How Can a Combination of Historical Demography and Prosopographical Methods Aid the Understanding of Causes of Death? An Illustration Using Maternal Mortality as an Example

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To cite this article: Reid, A., & Garrett, E. (2025). How Can a Combination of Historical Demography and Prosopographical Methods Aid the Understanding of Causes of Death? An Illustration Using Maternal Mortality as an Example. *Historical Life Course Studies, 15*, 75–84. https://doi.org/10.51964/hlcs23197

HISTORICAL LIFE COURSE STUDIES

Histories of Health

VOLUME 15, SPECIAL ISSUE 7

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HISTORICAL LIFE COURSE STUDIES
VOLUME 15 (2025), 75–84, published 29-08-2025

How Can a Combination of Historical Demography and Prosopographical Methods Aid the Understanding of Causes of Death?

An Illustration Using Maternal Mortality as an Example

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ABSTRACT

The growing availability of individual-level historic cause of death data is allowing increased insight into the construction of official mortality statistics, the role of changing medical provision and knowledge, and the practices of individual medical practitioners. Even the most detailed demographic data can shed little light on the particular choices that doctors made, however. We argue that a mixed methods approach, combining demographic and prosopographical approaches, can help to resolve such questions. We illustrate this using a particular conundrum relating to cause of death recording: why doctors "hid" deaths in childbirth by allocating them to causes which cannot be assumed to be maternal mortality. Triangulating different types of evidence from different sources for a particular, but fairly typical, Scottish doctor in the mid-19th century, we argue that doctors were unlikely to have deliberately obscured the maternal nature of deaths. The evidence suggests that they were more likely to have failed to realise that although they knew a woman had recently delivered, this fact was not indicated in the death register and thus the causes of death they offered could often not be identified as maternal mortality.

Keywords: Maternal mortality, Doctors, Cause of death, Civil registration, Prosopography, Scotland

e-ISSN: 2352-6343
DOI article: https://doi.org/10.51964/hlcs23197

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1 INTRODUCTION

This contribution brings together two of Angelique Janssens's academic interests — the understanding of causes of deaths — in particular the factors influencing what is written on death certificates (Janssens & Devos, 2022), and maternal mortality — the deaths of mothers in childbirth (Janssens & van Dongen, 2017).

Questions about how the characteristics of mortality changed as it declined (in the epidemiologic and health transitions) and why it declined (as in the McKeown hypothesis) — all rely on recorded causes of death (Colgrove, 2002; Frenk et al., 1991; Omran, 1971). To date, most research on these topics has been based on the numbers of deaths in different cause of death categories summarised in official reports, but these are ultimately derived from the decisions that individual doctors (or other informants) made and recorded on cause of death certificates as part of the death registration process. The characteristics of doctors and the influences on their choices are therefore among the many aspects of cause of death recording which complicate the analysis of changes over time. As medical knowledge and access to medical care grew, and more guidance was given to doctors on how cause of death should be certified, there was a shift in recording from vague and symptomatic causes to precise disease descriptions and an increasing propensity to list more than one cause on a certificate. Over time, these changes contributed to shifts in the way diseases or conditions were grouped into categorisations or nosologies. It has also been suggested, however, that in an era when doctors needed to maintain a private clientele the semi-public nature of the death registration process encouraged them to avoid certain causes of death which might be embarrassing for the family (such as a sexually transmitted disease) or hint at incompetence on their part (such as death during childbirth).

The growing availability of individual level cause of death data allows a variety of ways to check the accuracy of certain causes of death recorded in tables of official statistics. Historical demographers have linked the deaths of women to their recent births, finding that many of the causes of death on the certificates of women who died shortly after childbirth did not allow the death to be placed in a maternal mortality category (Kippen, 2005; Reid & Garrett, 2018). Furthermore, this was a particular problem when causes of death were certified by doctors as opposed to reported to the registrar by a relative of the deceased, something not uncommon in populations who had limited access to medical help (Reid & Garrett, 2018). Loudon (1992, pp. 34–38) has suggested that doctors may have deliberately "hid" maternal deaths, for example reporting a death as due to 'haemorrhage' rather than 'ante-partum haemorrhage', or writing 'peritonitis' or 'fever' rather than 'puerperal fever'. How might we be able to tell whether this was actually the case?

