Hidden Maternal Mortality? Under-Registration of Maternal Mortality in Maastricht, 1870–1910

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Hidden Maternal Mortality?

Under-Registration of Maternal Mortality in Maastricht, 1870–1910

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ABSTRACT

Maternal mortality rates in the 19th-century Netherlands were low compared to other European countries. But was this due to high-quality midwifery care or under-registration? This study examines maternal mortality registration in Maastricht by comparing data from 1870–1879 and 1900–1909 across three sources: municipal reports, individual-level causes of death from the Maastricht Death and Disease Database, and mortality rates based on women who were linked to births up to one year prior to their death. The results indicate under-registration of maternal mortality in the municipal reports. Half of the women who died within 42 days postpartum were recorded with causes unrelated to childbirth. In Maastricht, suspected cover-up causes like peritonitis and fever were not the most commonly used. Instead, tuberculosis, heart disease, and pneumonia were frequently recorded when pregnancy-related factors were omitted from the cause of death.

Keywords: Maternal mortality, Historical causes of death, 19th century

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1 INTRODUCTION

Today, the Netherlands are well-known for their exceptionally low maternal mortality rates compared to other high-income countries. With an average maternal death rate of 4 per 100,000 live births in the Netherlands in 2020, this is substantially lower than the average rate of 12 in other high-income countries (Kallianidis et al., 2022; World Bank Group, 2025). This modern-day phenomenon is also observed in the past, as the maternal mortality rates in the Netherlands were among the lowest in European countries in the late 19th century (Loudon, 1992, p. 449–452; Ory & van Poppel, 2013). The Dutch advantageous position has been linked to the widespread practise of giving birth at home and the high standard of midwifery care (Loudon, 1992; Ory & van Poppel, 2013; Shepherd et al., 2011). However, the estimation of historical maternal mortality is tricky, due to narrow definitions of maternal mortality and/or the intentionally or unintentionally obscuring of maternal deaths by contemporaries (Breathnach & Gurring, 2017; De Brouwere, 2007; Kippen, 2005; Loudon, 1992). The question remains if maternal mortality was registered with similar vigour across 19th-century Europe. Was Dutch maternal mortality truly low compared to other European countries or was the Dutch registration plagued disproportionally by accidental or even deliberate distortions?

Nowadays, maternal mortality is defined by the World Health Organization (WHO) as "The annual number of female deaths from any cause related to or aggravated by pregnancy or its management (excluding accidental or incidental causes) during pregnancy and childbirth or within 42 days of termination of pregnancy, irrespective of the duration and site of the pregnancy" (World Health Organization, 2025). These deaths can be divided into direct and indirect obstetric causes, where indirect maternal mortality is defined as "resulting from previous existing disease or disease that developed during pregnancy and not due to direct obstetric causes but were aggravated by the physiologic effects of pregnancy" (World Health Organization, 2025). Moreover, these indirect maternal deaths can occur, according to modern day definitions, up to one year after giving birth or experiencing pregnancy (World Health Organization, 2025).

In the past, no such standardized definition of maternal mortality existed. Loudon distinguished three categories of maternal mortality in historical registration. The first consists of the direct causes. These causes of death described maternal mortality rather straightforwardly, often directly mentioning the relation to pregnancy, childbirth, or the postpartum phase (Loudon, 1992, pp. 27–28, p. 35). However, other maternal mortality could remain unregistered because of the lack of a standardized definition. Thus, the other two categories Loudon identified refer to this under-registration of maternal mortality: hidden maternal deaths and associated maternal deaths.

Loudon suggests hidden maternal deaths are the causes where the recorded cause of death provides what actually led to death, but does not mention the childbirth factor, and thus uses the non-maternal equivalent of the cause of death (Loudon, 1992, p. 34). Common complications such as puerperal fever or peritonitis may have been registered without the specification of its occurrence after a birth or miscarriage, as simply fever or peritonitis, which could distort the estimations of total maternal mortality rates (Loudon, 1992, p. 35). These practices may have transpired due to an incentive for medical practitioners to hide maternal mortality. When their expertise was at stake and they were at risk of receiving the blame for maternal deaths, they may have felt the need to omit the childbirth factor from the registered cause of death.

The category of associated deaths contains causes that are not directly related to pregnancy and includes chronic illnesses such as heart disease, tuberculosis and nephritis (Kallianidis et al., 2022; Loudon, 1992, p. 28). These causes of death can be associated with childbirth due to the fact that women may have been weakened by the pregnancy or childbirth. As a result they no longer had the strength to fight the already existing disease. This category closely aligns with what is now referred to as indirect maternal mortality by the WHO (World Health Organization, 2025). In England and Wales, a separate category existed in the public reports for diseases as "not classified to pregnancy but returned as associated therewith" (Loudon, 1992, p. 30). The category of associated maternal mortality could have been quite extensive, as it has been estimated that one third of maternal deaths in Sweden was the result of a cause from this category (Högberg, 2004). In other countries, these associated deaths were often included in the total maternal mortality category, but the question still remains if *all* of these associated deaths indeed ended up to be counted as maternal deaths (Loudon, 1992, p. 30). Scalone (2014) contends that it is preferable to use time after birth to estimate maternal mortality, instead of causes of death, because these associated deaths remain unidentified when using the cause of death descriptions.

