Social Science & Medicine 201 (2018) 35–43

Contents lists available at ScienceDirect

Social Science & Medicine

journal homepage: www.elsevier.com/locate/socscimed

Medical provision and urban-rural differences in maternal mortality in late nineteenth century Scotland

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ARTICLE INFO

Keywords:
Scotland
Maternal mortality
Doctors
19th century
Certification of death
Under-recording
Obstetric transition

ABSTRACT

This paper examines the effect of variable reporting and coding practices on the measurement of maternal mortality in urban and rural Scotland, 1861–1901, using recorded causes of death and women who died within six weeks of childbirth. This setting provides data (n = 604 maternal deaths) to compare maternal mortality identified by cause of death with maternal mortality identified by record linkage and to contrast urban and rural settings with different certification practices. We find that underreporting was most significant for indirect causes, and that indirect causes accounted for a high proportion of maternal mortality where the infectious disease load was high. However, distinguishing between indirect and direct maternal mortality can be problematic even where cause of death reporting appears accurate. Paradoxically, underreporting of maternal deaths was higher in urban areas where deaths were routinely certified by doctors, and we argue that where there are significant differences in medical provision and reported deaths, differences in maternal mortality may reflect certification practices as much as true differences. Better health services might therefore give the impression that maternal mortality was lower than it actually was. We end with reflections on the interpretation of maternal mortality statistics and implications for the concept of the obstetric transition.

1. Introduction

After centuries of relative stability, almost all demographic regimes have undergone major changes in the last 150 years. The nearly universal fall from high and fluctuating birth and death rates to low rates of both has been designated as the demographic transition (Notestein, 1945). Relatedly, the epidemiologic transition describes a change in the balance of causes of death as mortality falls, from a dominance of infectious disease when mortality is high to a dominance of chronic and non-communicable diseases when mortality is low (Omran, 1971). Other transitions have also been proposed, including the health transition (Frenk et al., 1991), the nutritional transition (Popkin, 1993) and the obstetric transition (Souza et al., 2014). The obstetric transition describes the changes that take place as maternal mortality declines, encapsulating a shift in the balance of maternal mortality away from direct obstetric causes (due to the process of birth itself) towards indirect causes (due to deaths from other causes which are aggravated by the physiological effects of pregnancy or childbirth) (Souza et al., 2014). Like the demographic and epidemiological transition models, the obstetric transition is formed of several stages, and it is only in the fourth stage, when maternal mortality ratios have fallen to less than 50 maternal deaths per 10,000 live births, that indirect causes dominate. At this stage, indirect causes will be particularly due to non-communicable diseases. This conceptualization of the transition implicitly assumes, however, that the available statistics on maternal mortality over time and across space are complete and comparable. This assumption can be questioned as maternal mortality statistics are known to be subject to considerable underestimation, even in countries with complete vital registration systems and procedures in place to ensure high quality recording (Salanave et al., 1999; Gissler et al., 2004; Knight et al., 2016). Underestimation may be even more extreme in places without complete registration, but the sorts of double checks and detailed enquiries which can measure underestimation are often lacking (Songane and Bergström, 2002; Ronsmans and Graham, 2006'). Data collection, recording and coding practices are credited with variation in the degree of underestimation, but studies using recent data which have attempted to evaluate the effect of different ways of measuring maternal mortality on underestimation have been hindered by the fact that 'the different definitions invariably group countries according to their development status' (Betrán et al., 2005) and thus it is difficult to disentangle the degree of underreporting from real differences in maternal mortality. In a comparative historic context, different classification

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https://doi.org/10.1016/j.socscimed.2018.01.028
Received 4 August 2017; Received in revised form 7 December 2017; Accepted 22 January 2018

systems, including successive revisions of the International Classification of Diseases, have treated certain types of maternal death very differently, making comparisons between countries and over time problematic.

This paper examines the effect of variable reporting and coding practices on the measurement of maternal mortality in late nineteenth century Scotland, using recorded causes of death and women who died within six weeks of childbirth. This relatively high mortality setting provides data to compare different ways of measuring maternal mortality and to contrast urban and rural settings with different certification practices. We find that underreporting was most significant for indirect causes, and that indirect causes accounted for a high proportion of maternal mortality where the infectious disease load was high. However, distinguishing between indirect and direct maternal mortality can be problematic even where cause of death reporting appears accurate. Paradoxically, underreporting of maternal deaths was higher in urban areas where deaths were routinely certified by doctors, and we argue that where there are significant differences in medical provision and who reports a death, differences in maternal mortality may reflect certification practices as much as true differences. Better health services might therefore produce an illusion of low maternal mortality, rather than actually producing better maternal outcomes. We end the paper with reflections on the interpretation of maternal mortality statistics and implications for the concept of the obstetric transition.

2. Levels, trends and measurement of maternal mortality

Maternal death is the death of a woman while pregnant or within a certain number of days of the termination of a pregnancy from any cause related to or aggravated by the pregnancy or its management but not from accidental or incidental causes. It can be divided into direct mortality, which arises directly from the pregnancy (for example postpartum haemorrhage, puerperal eclampsia, and puerperal fever), and indirect mortality, which is from non-pregnancy related causes which become aggravated by the pregnancy (for example an expectant mother may be more likely to catch and die from influenza). Maternal mortality can be estimated using a variety of different methods and definitions (Betrán et al. 2005). Places with reliable registration systems generally use cause of death information, while places and eras without good registration systems are more likely to rely on sample populations to identify deaths within a certain time since the birth of a child.