One possibility is to check against other sources. "Triangulation" refers to the process of comparing different sources to verify a finding or interpretation, and can be used when comparing the same types of data (e.g. two quantitative sources, such as the birth and death registers of a community) or comparing quantitative with qualitative (e.g. comparing statistical rates with those suggested in a narrative account such as a diary or newspaper report and the way these were discussed). The use of mixed methods involves using insights from both qualitative and quantitative data to deepen the understanding of a phenomenon (Fielding, 2012).

The historical techniques of prosopography (narrative writings about individuals, or groups of individuals) and factoid prosopography, in which systematic information about a group of people is gathered into a database (Bradley & Short, 2005), can be used to provide both qualitative and quantitative data about doctors which can be combined with historical demographic data to shed light on the doctors' interests in childbirth and maternal mortality, opinions on different techniques, and even the maternal mortality rates in their own practices. On its own such information is unlikely to reveal any motivations for 'hiding' maternal deaths as other causes. When such factoid prosopographical databases are used in combination with demographic sources, however, it becomes possible to compare the recording of maternal mortality in both sets of data; a comparison which can shed light on why doctors might not have indicated a maternal cause for women dying as a result of childbirth. This paper illustrates such a comparison and argues that more use of mixed methods such as this has significant potential to further the understanding of causes of death.

2 DATA

The demographic data we use consists of a set of linked birth and death registers for the town of Kilmarnock, Scotland, between 1855–1901 (Reid et al., 2002). Maternal deaths were identified in the death register by a clear maternal cause, or though linkage to a birth up to six weeks previously (Reid & Garrett, 2018).

Each death in the Kilmarnock death register included the name of the doctor who certified the death, and these doctors were identified in the London and Provincial Medical Directories, which also covered Scotland, for the years 1855–1901 to generate our prosopographical database. Unlike the Medical Register (the official list of qualified and registered doctors), the Medical Directory relied on doctors returning an annual set of information.[1] In addition to their address, qualifications and positions held, doctors often included their contributions to journals, and we identified and downloaded those contributions by the doctors practicing in Kilmarnock that related to pregnancy, childbirth and delivery. Most of these relate to curious case studies, including two descriptions of introversion of the uterus (Arbuckle, 1885; Macleod, 1857), a possible case of superfoetation — the situation where a second conception takes place after a first has been established (Paxton, 1866), and contributions to a debate about whether reluctance to use forceps had allowed Queen Charlotte, the wife of King George III, to die in childbirth (McLeod, 1889). Most of the journal articles do not shed any light on maternal mortality or its recording, although they can be informative about doctors' obstetric practices and the type of details they recorded. They range from long and detailed contributions spanning tens of pages, to shorter notes such as the following communication entitled "Triplets":

> Dr David MacDonald (Walmer, Kilmarnock) writes: The following case may be of some interest as showing heredity. Mrs M., aged 38, gave birth to three girls on January 27th 1893. Labour began on the preceding evening about 8 p.m., and the first girl was born with the discharge of *liquor amnii*, with little pain, about 1.30 a.m. Pains were absent for about three hours. After the membranes were ruptured the second was born, about 5.30 a.m. Pains did not recur until about 6.15, when the membranes were ruptured and the third child was born at 6.30. The placenta was removed by hand at 7 a.m., after which the uterus was firmly contracted and small. The presentations were: First, head; second, cross, shoulder, changed to breech; third, breech. Placentae, three, partially joined. Large amount of *liquor amnii* from each sac. The children weighed 8lbs, 7.5lbs, and 7.5lbs respectively, and look healthy and fairly well developed and likely enough to live. The mother's history is that it is her ninth pregnancy (four alive and four dead); that she is herself a triplet; her sister died six years ago; her brother visited her a few days ago; (her mother died at the confinement); she was brought up by a foster mother. She did not expect her confinement until a month hence. (MacDonald, 1893)

Parts of this account can be double checked by cross-referencing the linked demographic records. Births for the three triplets were indeed registered, although with a birth date of January 26th rather than 27th. The doctor had been overly optimistic about their prospects for survival, as they were registered as dying on the 3rd, 8th and 12th of February respectively. He must have sent his letter to the *British Medical Journal* (BMJ) before the 3rd of February, as he certified the infants' causes of death himself: the first from 'asthenia' and the others from 'weakness from birth'.[2]

Other contributions allow a deeper insight, including two articles by Kilmarnock doctor John Thomson which presented statistics about complications and birth outcomes in his midwifery cases, illustrated with extensive commentary and quotes from his case notes. The first of these, published in 1855, was a statistical report about his 3,300 deliveries in the previous 15 years (Thomson, 1855). He followed this up with a further report in 1864, by which time his tally had risen to 5,000 cases (Thomson, 1864).[3]

1 If no return was received from a doctor, the information from the previous year's directory would be carried forward and marked with an asterisk.