In this study, we aim to delve into the registration of maternal mortality in the late 19th and early 20th century with a case study on Maastricht. Individual-level data on this Dutch city allow for a close scrutinization of the registration practices concerning maternal deaths. Using these data, Murkens (2023) observed relatively few causes of death among adult women pertaining to childbirth, compared to other causes of death in Maastricht between 1864 and 1955. However, a closer examination showed that some women died shortly after giving birth, while their cause of death did not refer to maternal mortality at all. This indicates the presence of at least some associated maternal mortality in the Maastricht cause-of-death registration. In this study, different measures of maternal mortality in Maastricht will be examined during two sample periods (1870–1879 and 1900–1909) to shed light on the question if and to what extent associated and hidden maternal mortality could have distorted the estimations of maternal mortality rates in the Netherlands. We compare these two periods, as in the first period the existence of puerperal fever had not yet been fully accepted by the medical profession, but the professionalisation of obstetric care had taken off as per the newly enforced medical legislation in 1865. By the second period, the existence and causes of puerperal fever had been accepted by medical professionals, and professionalisation had been on its way for quite some time. Therefore, we expect less under-registration of maternal mortality in the second period, compared to the first period. We do not yet expect actual decline in maternal mortality itself, since this decline is observed in later periods, starting in the 1930s (Loudon, 2000).

In order to find out whether these numbers provided a valid estimation of maternal mortality, or if under-registration of maternal mortality indeed occurred, this study will conduct a three-step examination for the two sample periods (1870–1879 and 1900–1909). First, the municipal reports of Maastricht will be examined to create an overview of the rate of direct maternal mortality. Second, the maternal mortality rates resulting from the official reports will be compared to the mortality rates based on individual-level causes of death and on the number of women dying within a year after giving birth. Third, we will look closer into which causes of death were used to describe the mother's death and whether there were registration differences as time passed by after giving birth. This third step may provide more insight into whether the under-registered deaths may have been hidden or associated deaths.

2 IDENTIFYING MATERNAL MORTALITY IN MAASTRICHT

The first step of our study examines the death statistics of the Maastricht municipal reports. In the Netherlands, municipal reports included aggregated cause-of-death statistics form 1865 onwards, and from 1875 onwards, these statistics were compiled at the national level.[1] These national statistics have been used by Loudon (1992) to estimate the Dutch maternal mortality rates. However, the standardization of the causes of death in the Dutch registration allowed for the registration of only one cause of death. In case of multiple causes of death, for instance childbirth and tuberculosis, a doctor could only assign one cause of death. Consequently, the registration of maternal mortality in public reports is likely to have under-registered maternal mortality (Loudon, 1992, p. 28). To calculate maternal mortality rates, we used the total number of births plus the total number of stillbirths reported in the municipal reports as the denominator of maternal mortality.

To examine maternal mortality rates based on individual-level cause-of-death data we used the Maastricht Death and Disease Database (MDDD; Sociaal Historisch Centrum Limburg). This dataset includes individual-level data of 76,264 individuals that died in Maastricht, or were registered as a citizen of Maastricht, between 1864 and 1955. Not only the non-standardized, individual-level cause of death has been preserved; the dataset also includes information on the name, address, occupation, age, sex and religion of the deceased. These data were derived from a combination of death registers and death certificates and are believed to be complete (Murkens, 2023). The individual-level causes of death provide more detailed information about death than municipal reports, as they include more elaborate descriptions and often contain second, third or even more causes of death. As such, these sources can shed more light on the amount of hidden maternal deaths in Maastricht. All women that died between age 16 and 50 (i.e. the reproductive age) in the periods 1870–1879 and 1900–1909 have been selected to be included in our analysis, which resulted in an initial dataset of 1,262 female deaths.

1 See Appendix Table A1 for the categories used in the municipal reports over time.

Our other estimation of maternal mortality examines women that died up to one year after giving birth. In order to gain information on the time passed between giving birth and dying, we first linked the deaths of women between the ages 16 and 50 from the MDDD to the Maastricht birth registers. We manually assigned links based on the first name(s) and last name of the mother in the birth register and the names of the deceased women in the MDDD. If the interval between a birth date and the death of a mother was more than one year, no link was assigned. 757 (60%) of the selected women in the MDDD were registered with a partner. The names of the father (birth certificate) and partner have been used to check these assigned links. The linkage of women without a registered partner in the MDDD might be less precise compared to those with a partner. The first names in the MDDD and birth registers often included second and third names, thus creating more unique names and therefore reducing the chances of false links. Moreover, in cases where there was any doubt no links were assigned, to minimize the number of false positive links. The data sample is therefore more likely to contain an under-representation than an overrepresentation of women that died after giving birth.

