 to 18.0) | 9.5 (9.3 to 9.6) | 81 |
| 1982-4 | 8.2 (7.6 to 8.7) | 5.7 (5.6 to 5.8) | 43 |
| 1989-91 | 5.3 (4.9 to 5.6) | 4.4 (4.3 to 4.5) | 19 |
| 1994-6 | 4.2 (3.8 to 4.5) | 4.1 (4.0 to 4.1) | 2 |
| Postneonatal mortality/1000 live births | | | |
| 1975-7 | 7.6 (7.1 to 8.3) | 4.4 (4.3 to 4.5) | 74 |
| 1982-4 | 7.5 (7.0 to 8.0) | 3.9 (3.8 to 4.0) | 91 |
| 1989-91 | 6.6 (6.2 to 7.0) | 3.0 (2.9 to 3.0) | 123 |
| 1994-6 | 3.7 (3.4 to 4.0) | 1.8 (1.7 to 1.9) | 103 |
| Overall infant mortality/1000 live births | | | |
| 1975-7 | 24.7 (23.7 to 25.9) | 13.9 (13.7 to 14.0) | 79 |
| 1982-4 | 15.7 (14.9 to 16.4) | 9.6 (9.5 to 9.7) | 63 |
| 1989-91 | 11.9 (11.3 to 12.4) | 7.4 (7.3 to 7.5) | 61 |
| 1994-6 | 7.8 (7.4 to 8.3) | 5.9 (5.8 to 6.0) | 33 |

Perinatal refers to age under 7 days, neonatal to age under 28 days, postneonatal to age 28 days and over but under 1 year, infant to age under 1 year.

Table 2 Trends in infant mortality rates (95% confidence interval) for couple registrations by father's social class England and Wales, 1975 to 1996

| Year | Class I-II | Class IV-V | Excess mortality classes IV-V over I-II (%) |
|--|---------------------|---------------------|---|
| Perinatal mortality/1000 total births | | | |
| 1975-7 | 13.8 (13.4 to 14.1) | 20.6 (20.1 to 21.0) | 50 |
| 1982-4 | 8.2 (8.0 to 8.5) | 12.4 (12.1 to 12.8) | 51 |
| 1989-91 | 6.5 (6.3 to 6.7) | 9.5 (9.2 to 9.8) | 47 |
| 1994-6 | 7.2 (7.0 to 7.4) | 10.2 (9.9 to 10.5) | 41 |
| Neonatal mortality/1000 live births | | | |
| 1975-7 | 7.6 (7.4 to 7.9) | 11.3 (11.0 to 11.7) | 48 |
| 1982-4 | 4.7 (4.5 to 4.8) | 7.0 (6.7 to 7.3) | 50 |
| 1989-91 | 3.7 (3.6 to 3.9) | 5.2 (5.0 to 5.5) | 40 |
| 1994-6 | 3.4 (3.2 to 3.5) | 4.8 (4.6 to 5.0) | 42 |
| Postneonatal mortality/1000 live births | | | |
| 1975-7 | 3.0 (2.8 to 3.2) | 6.1 (5.9 to 6.4) | 105 |
| 1982-4 | 2.9 (2.8 to 3.1) | 5.2 (5.0 to 5.4) | 78 |
| 1989-91 | 2.0 (1.9 to 2.1) | 4.3 (4.1 to 4.6) | 118 |
| 1994-6 | 1.3 (1.2 to 1.4) | 2.2 (2.1 to 2.4) | 78 |
| Overall infant mortality/1000 live births | | | |
| 1975-7 | 10.6 (10.3 to 10.9) | 17.5 (17.0 to 17.9) | 64 |
| 1982-4 | 7.6 (7.3 to 7.8) | 12.2 (11.8 to 12.5) | 61 |
| 1989-91 | 5.7 (5.5 to 5.9) | 9.6 (9.3 to 9.9) | 67 |
| 1994-6 | 4.6 (4.4 to 4.8) | 7.0 (6.8 to 7.3) | 52 |

Perinatal refers to age under 7 days, neonatal to age under 28 days, postneonatal to age 28 days and over but under 1 year, infant to age under 1 year.

or "couple parents." Data for social class I (registrar general's system) were combined with class II and those for class IV with class V to increase the numbers in the analysis and thereby the robustness of the calculated rates. Three year moving averages were calculated for the same reason. Confidence intervals around the mortalities were calculated by the methods of Breslow and Day.⁹

Results

The figure shows that the trends varied for each stage of infancy and by social grouping. At the beginning of the period mortality was highest for the babies of lone mothers followed by a gradient from classes IV-V

down to classes I-II with the lowest mortality. The most obvious changes occurred in relation to babies of lone mothers compared with those of couple parents. Infant mortality fell steadily for the sole registration category until 1984 and remained stable until 1989, when the decline resumed. During that time there was a distinct narrowing of the differential between the sole and couple registrations. In the mid-1970s infant mortality was 79% higher in the sole registrations compared with the couple registrations, and by 1996 this had reduced to a 33% excess (table 1). The confidence intervals show that the decreases in mortality over time in the various stages of infancy were all significant for both sole and couple registrations. It should be noted that there was a significant rise in perinatal mortality in couple registrations from 1989-91 to 1994-6.