2 The mother's history is less easy to verify. We can find the parents' marriage in December 1883 and one previous birth, as well as a possible birth to the mother prior to her marriage (October 1883), and a birth to the husband and his former wife in 1876. It is possible that some the mother's other pregnancies resulted in stillbirths or miscarriages and were therefore not recorded in the registers, or that they took place before marriage and/or outside Kilmarnock.

3 The titles of his articles refer to 3,300 and 5,000 cases respectively, but it is a little confusing as the texts also mentions "upwards of four thousand cases" and "six thousand" respectively. However it seems that the latter refer to the total cases he had ever witnessed, while statistics (and the titles) exclude those where he attended a case to aid another doctor (and possibly a period at the start of his career when he was training), and so does not have complete case notes.

Table 1 *Number of births with "complications" and maternal deaths out of Dr John Thomson's 5,000 maternal deliveries, by type of complication.*

Presentations	No. of cases	Maternal deaths	Stillborn
Breech	31		10
Face to pubes	51		
Face	9		
Shoulder	9	1	7
Placental	10	3	10
Forceps	104	2	3
Complicated with convulsions	8		6
Funis umbilicalis	7		4
Ovarian tumour	2		1
Footling	10		1
Contracted pelvis	3		2
Flooding	11	1	2
Puerperal fever	23	12	
Twin cases	41		
Stillborn*	102		102
Triplets	1		
Puerperal mania	3	2	
Perforator and crotchet	2		2
TOTAL		21	150
Number per 1,000 cases		4.2	30

Source: Thomson, 1864

*Notes: * We assume that stillbirths listed against other complications are not also listed in the stillbirth row. If they are then the stillbirth rate would be 20.4 per 1,000.*

In his first contribution, Thomson discussed the management of long labours, his approach to breech deliveries, placenta praevia and eclampsia, with detailed accounts including both happy and unhappy outcomes. In his second contribution he engaged in an extensive discussion of the relative merits and dangers of the long and short forceps. In both pieces he provided a table listing the number of different complications, together with the numbers of maternal deaths and stillbirths associated with each complication, he had encountered. The table from his second publication is reproduced as Table 1, with the addition of rows for the total numbers of maternal deaths and stillbirths, and their rates per 1,000 cases (assuming a denominator of 5,000).

3 DR THOMSON'S OBSTETRIC PRACTICE

What can we learn from Dr Thomson's statistics and discussions? First, we should consider his obstetric practice and experience. Midwifery was clearly a major part of John Thomson's general practice: his published papers suggest that he averaged 220 deliveries a year between 1840 and 1855, and 190 per year between 1855 and 1864 (an overall average of 208 per year), amounting to around four deliveries per week. This number would have been very high for a midwife in the late 19th or early 20th century — in 1915 Janet Lane-Claypon considered that 150 cases a year was 'as many as one midwife can reasonably undertake' (Lane-Claypon, 1915). Thomson's level of midwifery was clearly not unusual; in his contribution to the *BMJ* Donald McLeod, another Kilmarnock doctor, indicated that his annual average was around 175 deliveries a year over a 40 year career (McLeod, 1889). However, such doctors were unlikely to have been present for the whole of each labour. Dr Thomson's case reports indicate

that he was called at various stages during the labour to assess progress, and a monthly nurse or handy-woman may have provided continuity of care, possibly even delivering some of the uncomplicated births herself (Leap & Hunter, 1993). Nevertheless, doctors most likely attended all the complicated cases for which they were booked. Dr Thomson was also sometimes called in to assist births for which a midwife or another doctor had been booked, but his publications indicate that his statistics are "exclusive of all [he saw] in the practice of others" (Thomson, 1864, p. 27). The cases reported in Dr Thomson's publications were therefore probably a reasonably representative sample of confinements in Kilmarnock.

Thomson's articles indicate that his maternal mortality ratio was around 4.2 per thousand deliveries, a rate which was only a little under the average ratio for Scotland between 1855 and 1864; and his stillbirth rate was a bit lower than the estimated rate for England and Wales at a similar time.[4] Neither suggests he was likely to be systematically hiding or under-reporting results. In fact he might have had better outcomes than other birth attendants: his case reports suggest that he was a thoughtful practitioner, arguing against the sort of "meddlesome midwifery" which reportedly characterised some "male midwives" (Thomson, 1855, pp. 129, 135). While he congratulates himself on his success, this does not prevent him from admitting to mistakes: "In one or two cases, on looking back, I have to regret that the forceps were not used, instead of leaving them to the unaided efforts of nature" (Thomson, 1855, p. 135).