Next, we manually searched for all women in the online search engine for civil registry records WieWasWie. This search allowed the inclusion of other links that were missed in the linkage to the birth registered due to spelling variations. Moreover, WieWasWie includes death certificates which allowed the linkage of mothers' deaths not only to live births but also to stillbirths. In this period, stillbirths were not recorded in the birth certificates in the Netherlands, but they were registered in death certificates. We could therefore also link women who died after stillbirths. Ideally, we would also have information on which women died after a miscarriage where the fetus was not old enough to be registered as a stillbirth. Unfortunately, that information is not available. However, including the registered stillbirths already improves our dataset compared to using only maternal mortality linked to live births. In total, 236 deceased women have been identified as to have died up to one year after giving birth (see Table 1).

Table 1 *Number and share of number of deceased women linked to births*

Period	Total female deaths in selected period	Linked mothers N (%)
1870–1879	620	134 (*21,6*)
1900–1909	642	*102* (*15,9*)

The causes of death of the women aged 16–50 were classified into three categories. Category one includes all causes of death that belong to the O category of the ICD10h, which is the designated category for all pregnancy- and childbirth-related mortality (Reid et al., 2024a, 2024b) and which includes by default terminology referring to pregnancy or childbirth (words used such as puerperal, gravidity, pregnancy, partum). There were 18 cases where the woman had been assigned a cause of death clearly related to childbirth that had not been linked to a birth or stillbirth. In some instances the cause of death itself specified that the death was a result of a miscarriage or abortion. Of the other women, it is not clear whether they suffered a miscarriage or died after having given birth. Yet this means we should keep in mind that the women we could link to a birth or stillbirth may still be an under-representation of the actual numbers.

The second category comprises the common complications of pregnancy or giving birth, such as peritonitis, endometritis, phlebitis, or thrombosis (Shorter, 1982). These are the causes of death that could contain hidden maternal death. The final category contains all other deaths which could not be connected directly to pregnancy. Tuberculosis, heart disease and nephritis all belong to this category. This last category is most likely to include associated maternal mortality, if there was any. Five women that were linked to a birth or stillbirth had no specification of the cause of death (i.e. either a blank or stated to be unknown). We included these women in category three as well. There were no causes of death referring to accidents, which should be excluded from maternal deaths in case of using the WHO definition of deaths occurring within 42 days after birth.

3 MATERNAL MORTALITY IN MAASTRICHT

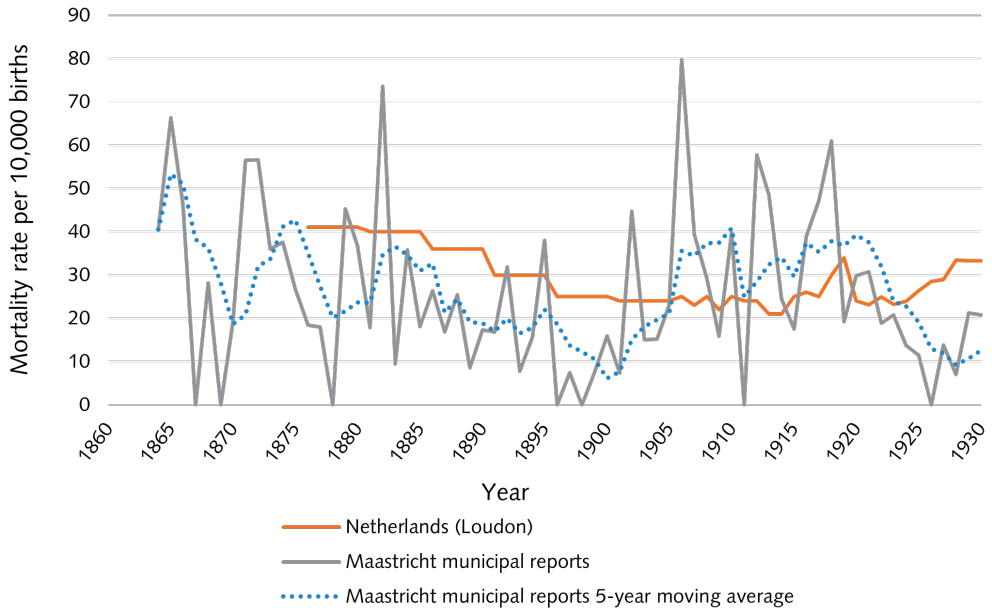
3.1 TOTAL MATERNAL MORTALITY RATES

Compared to the rates of the Netherlands, maternal mortality in Maastricht was fairly low in the final decades of the 19th century (see Figure 1). Although a decline in maternal mortality could be expected in the later 19th century as a result of antisepsis and improved birth care, such a trend is difficult to identify for Maastricht. There is a slight decline in official maternal mortality after the mid-1860s, but this is followed by an increase in the early 20th century, which even exceeds the national average. The early-20th century increase could be a statistical artefact, resulting from improved diagnostic practices. In 1913, a school for midwives was founded in Heerlen, near Maastricht, which could have improved the registration of maternal deaths. However, the increase in maternal mortality already appears from 1905 onwards. The effects of the midwifery school should be expected to show only a couple of years after 1913, when midwives had completed their training and started practicing in for example Maastricht. The foundation of the school itself may also indicate another transformation; perhaps maternal deaths had gained more attention over the years, resulting both in the establishment of the school and increased registration.