Most of the narrowing resulted from greater improvements in mortality of solely registered births in the perinatal and neonatal periods from the mid-1970s and throughout the 1980s. By 1994-6 the difference between mortality in sole registered and couple registered babies in the neonatal period was no longer significant (table 1). This contrasted with the pattern of postneonatal mortality seen in the figure, for which there was little improvement in mortality for the couple registrations from 1975 to 1989 and a rise in mortality for sole registrations from 1985 to 1989. The postneonatal mortality differential between sole and couple registrations has been large and has shown no tendency to narrow; if anything it has widened over the 21 year period (table 1).

The figure also shows a different pattern for mortality in social classes I-II to IV-V. Although infant mortality declined in each social class, there has been a little narrowing of the differential between IV-V and I-II. In 1975-7 infant mortality was 64% higher in classes IV-V, since when it has fluctuated, but was still 52% higher in 1996 (table 2). What is striking, however, is the clear reduction in the differential to a negligible level between the infant mortality of the solely registered group and that of classes IV-V (tables 1 and 2).

The figure and table 2 show that the differential between social classes is larger in the postneonatal period than in the perinatal period (an excess in classes IV-V over I-II of 78% and 41%, respectively).

Infant mortality in the "other" category (couple registrations unclassified by social class) followed a similar pattern, with the rate more than halving from 1975 to 1996, decreasing from 26 per 1000 to 10 per 1000. The rate for this category still remains higher than for any of the social classes or for the solely registered (data not shown).

Discussion

This analysis shows an improvement in mortality in babies registered solely by their mothers. In absolute terms, infant mortality for this group has declined to a third of its 1975 level. In addition, the mortality of babies in this group relative to other groups has fallen. Although infant mortality is still 33% higher than for couple registrations, the gap has reduced from an excess of 79%. Furthermore, there is now little difference between the death rates of solely registered babies and those of classes IV-V, in contrast with the findings of studies in the 1970s¹⁰ and the 1980s.¹¹ It is

noteworthy that much of this improvement for the solely registered babies up until 1990 was in relation to the perinatal and neonatal periods rather than for postneonatal mortality.

For each social class infant mortality has more than halved since 1975, but the gap between the top and bottom of the social scale has shown little narrowing. As with sole registrations the differential between classes IV-V and I-II is smallest in the neonatal and largest in the postneonatal period.

Limitations

We have not been able to identify all the babies of lone mothers. Although we are confident that the solely registered births are predominantly those to lone mothers, some babies of lone mothers may also be included in the joint registration category, and these cannot be identified separately from published sources. There is no reason to believe, however, that this form of misclassification has changed over the study period in a way which would affect the interpretation of trends. Secondly, the status of the baby at death may be different to that at birth—for example, if the lone mother has since married. This is unlikely to be an issue for most deaths that take place in the relatively short neonatal period (within 1 month of birth).

A narrowing gap

The findings of this study raise two major issues. First, they show a positive reduction in social inequalities in health because of a greater improvement in infant mortality in solely registered births compared with other groups. This is in clear contrast with the trends for adults. The finding that there can be improvements, or at least a standstill, in the differential at the youngest ages may provide important new clues about tackling health inequalities. There is a need to look more closely at what the underlying determinants of the observed improvements are.

We tested the possibility that shifts in the demographic characteristics of lone mothers, such as their age distribution,^{12 13} could account for the improvement¹⁴ and could show that there were similar shifts in the age distribution of the two groups, with the average age of motherhood increasing for both sole and couple mothers over the period but at the same rate.

The role of health care

Secondly, and linked to the first issue, the timing of the improvements—largely confined to the perinatal and neonatal stages of infancy—focuses attention on the part played by maternal and neonatal health care in reducing these specific differentials. Mortality in these early stages of infancy is especially sensitive to the quality of care given to the mother and baby.¹⁵ Over the past 10 years deaths from congenital malformation have fallen by 50%, probably related to improved prenatal diagnosis with a combination of preregistration abortion and improved survival after treatment.¹⁶ Our results raise the possibility that these improvements in diagnosis and treatment have been particularly beneficial for the babies of lone mothers or that their access to the relevant services has improved, or both.