4 COMPARISON OF DR THOMSON'S MATERNAL MORTALITY BASED ON HIS ARTICLES AND HIS CERTIFIED CAUSES OF DEATH

Thomson's publications allow us not only to assess his self-reported outcomes in obstetric practice, but also to compare them against the way he certified maternal deaths, as recorded in the civil registers of death in Kilmarnock. Because our dataset starts in 1861, there is only a short overlap between Thomson's reported statistics and our own. We do not know how many of the births and deaths which contribute to the table in Thomson's *BMJ* article occurred between 1861 and 1865, but if his delivery rate and maternal mortality ratios were similar to his average rate between 1855 and 1864, we would expect to see him certify around seven maternal deaths in the registers. Thompson certified his last death in Kilmarnock in 1865, and although he certified 273 causes of death during the 1861–1865 period, none of them referred directly to maternal causes. However, linkage to the Kilmarnock birth registers shows that six of the deaths he certified were of women who had given birth in the six weeks before their demise, as detailed in Table 2. The causes that Dr Thomson assigned in these six cases all strongly suggest that the women died as a direct consequence of having given birth. The 'peritonitis' and 'fever' that killed four of them were almost certainly puerperal and the 'repeated haemorrhage' was also likely to have been linked to delivery. Dr Thomson could therefore be accused of having "hidden" these six deaths by ascribing them to causes which would not allow them to be classed as maternal deaths in the official statistics. The obvious question is why would he do this? Was it, as suggested by Loudon (1992, pp. 34–38), fear of losing business or professional prestige? The Scottish death registration system and the way he talks about his midwifery cases in print offer some answers.

Table 2 *Dr John Thomson's maternal deaths, 1861–1865*

Days since birth of child	Length of last illness	Original cause of death given by Thomson
3	5 & 4 days	diarrhoea, peritonitis
4	3 days	inflammation of bowels
5	3 days	peritonitis
8	7 days	peritonitis
9	2 days	fever
31	4 weeks	repeated haemorrhage

Source: Kilmarnock linked database

4 The maternal mortality ratio for 1855–1864 in Scotland was 4.8 per 1,000 births (Loudon, 1992, p. 546), and the stillbirth rate for England and Wales 1840–1859 was 41 per 1,000 (Woods, 2009, p. 96).

Was it likely that when certifying the deaths he was suppressing information in order to shield his reputation among potential clients? If this was the case, he would probably have been most anxious to conceal information about deaths from puerperal fever. Thomson's 1855 article discusses a local outbreak of cases of puerperal fever in 1848–1849, following an epidemic of erysipelas, a closely related infection also caused by the streptococcus bacterium, making it clear that doctors were aware of the possibility that they might transfer the infection between patients, probably influenced from Semmelweis's seminal publication on the matter in the previous year. Thomson writes "The boldest and best of our practitioners were panic-struck, and, afraid lest they themselves might be the means of carrying the contagion from patient to patient, in some cases sought to escape from the responsibility by refusing attendance altogether". Despite this, by far the most common cause of maternal death in Thomson's own statistical summary of his cases was puerperal fever — he clearly was not worried about admitting to it in print.

Thomson's reports were, however, published in the *British Medical Journal* (BMJ), aimed at a professional medical audience. It is possible that doctors happy to admit to puerperal fever deaths to an audience of their peers were still concerned about revealing such mortality to their existing or potential clientele. This was certainly considered to be a problem in England and Wales, where the process of death certification and registration involved the doctor filling in a cause of death certificate and handing it to a relative of the deceased, who was then responsible for handing it to the registrar when registering the death. A parliamentary enquiry in 1893 heard evidence that this meant that doctors south of the Scottish border were often reluctant to certify causes such as delirium tremens, syphilis, cancer, and suicide (Select Committee on Death Certification, 1893, p. xlii).

In Scotland, however, the system was different: the doctor independently delivered the medical certificate of cause of death direct to the registrar, who then copied the information into the register alongside the details of the deceased supplied by the next-of-kin or another informant. The next-of-kin did not see the official cause of death, leaving the possibility open for the doctor to verbally offer them a vaguer cause, while supplying the accurate cause on the cause of death certificate. Various witnesses to the parliamentary enquiry certainly felt that a move to this system in England and Wales was likely to improve the accuracy of cause of death recording (Select Committee on Death Certification, 1893, p. xlii). As Dr Thomson practiced in Scotland, he was therefore unlikely to have been concerned that he might incur reputational damage through his certification of a maternal death.