Next, the maternal mortality rates of Maastricht are compared to the other estimations based on the individual-level data. Figure 2 shows the annual maternal mortality rates per 10,000 births (including stillbirths) based on four different calculations and sources. It compares the maternal mortality rate in (1) the municipal reports, (2) the causes of death of all women that were clearly related to childbirth from the MDDD (category 1), (3) the number of linked deaths occurring within 42 days after birth (WHO definition) regardless of the cause of death, and (4) the number of linked deaths that occurred within a year after birth regardless of the cause of death.[2]

When comparing the official maternal mortality statistics to the other rates, it is clear that the statistics in the municipal reports likely under-reported maternal mortality. However, the differences between the municipal reports and the MDDD-causes-of-death are limited. In some years, the rates are similar, and in other the maternal mortality rate calculated from the individual-level causes of death is even lower. This would mean that some causes that we would not identify as direct maternal mortality, were actually viewed as such by contemporary physicians and/or clerks.

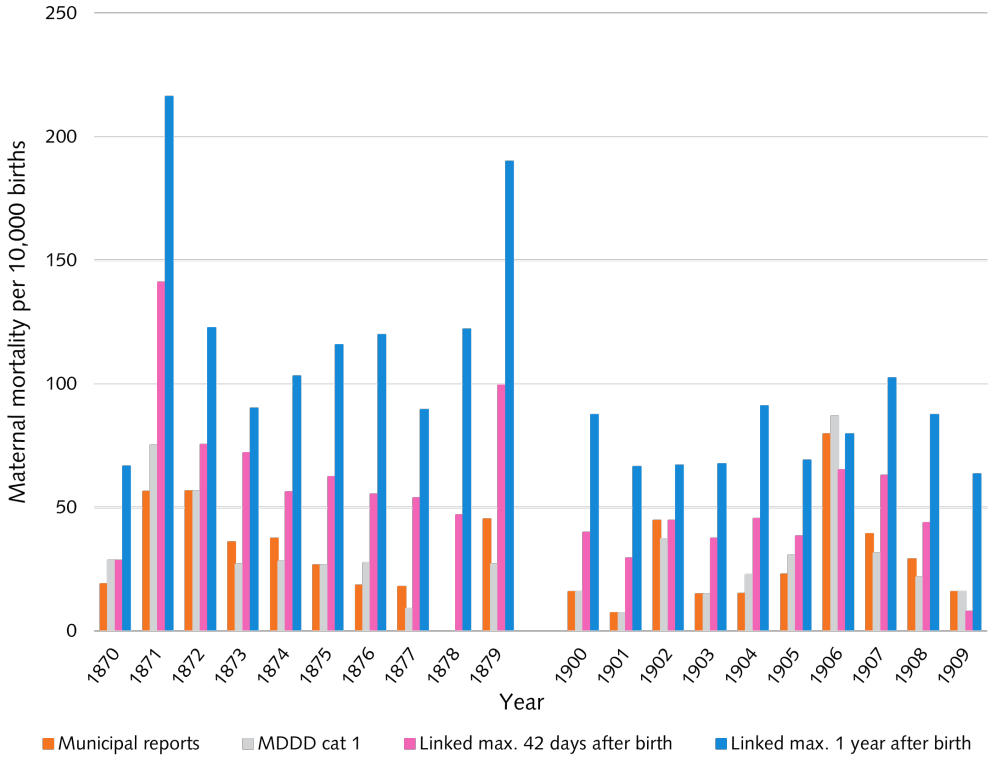
Figure 1 *Maternal mortality rate per 10,000 births, the Netherlands and Maastricht, 1864–1930*



Source: Loudon, 1992, p.561–563; Verslag van de toestand der gemeente Maastricht over het jaar 1864–1930

2 See Appendix Table A2 for the annual number of deaths and death rates per estimation method.

Figure 2 *Maternal mortality per 10,000 births, Maastricht 1870–1879 and 1900–1909*



Sources: Verslag van de toestand der gemeente Maastricht over het jaar 1870–1879 and 1900–1909; Maastricht Death and Disease Database; Maastricht birth registers years 1869–1879 and 1899–1909.

