

# Proximity to maternity services and stillbirth risk

Louise Parker, Heather O Dickinson, Tony Morton-Jones

## Abstract

**A study of all 77 995 live births and 1234 stillbirths to mothers living in West Cumbria from 1950 to 1989 found no significant increase in stillbirth risk with distance of mother's residence from the first or second nearest maternity services, after allowing for year of birth, father's social class, and birth order.**

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It is known that, in developing countries, distance from hospital is a major risk factor for both maternal and perinatal mortality.<sup>1</sup> However, even in England and Wales, residential proximity to hospitals can be an important determinant of health outcome as demonstrated by a recent study which showed an increasing risk of death from asthma with increasing distance from hospital.<sup>2</sup>

Cumbria is a predominantly rural county with several isolated settlements from which travel to hospitals, especially in the 1950s, would have been difficult and arduous. West Cumbria contains the Sellafield nuclear reprocessing plant and there has been public concern that it may have adverse effects on the health of those living in its vicinity. Dummer *et al*<sup>3</sup> investigated whether proximity to Sellafield increased the risk of stillbirth in the resident population, but found no evidence to support this. Nevertheless, after allowing for factors known to influence stillbirth rates, they found spatial heterogeneity in stillbirth risk in Cumbria, in particular an increased risk between 10 and 15 km north west of Sellafield during 1950-59.<sup>3</sup> The present study uses an additive isotonic regression model to investigate whether this geographical heterogeneity could be explained by an increase in risk of stillbirth with increasing distance of mother's residence from the first and second nearest maternity services within West Cumbria during 1950-89.

## Methods

### DATA

The area considered was West Cumbria. Details of singleton births between 1 January 1950 and 30 September 1989 to mothers domiciled in West Cumbria were extracted from a database of Cumbrian births.<sup>4</sup> The data comprised: stillbirth/live birth status, grid reference of the postcode of the mother's address, year of birth, occupational social class of the child's father, and birth order of the child within Cumbrian born children of the same father. Of the 79 229 births, 1234 were stillbirths. We were unable to obtain a grid ref-

erence for 0.7% of the births, and social class was not known for 0.3% of live births and 1.2% of stillbirths; these births were omitted from the study.

West Cumbria is a predominantly rural area, bounded by the sea on the west and mountains on the east, with most settlements situated on a coastal plain. Mothers in the area were referred to maternity services in three towns on the coast and to other services outside West Cumbria. Locations and time periods of operation of the 16 units offering maternity services to the population of West Cumbria over this period were ascertained. These comprised: four district general hospitals open during 1950-89, 1950-64, 1964-89, and 1984-89; three general hospitals open during 1958-80,

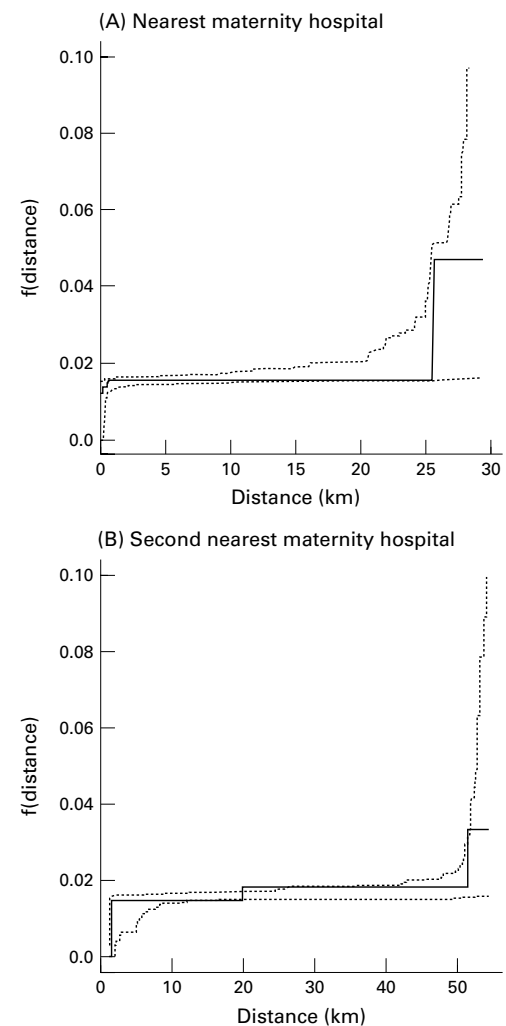


Figure 1 Isotonic regression functions (solid lines) and 95% tolerance bands (dotted line), adjusted for year of birth, social class, and birth order, showing probability of stillbirth by distance from (A) nearest and (B) second nearest maternity hospitals.

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1960–77, and 1974–84; three cottage hospitals open during 1950–89, 1950–64, and 1951–68; four maternity hospitals open during 1950–89, 1950–84, 1960–89, and 1974–89; and two maternity homes open during 1950–73 and 1950–68. The median distance of mother's domicile from a maternity unit was 6 km, 3 km, and 10 km during 1950–57, 1958–80, and 1981–89 respectively, while the range was 0–25 km in the earlier time periods and 0–29 km in the later time period.

#### ANALYSIS

The distances of the mother's residence from the first and second nearest maternity services were calculated from the grid references of postcodes of the mother's address and of the units open at the time of the birth. The effect of distance was modelled using isotonic regression while adjusting for other factors (year of birth, paternal social class, and birth order).<sup>5</sup> The isotonic model assumed that the risk of stillbirth did not decrease—that is, remained constant or increased—as the distance from the maternity services increased. Significance levels and tolerance bands were estimated by Monte Carlo simulation,<sup>5</sup> assigning the 1234 stillbirths at random to the 79 229 births and remodelling 100 times.

#### Results

The stillbirth rate fell significantly over the 40 year period of the study from 25 per 1000 births in the early 1950s to five per 1000 births in the late 1980s. The rate was significantly higher among less advantaged social classes, and it also varied significantly with birth order, the lowest risk being associated with second births.

Figure 1 shows the estimated isotonic functions that model the changing risk of stillbirth with distance from the nearest maternity services, together with 95% tolerance bands, adjusted for year of birth, social class, and birth order. These functions remained virtually flat, except at large distances (over 25 km) from hospitals, where there were few births, reflected in the wide tolerance bands. The overall test of the distance effects showed no significant increase in risk with increasing distance from either the first or second nearest maternity services ( $p = 0.85, 0.11$  respectively).

#### Discussion

The overall fall in stillbirth rate is similar to that seen in England and Wales over the same time

period, where rates fell from 23.0 per 1000 births in 1950 to 4.7 per 1000 births in 1989.<sup>6</sup> The rate in Cumbria has always been, and remains, slightly higher than that for the remainder of England and Wales. The increased risk we have observed with social class and the J shaped curve for risk with birth order are again consistent with other studies.<sup>6</sup>

Although births in the 1980s tended to be at greater distances from maternity services than earlier births, as the result of the closure of small local maternity units, our results will be heavily influenced by the earlier decades of the study when the stillbirth rate was higher. Furthermore, obstetric practice was different then, with less routine antenatal care, a high proportion of home deliveries, and many deliveries in maternity units lacking consultant obstetric involvement. Nevertheless, they provide no evidence that living further from maternity services increased the risk of stillbirth. Thus the heterogeneity in stillbirth risk in Cumbria<sup>3</sup> cannot be accounted for by differences in ease of access to both routine and emergency antenatal care as measured by distance from maternity services, nor can it be an explanation for the slightly higher rate of stillbirth in Cumbria relative to the remainder of England and Wales.

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