Key messages

- Social inequalities in infant mortality are widely regarded as unacceptable and as a spur to action
- Babies of lone mothers and those born to couple parents in manual social classes continue to be at higher risk of infant mortality
- From 1975 to 1996 the differential in infant mortality between social classes for babies of couple parents showed little tendency to narrow, whereas there was a clear improvement in the mortality differential between the babies of lone and couple parents
- The pattern of reduction in the lone-couple differential—confined to the neonatal period—suggests that healthcare factors may have made a major contribution to the observed improvement
- In contrast, the lack of improvement of the differentials in postneonatal mortality add to the concern that insufficient progress is being made in this critical period of babies' lives with the groups at greatest risk

Conclusions

Conversely, postneonatal mortality is thought to be influenced to a much greater extent by parents' socio-economic circumstances, reflected in the causes of death.^{17 18}

Our findings of a lack of improvement in the differentials in postneonatal mortality between lone mothers and couple parents and between more and less disadvantaged social classes add to the concern that insufficient progress is being made with the groups at greatest risk. The lack of improvement is also in line with the trends we have found elsewhere³ in the material disadvantage of lone mothers and less skilled social classes, for many of whom conditions deteriorated during the 1980s and 1990s. The research highlights the need for lone and unsupported mothers to be given every possible assistance after the birth of their babies, not just in the neonatal period, but on a sustained basis.

We thank Jeremy Schuman, Office for National Statistics, for help in extracting the data on deaths.

Contributors: MW and FD jointly developed the idea for this study and worked on its design. FD carried out the statistical analysis, while MW took responsibility for reviewing the literature. They both then participated in the interpretation of the results and the writing of the paper.

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Competing interests: None declared.

- 1 Babb P, Bethune A. Trends in births outside marriage. *Popul Trends* 1995;81:17-22.
- 2 Bradshaw J. International comparisons of support for lone parents. In: Ford R, Millar J, eds. *Private lives and public responses: lone motherhood and future policy in the UK*. London: Policy Studies Institute, 1998.
- 3 Shouls S, Whitehead M, Burström B, Diderichsen F. Trends in the health and socio-economic circumstances of British lone mothers over the last two decades. *Popul Trends* 1999;95:5-10. (16 March.)
- 4 Roberts I, Pless B. Social policy as a cause of childhood accidents: the children of lone mothers. *BMJ* 1995;311:925-8.
- 5 Wadsworth J, Burnell I, Taylor B, Butler N. Family type and accidents in preschool children. *J Epidemiol Community Health* 1983;37:100-4.
- 6 Office for National Statistics. *Mortality statistics: childhood, infant and perinatal, England and Wales, 1996*. London: Stationery Office, 1998. (Series DH3 No 29.)

- 7 Office of Population Censuses and Surveys. *Standard occupational classification*. Vol 3. London: HMSO, 1991.
- 8 Office for National Statistics. *Birth statistics 1995*. London: Stationery Office, 1997. (FMI Series No 27.)
- 9 Breslow N, Day N. The standard mortality ratio. In: Sen P, ed. *Biostatistics: statistics in biomedical public health and environmental science*. New York: Elsevier, 1985.
- 10 Macfarlane A, Mugford M. *Birth counts: statistics of pregnancy and childbirth*. London: HMSO, 1980.
- 11 Leon DA, Vägerö D, Olausson OP. Social class differences in infant mortality in Sweden: a comparison with England and Wales. *BMJ* 1992;305:687-91.
- 12 Office of Population Censuses and Surveys. *Birth statistics. Historical 1837-1983*. London: HMSO, 1987. (FMI Series No 13.)
- 13 Office for National Statistics. *Birth statistics 1996*. London: Stationery Office, 1998. (FMI Series No 25.)
- 14 Howell D. *Statistical methods for psychology*. 2nd ed. Boston: Duxbury Press, 1982.
- 15 Spencer N. *Poverty and child health*. Oxford: Radcliffe Medical Press, 1996.
- 16 Confidential Enquiry into Stillbirths and Deaths in Infancy (CESDI). *4th Annual Report, 1 January-31 December 1995*. London: Department of Health, 1997.
- 17 Pharoah POD, Macfarlane A. Recent trends in postneonatal mortality. In: *Studies in sudden infant deaths*. London: HMSO, 1982. (Studies in medical and population subjects No 45.)
- 18 Pharoah POD, Alberman E. Annual statistical review. *Arch Dis Child* 1990;65:147-51. (Accepted 15 December 1998)

Short version 2

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may be more a reflection of healthcare factors than of factors associated with lone mothers' social and economic circumstances.

Introduction

Infant mortality is an important indicator of a population's health, and any social differentials in this indicator are regarded as unacceptable. The traditional way of analysing social trends in infant mortality has, however, become increasingly problematic: growing numbers of infants are excluded from such an analysis, not least the babies of lone mothers. The size of this potentially vulnerable group has increased from 5% of births in 1975 to 8% in 1996. In Britain a high proportion of lone mothers live in poverty,^{1 2} and their children face socioeconomic disadvantage and have higher risks of health problems such as accidents and infections.^{3 4}

We analysed trends in mortality in babies of lone mothers and compared these with mortality trends in babies of couple parents from different social classes, whether married or not.

Methods

The numbers of live births, stillbirths, and early neonatal, late neonatal, and postneonatal deaths for each year from 1975 to 1996 were obtained from the Office for National Statistics for babies born inside marriage, babies born outside marriage but jointly registered by both parents, and babies born outside marriage registered solely by the mother.

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