The differences between the official statistics and deaths based on the time after giving birth are more striking. In 1870–1879, the maternal mortality rate based on the 42-day period after birth exceeds the rates of both the municipal reports and the individual-level causes of death. This suggests the presence of associated maternal mortality: women who died from other causes that might have become fatal due to a recent pregnancy or childbirth. In 1906, this rate is lower than the one based on the individual-level causes of death. In fact, the deaths of six women in this year have been attributed to a cause of death related to pregnancy or childbirth in the MDDD, while they were not linked to a birth. This could concern women who died following a miscarriage or a failed pregnancy, when the fetus had not been old enough to be registered as a stillbirth. However, since 1906 stands out in the missing links, it may be the case that the registration of 1906 was not complete. In the 1900s, the number of deaths within the 42-day mark still exceeded those officially related to childbirth. Apparently, diagnostic practices still did not include all maternal mortality, even when these deaths occurred relatively soon after giving birth.

Maternal mortality rates were the highest in the final category containing the linked deaths up to one year after birth, indicating potential higher associated maternal mortality rates in a longer birth-death interval. Maternal mortality was highest in the first researched period. Since the mortality decline for adult women was in progress at that moment in time (Murkens, 2023), it is likely that some of these deaths were not related to maternity. However, it should still be considered that a combination of circumstances, including pregnancy and childbirth, contributed to the eventual death of these women. After all, several scholars have argued that multiple births took a toll on women's bodies. The resulting maternal depletion constituted an important factor in tuberculosis mortality among women (Janssens & van Dongen, 2017; Manfredini et al., 2020).

3.2 HIDING MATERNAL MORTALITY

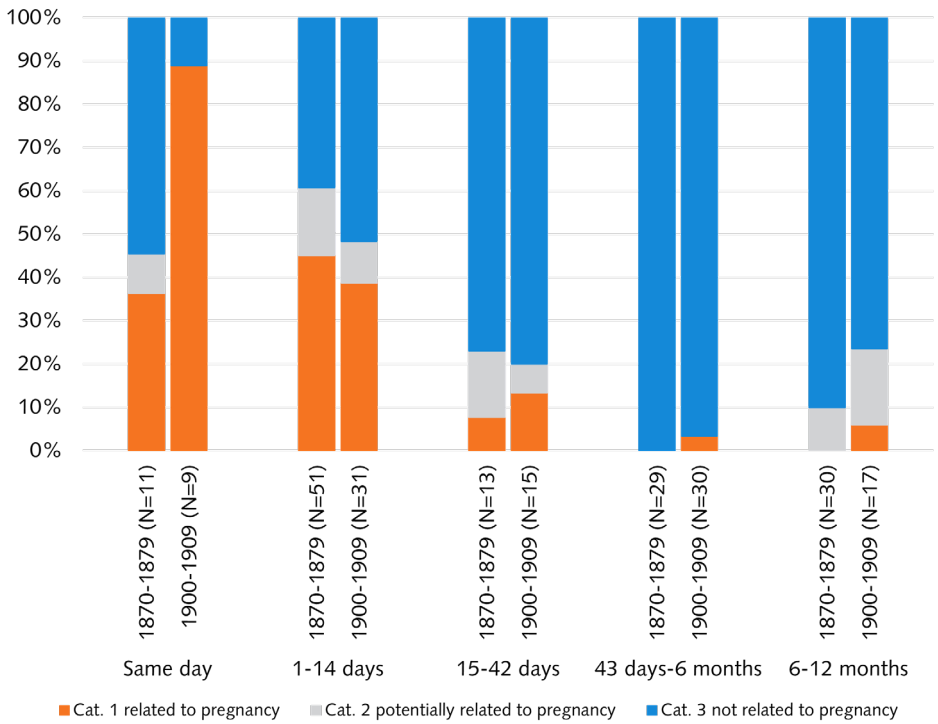
Higher mortality rates among women linked to a birth or stillbirth suggest the presence of hidden maternal mortality in the Maastricht registration. To shed more light on the registration practices, the share of each of the causal categories is shown across different interval periods between the birth of a

child and death of the mother.[3] Figure 3 demonstrates the deaths occurring on the same day, within 14 days (i.e. the period in which puerperal fever generally develops), between fifteen and 42 days (WHO definition), and the remaining period up to one year.

Figure 3 reveals that the vast majority of deaths characterized as being related to childbirth (category 1) occurred within the 14-days interval in both periods. After the first 14 days the chances of a death being registered as a maternal death had declined substantially. In general, limited differences are observed in the relative registration of maternal deaths between the two time periods; only the recognition of maternal deaths occurring on the same day as the birth had increased by the early 20th century. However, the total number of women dying on that same day is exceptionally small. We should therefore refrain from drawing conclusions based on the changes in registration over the two periods that we observe for the first day.