Table 3 *Certification of maternal deaths by individual doctors, Kilmarnock 1861–1901*

Forenames	Surname	Year of 1st qualification	First seen in K	Last seen in K	Direct maternal deaths		Puerperal fever	
					Number	% Allocated a maternal cause	Number	% Allocated a puerperal fever cause
Donald	Macleod	1850	1861	1901	27	74.1	20	75.0
Alexander	Marshall	1851	1861	1894	74	85.1	55	92.7
James	Rankin	1857*	1869	1901	24	66.7	12	41.7
James	McAlister	1858*	1866	1900	23	95.7	12	100.0
William	Frew	1872	1888	1901	15	86.7	12	83.3
John Christie	McVail	1873	1874	1891	14	100.0	9	100.0
Wm. Aitken	MacLeod	1881	1882	1897	26	34.6	24	33.3

Source: Kilmarnock linked database, Medical Directory

*Notes: * indicates a Licentiate of Midwifery qualification.*

Direct maternal deaths include deaths from puerperal fever.

Only doctors with at least 10 direct maternal deaths are shown.

Another possibility is that Dr Thomson wrote 'puerperal peritonitis' or some other cause which clearly specified the maternal nature of the death on the certificate, but the registrar did not transfer the full certified cause into the register. While this is a possibility, we would then expect clear patterns by registrar or by year (as there was only one registrar at any one time in Kilmarnock), but these are not visible in the data. Instead, the patterns by doctor are far clearer, as shown in Table 3 which provides the statistics for each of the seven doctors who certified at least 10 *direct* maternal deaths in Kilmarnock between 1861 and 1901, listed in order of the year of their first qualification.[5]

In contrast to John Thomson, some doctors made the maternal nature of the deaths they certified very clear — and this is reflected in the relevant entries in the death register. This was certainly the case for all the maternal deaths certified by John Christie McVail, and for all but one of those certified by James McAlister. Although he has too few deaths to appear in this table, John Thomson (present in Kilmarnock only at the start of the period) seems to have been the worst offender, but William Aitken MacLeod (present only at the end) was a close second, obscuring the nature of two-thirds of the maternal deaths he certified. With the variation seen, it is likely that the registrars were faithfully copying the information received on the medical certificates supplied by each doctor. There seems to have been little pattern in terms of cohort of doctor, whether or not they had a qualification in midwifery[6], or the probable size of their practice (based on the number of maternal deaths per year in Kilmarnock). It is likely that instead, how doctors recorded a death was an individual and personal matter, whether a death was maternal or due to another cause (for an analysis of deaths in old age, see Reid et al., 2015).

It seems probable then, that it was sloppy certification rather than deliberate obfuscation which prevented Thomson's maternal deaths from being classified as such. We suggest that he knew that the deaths from peritonitis and fever were puerperal, and that he was simply not being specific enough in the type of peritonitis or fever. Perhaps he failed to realise that there was no reason for the coding clerks to know that the death was maternal unless he made that clear as part of the cause of death (at that time there was no systematic way in the death register to indicate a recent delivery — this would be introduced later). Similarly, he probably did not realise that identifying a death as 'repeated haemorrhage' was not specific enough to allow maternal haemorrhage to be assumed. Thomson was undoubtedly not alone. The booklets of medical certificates of cause of death, issued to medical practitioners from the earliest days of civil registration in Scotland, contained "Suggestions for Medical Practitioners on death certification" which even in the first decades of the 20th century were still exhorting doctors to ensure that if "parturition or miscarriage [had] occurred in the month before the death of the patient, the fact should be certified…" and stating that deaths from "puerperal eclampsia or puerperal septicaemia should be so described, and not merely described as eclampsia or septicaemia", suggesting that the accuracy of some doctors' certificates was less than optimal.[7]

Of course the fact that doctors were careless in their cause of death recording does not mean they did not care deeply and carefully for their patients — but the process of inspecting the body and producing a certificate was regarded by some as "burdensome and unreasonable" and some doctors may have preferred to concentrate on caring for patients before death (Select Committee on Death Certification, 1893, p. xlii).