Studies of historic maternal mortality in the UK can be divided into two periods dominated by these different recording methods based on type of source (Galley and Reid, 2014). The earliest estimates of maternal mortality in the UK refer to the late sixteenth century and are based on the numbers of women dying within 60 days of a live birth, identified by linking the births and deaths within parish registers (Dobbie, 1982; Schofield, 1986; Wrigley et al., 1997). Despite being based on samples of places and subject to adjustments for background mortality and women dying without having delivered a live birth, these estimates generally match well with contemporary estimates obtained from reports of causes of death in the form of the London Bills of Mortality (Woods and Galley, 2014, p.21-3). Estimates from parish registers for the early nineteenth century also match well with those obtained from causes of death on the newly introduced death registers in the mid-nineteenth century lending confidence to the estimates (Woods and Galley, 2014, p.21-3). In the UK maternal mortality peaked in the late seventeenth century, at a time when all-cause mortality was also high, and declined gradually from then until the early nineteenth century when it stagnated at levels of about 55 maternal deaths per 10,000 live births until major declines in the 1930s and 40s.

The literature on maternal mortality in historic Europe and North America concentrates on midwifery and obstetric care, maternal nutrition and disease loads as factors behind differing levels and trends. The development of sulphonamides and antibiotics has been credited with the rapid decline in maternal mortality which started in the 1930s (Loudon, 1987, 1992), but improvements in midwifery and obstetric care have also been linked to better maternal survival in parts of nineteenth and twentieth century Europe (Loudon, 1997; Högberg, 2004; Curtis, 2005; De Brouwere, 2007). Woods and Shelton (1997) suggested that registration practices might affect geographical patterns and it is this aspect of maternal mortality, the measurement and recording of it, on which this paper concentrates.

2.1. Measuring maternal mortality from causes of death

Although the identification of women dying in childbirth using cause of death might seem straightforward, it is in fact fraught with difficulty. Even in countries where most, if not all, deaths are certified by a medical professional, it is estimated that between 25 and 70 percent of maternal deaths are misreported (British Medical Bulletin 2003, p.2). The problem may have been much greater during the nineteenth century when the accuracy of cause of death recording in general was hampered by the pitfalls of rapid advances in medical knowledge and ideas about disease causation, changing nosologies, a lack of clarity in cause of death reporting, and relatively high levels of deaths which were not medically certified (Alter and Carmichael, 1996, 1998; Williams, 1996; Risse, 1997, 1999; Kunitz, 1999; Anderton and Leonard, 2004; Reid and Garrett, 2012; Reid et al., 2015). There were additional problems with the recording of maternal death, however. It was felt that doctors might be averse to confessing that they had attended a maternal death - because it might suggest incompetence to potential clients - and that they would be tempted to 'hide' the death by ascribing a different cause - usually one which might be at least partially correct but omitted to mention the crucial detail of a recent childbirth. Examples might include ascribing a death to 'haemorrhage' or 'peritonitis', rather than 'post-natal haemorrhage' or 'puerperal peritonitis'. In 1881 the Registrar General of England and Wales started to conduct special follow-up investigations, whereby individual doctors registering deaths were contacted and asked to provide more information about particular instances. These enquiries revealed a considerable number of maternal deaths which had been originally undetected, although it is likely that not all under-reporting was exposed (Loudon, 1992). Even when doctors did mention childbirth on the death certificates, these were not always allocated to maternal death categories in local and national statistics. Deaths were supposed to be coded to the antecedent cause (e.g., in the case of pneumonia following measles, measles is the antecedent cause as pneumonia is a complication - a direct consequence of having contracted measles), but researchers have noted that this was not always done systematically or accurately (Williams, 1996; Kippen, 2005; Reid et al., 2015).

Indirect causes of death are particularly problematic. This category contains deaths precipitated by a non-childbirth related cause which might not have occurred at all had the woman not been pregnant or recently delivered, their risk being increased by a pregnancy-related immunological transformation which increases vulnerability to a range of infectious diseases (Weinberg, 1984; Schofield, 1986; Reid, 2005; Racicot et al., 2014). Such deaths include causes such as ‘heart disease following childbirth’ or ‘tuberculosis exacerbated by childbirth’. The international cause of death coding system used today, ICD10, contains codes for such deaths and many death certificates now have a box to indicate if the deceased was pregnant or recently delivered. However, this was not the case for early versions of the ICD and its country-specific precursors, or for historic death certificates. In the past, doctors concentrating on the immediate cause of death and not realizing the contribution of the parturient state, might have failed to mention pregnancy or childbirth.

Again, coding issues may be particularly important for indirect causes. Although today such deaths are routinely included in maternal mortality, in the mid-nineteenth century opinion varied as to whether they should be counted in maternal deaths. The argument for including them was based on the fact that some women would not have died had