The share of deaths potentially related to pregnancy (category 2), such as peritonitis or fever, is low, as the small discrepancy between the maternal mortality rates of the MDDD and the linked mothers in Figure 2 already suggested. This indicates that the share of hidden maternal mortality in Maastricht was probably low. There are, however, many causes of death that could have been associated with pregnancy or childbirth, even for deaths occurring within the first 14 days after birth. This suggests that the factor of associated deaths may have been more prevalent than hidden deaths. However, a death occurring on the same day as the birth can hardly be recognized as an associated death. Perhaps attending physicians tried to hide the death not by writing down the non-maternal equivalent of the cause of death, as Loudon explained, i.e. peritonitis instead of puerperal peritonitis or fever instead of puerperal fever. Instead, they recorded something entirely different, unrelated to childbirth.

Figure 3 *Share of deaths per category, by time interval and period, Maastricht 1870–1879 and 1900–1909*



Sources: Verslag van de toestand der gemeente Maastricht over het jaar 1870–1879 and 1900–1909; Maastricht Death and Disease Database; Maastricht birth registers years 1869–1879 and 1899–1909.

3 We checked whether these patterns differed by age of the women dying, but no clear differences were found.

A closer inspection of the registration of specific causes of death shows that there was some hidden maternal mortality among 'usual suspects' such as peritonitis. However, the term 'fever' without further specification did not occur. In itself, fever was not a widely used term either, as only two women out of all the women dying in these two research periods (n = 1,262) died of fever, albeit not as a consequence of childbirth. Peritonitis, on the other hand, was used in total in nine instances. It was used five times for a death occurring within the first 42 days, but the birth had occurred longer ago in the other four cases. Whether the latter actually concerned maternal mortality is therefore difficult to establish. It seems possible that something else had happened to these women to cause peritonitis. Another 'usual suspect', septicaemia, was only used twice, for deaths occurring before the 42-day mark. In sum, although the 'non-maternal equivalent' causes reveal there may have been some hidden maternal mortality, this does not appear to have been a common practice.

Causes of death that were not directly associated with childbirth were more prevalent. The three most common causes of death across the entire period for the whole 365 day interval were tuberculosis of the lung (n = 49), heart disease (different specific terminology used, total n = 17) and pneumonia (n = 16). Janssens and van Dongen (2017) already suggested that tuberculosis in women could have been related to maternal depletion due to many pregnancies, yet this relation might have been even stronger. Not only were these causes of death registered after the 42-day mark, which would make sense as they might be considered to be associated deaths, but they were also used before the 42-day mark. Tuberculosis of the lung even occurred twice as a cause of death in a woman dying on the same day as giving birth, and six more times before the 14-day mark. The same applies to heart disease and pneumonia; both were used for deaths occurring within 14 days and even on the same day.

It is striking how common these causes of death were, even though the total number of deaths was low (only 236 in total). Tuberculosis of the lung was the second most frequently used cause of death in the deaths occurring between day 1 and 14 after birth, coming second to puerperal fever. Heart disease came fourth, after eclampsia. A considerable amount of mothers were not registered as having died of causes related to childbirth, even though some of them had died only a few days after giving birth. If women had suffered from tuberculosis, a heart disease, or pneumonia, it is likely that pregnancy and delivery took a substantial toll on women's health, and therefore contributed to their death.

4 CONCLUSION

Maternal mortality in the Netherlands was among the lowest across Western Europe. Were the circumstances indeed so much better in the Netherlands as a result of the high standard midwifery care? Or was low maternal mortality a consequence of considerable under-registration? Although it is beyond the scope of this paper to compare potential under-registration of maternal mortality in the Netherlands to other Western countries, the highly detailed dataset created here, allows for a close scrutinization of maternal mortality in the Dutch city of Maastricht. Based on the existing literature, under-registration of maternal mortality was expected for two reasons. First, Loudon (1992) stated certain incentives existed for medical practitioners in the late 19th century to cover up maternal deaths, resulting in hidden maternal mortality. Second, an exploration of total female adult mortality in Maastricht ran into some odd deaths, that were registered as non-pregnancy related, even though the death had occurred shortly after giving birth (Murkens, 2023). In this paper, we aimed to shed light on the extent of under-registration of maternal mortality and asked whether this could be related to more deliberate practices or resulted from associated deaths not being considered as maternal mortality. Additionally, we asked whether registration practices may have improved over time, making hidden maternal mortality less common.

The registration of maternal mortality by contemporary officials and medical practitioners was most likely flawed. Municipal reports account for considerably lower maternal mortality than the maternal mortality rates we calculated based on individual-level causes of death and the number of mothers dying within 42 or 365 days after giving birth. The differences could be very substantial. One year after birth maternal mortality rates were four times higher than what the official statistics reported. Similarly, rates estimated for the 42-day mark were at times double the size of what was stated in the official statistics. The deaths of mothers were not only registered as unrelated to childbirth after the 42-day mark, but also before. In total, 50% of deaths occurring within 42 days of giving birth were supposedly

induced by causes unrelated to childbirth. Only 11.5% of the deaths could be attributed to pregnancy while leaving out the childbirth qualifier, based on the individual cause-of-death information. As Loudon (1992) suggested, this concerned causes that medical practitioners could most easily, and with the fewest consequences, use to obscure maternal mortality, if they felt the need to do so. However, these causes of death, such as peritonitis, fever or phlebitis, do not seem to have been the most prevailing causes to cover up a maternal death. Instead, more general causes of death were used for that purpose, such as tuberculosis of the lung, heart disease and pneumonia.