5 Direct maternal deaths arise as an immediate result of pregnancy or childbirth (for example pre- or post-partum haemorrhage, puerperal eclampsia, and puerperal fever). Indirect maternal deaths are due to 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). Indirect maternal deaths were much less likely to be allocated a maternal cause, but we do not show these here as there was less consensus at the time over what should be attributed to maternal mortality. See Reid and Garrett (2018) for details of the underreporting of indirect maternal mortality in Kilmarnock; Appendix A indicates levels for individual doctors.

6 It was not until the Medical Act of 1886 that all medical training had to include obstetrics, although the Medical Act of 1858 had made it possible and some medical schools had instituted compulsory obstetric training from even earlier dates, such as Edinburgh in 1833 (Reid, 2012).

7 The Suggestions were "prepared and issued by the Registrar General for Scotland"; they changed over time. Those quoted date from the 1910s. See National Records of Scotland GRO5/814 Registration Branch Files 1855–1944, pp. 46 and 50.

5 CONCLUSIONS

In this paper we have illustrated the ways in which a combination of historical demography and prosopographical sources and approaches can shed more light on aspects of the recording of maternal death, in ways that each source on its own cannot do.

As individual level cause of death data have become increasingly available to researchers much progress has been made in our understanding of cause of death statistics. In particular they have revealed the variations and changes in terminology within the apparently uniform and stable categories used in official statistics, and allowed changes in ways that the balance of causes shifted over time to be detailed (Janssens & Devos, 2022; Reid & Garrett, 2018; Reid et al., 2015; Revuelta-Eugercios et al., 2022). Working with individual level causes forces us to confront the messy and highly variable ways that causes of death were recorded by doctors — and lay people — and to consider the influences on the choice of words they made. Although comparisons with official statistics can point to ways in which one phrase became superseded by another as medical knowledge developed or fashions changed, some of the choices made by doctors remain clouded in mystery. Better understanding of registration practices and how doctors interacted with them to choose what cause to write on the certificate is necessary if we are to achieve greater understanding of the factors influencing the manifestation of causes of death in the official record and how we should interpret them.

In this paper, we advocate for a mixed method approach combining qualitative and quantitative elements. On their own, our demographic sources (cause of death records linked to births records) reveal that many doctors managed to obscure the maternal nature of deaths to women who had recently given birth, but cannot tell us why, so we are forced to speculate about whether or not this was deliberate.

Similarly, reading the opinions of doctors and examples of their case notes is fascinating, but can only take us so far, even when organised into a systematic factoid prosopographical database. In the case of John Thomson we would know that he was interested in obstetrics and difficult births, provided extensive details of particular cases, held strong opinions on a number of related matters, and was not unusual in these matters among his peers.

It is only combining the demographic and prosopographical sources — following Thomson's career and triangulating the cases he wrote up with the demographic records — which allows the mismatch between his writings and his recording to be revealed. The incorporation of qualitative evidence from the way he wrote about his cases and mistakes gives us insight into his recording practices, and offers plausible reasons for the mismatch. Given our findings, we argue that Thomson, and Scottish doctors in general, were unlikely to have been deliberately "hiding" maternal deaths within other cause categories.

Individual level causes of death are highly detailed but deeply complex. Trends over time and differences between places are affected not only by real differences in mortality from different conditions, but by medical provision, organisation and knowledge, and by registration and recording practices. Many cause of death registers include the names of the certifying doctor. Gathering these into a database and enriching with more qualitative sources such as the writings of medical practitioners can allow researchers to compare the recording practices of individual doctors with their views on particular diseases or conditions which may, in turn, suggest why they came to write the causes of death they reported on death certificates. We feel that the mixture of approaches in this methodology has considerable potential to enhance understanding of other causes of death, particularly those which may be under-recorded such as syphilis, cancer and suicide, and how they change over time and vary between places. In this way it offers a fruitful avenue towards a deeper understanding of historical cause of death statistics.

ACKNOWLEDGEMENTS

This work was funded by the ESRC (Determining the demography of Victorian Scotland through record linkage, PI Alice Reid, grant number RES-000-23-0128) and the Wellcome Trust (Doctors, deaths, diagnoses and data: a comparative study of the medical certification of cause of death in nineteenth-century Scotland, PI Richard Smith, grant number WT082200MA).

We wish to thank the General Registry Office for Scotland (GROS), now NRS, for special permission to transcribe the contents of the civil registers of the Isle of Skye and the town of Kilmarnock from 1855–1901, which was carried out under the Determining the Demography of Victorian Scotland grant.

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