This means that the estimations of maternal mortality were most likely distorted because associated maternal mortality was under-registered in Maastricht. Other categories of death are therefore likely to include some maternal mortality as well. Although the share of total maternal mortality, defined as every woman dying within a year after giving birth, was not extremely large in total female adult mortality (19%), historical demographers should be aware that when studying for example female tuberculosis mortality, this could include some associated maternal deaths as well. Moreover, the diagnostic practices did not seem to have improved much by the early 20th century. Studying mortality after the turn of the century does by no means exempt one from the issues of under-registration.

Although we revealed considerable under-registration, this study does suffer from small numbers. We should therefore not only interpret some of our results with caution, it also remains to be seen whether the results are representative for the Netherlands as a whole. How these results relate to registration practices in other countries requires further scrutiny. Moreover, this study does not examine the motives of medical practitioners to register maternal deaths differently. Potential ways of doing so are to analyse whether maternal deaths occurred in hospitals, or if they were the results of home births, attended by midwives. Which profession needed to protect their professional reputation the most? A turning point analysis may provide additional clues as to whether professionalisation among medical doctors or midwives could have played a role in improving registration. Whatever the reasons may have been, it is clear that women in Maastricht suffered considerably more from maternal mortality than has up until now been assumed.

REFERENCES

Breathnach, C., & Gurrin, B. (2017). Maternal mortality, Dublin, 1864–1902. *Social History of Medicine, 31*(1), 79–105. https://doi.org/10.1093/shm/hkx010

De Brouwere, V. (2007). The comparative study of maternal mortality over time: The role of the professionalisation of childbirth. *Social History of Medicine, 20*(3), 541–562. https://doi.org/10.1093/shm/hkm070

Gemeente Maastricht. (1864–1874). *Uitvoerig en beredeneerd verslag van den toestand der gemeente Maastricht over het jaar …* [Extensive and discursive report of the state of the municipality of Maastricht over the year ...]. Stedelijk Stadbestuur van Maastricht, de Bibliotheek van Maastricht.

Gemeente Maastricht. (1875–1930). *Verslag van den toestand der Gemeente Maastricht over het jaar …* [Report on the state of the municipality of Maastricht during the year ...]. Gemeente Maastricht, de Bibliotheek van Maastricht.

Historisch Centrum Limburg. (1796–1942). *Registers van geboorte, 1796–1942* [Birth registers, 1796–1942] (Inventory numbers 48–54 and 64–69). Burgerlijke Stand in Limburg: Maastricht, 1796–1942, archive number 12.059.

Högberg, U. (2004). The decline in maternal mortality in Sweden: The role of community midwifery. *American journal of public health, 94*(8), 1312–1320. https://doi.org/10.2105/ajph.94.8.1312

Janssens, A., & van Dongen, E. (2017). 'A natural female disadvantage'. Maternal mortality and the role of nutrition related causes of death in the Netherlands, 1875–1899. *TSEG - The Low Countries Journal of Social and Economic History, 14*(4), 84–115. https://doi.org/10.18352/tseg.988

Kallianidis, A. F., Schutte, J. M., Schuringa, L. E. M., Beenakkers, I. C. M., Bloemenkamp, K. W. M., Braams-Lisman, B. A. M., Cornette, J., Kuppens, S. M., Rietveld, A. L., Schaap, T., Stekelenburg, J., Zwart, J. J., & van den Akker, T. (2022). Confidential enquiry into maternal deaths in the Netherlands, 2006–2018. *Acta Obstetricia et Gynecologica Scandinavica, 101*(4), 441–449. https://doi.org/10.1111/aogs.14312

Kippen, R. (2005). Counting nineteenth-century maternal deaths. The case of Tasmania. *Historical Methods: A Journal of Quantitative and Interdisciplinary History, 38*(1), 14–25. https://doi.org/10.3200/HMTS.38.1.14-25

Loudon, I. (1992). *Death in childbirth. An international study of maternal care and maternal mortality 1800–1950*. Oxford University Press.

Loudon, I. (2000). Maternal mortality in the past and its relevance to developing countries today. *The American Journal of Clinical Nutrition, 72*(1), 241S–246S. https://doi.org/10.1093/ajcn/72.1.241S

Manfredini, M., Breschi, M., Fornasin, A., Mazzoni, S., De Iasio, S. & Coppa, A. (2020). Maternal mortality in 19th-and early 20th-century Italy. *Social History of Medicine, 33*(3), 860–880. https://doi.org/10.1093/shm/hkz001

Murkens, M. (2023). *Unequal pathways to the grave? Time lags and inequalities in the Dutch health transition, the case of Maastricht, 1864–1955* [Doctoral dissertation, Maastricht University]. https://doi.org/10.26481/dis.20230131mm

Ory, B. E., & van Poppel, F. W. A. (2013). Trends and risk factors of maternal mortality in late-nineteenth-century Netherlands. *The History of the Family, 18*(4), 481–509. https://doi.org/10.1080/1081602X.2013.836457

Reid, A., Garrett, E., Hiltunen Maltesdotter, M., & Janssens, A. (2024a). *Historic cause of death coding and classification scheme for individual-level causes of death – Codes*. Apollo – University of Cambridge Repository. https://doi.org/10.17863/CAM.109961

Reid, A., Garrett, E., Hiltunen Maltesdotter, M., & Murkens, M. (2024b). *Historic cause of death coding and classification scheme for individual-level causes of death – Manual*. Apollo – University of Cambridge Repository. https://doi.org/10.17863/CAM.109960

Scalone, F. (2014). Effects of nutritional stress and socio-economic status on maternal mortality in six German villages, 1766–1863. *Population Studies, 68*(2), 217–236. https://doi.org/10.1080/00324728.2013.821153

Shepherd, J. R., Schoonheim, M., Tian-yun, C. & Kok, J. (2011). Maternal mortality in Taiwan and the Netherlands, 1850–1945. In T. Engelen, J. R. Shepherd, & Y. When-Shan (Eds.), *Death at the opposite of the Eurasian continent: Mortality trends in Taiwan and the Netherlands 1850–1945* (pp. 229–274). Amsterdam University Press.

Shorter, E. (1982). *A History of women's bodies*. Allen Lane.

Sociaal Historisch Centrum Limburg (SHCL). (2023). *Maastricht Death and Disease Database (1864–1955)* (Version 2023) [Unpublished data set].

World Bank Group. Netherlands. (n.d.). *Gender Data Portal*. https://genderdata.worldbank.org/en/economies/netherlands#sr-subnavigation

World Health Organisation. (n.d.). *Maternal Deaths*. https://www.who.int/data/gho/indicator-metadata-registry/imr-details/4622

APPENDIX

Table A1 *Categorization of maternal mortality in the Maastricht municipal reports*

Year	Category	Disease
1864–1870	Peritonitis puerperalis	-
1871–1877	Puerperal disease (*Ziekte van het kraambed*)	Metrorrhagia, Dystocia, Abortion, Sudden death
		Eclampsia, Mania puerperalis
		Febris puerperalis
1878–1886	Puerperal disease *(Ziekte van het kraambed)*	Febris puerperalis
1887–1900	Diseases of the urinary and genital organs	Puerperal diseases
1901–1930	Puerperal fever	-
	Other diseases of pregnancy and labour	

Source: Verslag van de toestand der gemeente Maastricht over het jaar 1864–1930.

Table A2 *Number of deaths and mortality rate per 10,000 births per estimation method, Maastricht 1870–1879 and 1900–1909*

Year	Municipal reports		MDDD cat. 1		Linked max 42 days		Linked max 1 year	
	N	Rate	N	Rate	N	Rate	N	Rate
1870	2	19,1	3	28,6	3	28,6	7	66,8
1871	6	56,4	8	75,3	15	141,1	23	216,4
1872	6	56,7	6	56,7	8	75,5	13	122,8
1873	4	36,0	3	27,0	8	72,1	10	90,1
1874	4	37,5	3	28,1	6	56,3	11	103,2
1875	3	26,7	3	26,7	7	62,4	13	115,9
1876	2	18,5	3	27,7	6	55,4	13	119,9
1877	2	17,9	1	9,0	6	53,8	10	89,7
1878	0	0,0	0	0,0	5	47,0	13	122,2
1879	5	45,2	3	27,1	11	99,5	21	190,0
1900	2	15,9	2	15,9	5	39,8	11	87,6
1901	1	7,4	1	7,4	4	29,5	9	66,5
1902	6	44,7	5	37,3	6	44,7	8	59,7
1903	2	15,0	2	15,0	5	37,5	9	67,6
1904	2	15,2	3	22,8	6	45,5	12	91,0
1905	3	23,1	4	30,7	5	38,4	9	69,2
1906	11	79,8	12	87,0	9	65,3	11	79,8
1907	5	39,4	4	31,5	8	63,0	13	102,4
1908	4	29,2	3	21,9	6	43,8	12	87,7
1909	2	15,9	2	15,9	1	7,9	8	63,6

Sources: Verslag van de toestand der gemeente Maastricht over het jaar 1870–1879 and 1900–1909; Maastricht Death and Disease Database; Maastricht birth registers years 1869–1879 and 1899–1909.