# Stillbirth and early neonatal mortality in late19th century London: Implications from Lying-in Hospitals*

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**Abstract**

Infant mortality rates have long been pivotal indicators, reflecting living standards influenced by environmental hygiene, infectious diseases, and nutrition. Stillbirth and early neonatal mortality rates, affected by factors like premature birth and congenital conditions, have been subject to extensive study. Previous research focused on detailed records from maternity hospitals often portrayed hospital patients as a "highly selected group" of poor married women, while young unmarried women were associated with workhouse infirmaries. Due to this assumption, hospital records have not been thoroughly studied. However, a closer examination of patient records reveals nuanced trends in age and marital status, challenging previous assumptions about hospital admissions. Contrary to expectations, stillbirth rates among young unmarried women do not surpass those of married women in maternity hospitals, suggesting a more complex demographic landscape. Despite historical perceptions limiting the analysis of hospital records, a detailed examination may shed light on the realities and peculiarities of stillbirths and early neonatal mortality rates in urban London, offering valuable insights into public health during the late 19th and early 20th centuries.

Key words: Still Birth, Neonatal Mortality, Premature Birth, Lying-in Hospital, Voluntary Hospital

JEL Classification : J11, J12, J13, N33

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## 1. Introduction

Infant mortality rates are a reliable indicator of living standards because of their sensitivity to public sanitation, infectious diseases, and nutrition[3]. Conversely, neonatal mortality and stillbirth rates are predominantly shaped by variables such as preterm birth, congenital ailments, and birthing complications. Given the critical importance of these two metrics, numerous studies have aimed to understand their complexities.

This study examines neonatal mortality, stillbirth rates, and prematurity, using historical archives from London's maternity hospitals in the late nineteenth and early twentieth centuries. Despite their detailed recording of birth outcomes, these archives remain relatively understudied. Stillbirth rates have been used to assess maternal well-being and obstetric practices, while also potentially influencing fertility rates. Notably, the recording of stillbirths in England and Wales did not become commonplace until the 1920s[4]. Consequently, while attempts have been made to estimate stillbirth rates using available neonatal and maternal mortality data, reliable datasets remain elusive[5]. Furthermore, one of the significant factors contributing to stillbirths and early neonatal mortality, prematurity, often remains inadequately understood. This is primarily due to the fact that while causes of death are documented by the Registrar General, they are typically listed in a simplified manner, lacking specificity in classification methods and detailed explanations.

The historical records of nineteenth-century maternity hospitals have often been overlooked in scholarly analysis, primarily due to the prevailing assumption that these institutions exclusively catered to “poor young married women”. Woods (2009) examines data from maternity hospitals where stillbirths are recorded in some detail[6]. However, Woods (2009) considers patients in maternity hospitals to be a "highly selected group" and assumes them to be "poor married women who were recommended by a trustee or a medical officer", while “young unmarried women” were accepted in workhouses. Nevertheless, a closer examination of the actual patient records reveals a more nuanced reality. Trends in patient demographics, including age and marital status, in fact varied significantly among different maternity hospitals and

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[3] Discussion of infant mortality from endogenous and exogenous causes could be found in Woods (2005), p.154-155.

[4] From 1927 onwards, stillbirth records were added to the Register General's Annual Report, making analysis possible. Hart (1998) and Woods (2005) use these results to estimate stillbirth rates.

[5] Wrigley, E. A., R. S. Davies, J. E. Oeppen, and R. S. Schofield (1997) *English Population History from Family Reconstitution, 1580-1837* . Cambridge: Cambridge University Press.; Nicky Hart(1998). Beyond infant mortality: gender and stillbirth in reproductive mortality before the twentieth century, Population Studies 52(2): 215- 229.; LICE REID (2001) Neonatal mortality and stillbirths in early twentieth century Derbyshire, England, Population Studies, 55:3, 213-232.; Robert Woods (2005) The measurement of historical trends in fetal mortality in England and Wales, Population Studies, 59:2, 147-162; Robert Woods (2008) “Late-Fetal Mortality: Historical Perspectives on Continuing Problems of Estimation and Interpretation”, *Population*-E, 63 (4), pp.591-614.

[6] Woods (2009) *Death Before Birth* p. 90-94.

across different time periods. Consequently, it would be inaccurate to generalize that maternity hospitals only served “poor young married women”[7].

Woods (2009) further elucidated this point by noting that “Since most women giving birth in such institutions were young and unmarried...Stillbirth rates in excess of 100 should not be surprising in this particular case”[8]. Nevertheless, an analysis of maternity hospital data fails to support the notion that stillbirth rates among young unmarried women are higher than those among married women. Accordingly, prevalent misconceptions surrounding patient demographics and the perceived “representativeness” of maternity hospital records have deterred their comprehensive analysis. By scrutinizing these records more closely, we have the opportunity to uncover the realistic dynamics and intricacies of stillbirths, early neonatal mortality and prematurity in urban London during this era. Such an endeavor may offer valuable insights into maternal and infant health and challenge existing assumptions about patient demographics and hospital records.

Indeed, the notion of "representativeness" remains pertinent, especially considering that in-patient records alone do not offer a comprehensive view of childbirth practices during that era. Given that the majority of births occurred at home during the nineteenth century, those admitted to maternity hospitals represented a select subset of women, perhaps accounting for less than 10 percent of births, who either lacked the means to give birth at home or faced other constraints. Consequently, the admission records from maternity hospitals offer a limited perspective. However, it's worth noting that many hospitals of that time period also extended home nursing services to out-patients in addition to in-patient care. For instance, in the Queen Charlotte’s Lying-in Hospital, a little over half of the births attended were out-patient. In City of London Lying-in Hospital, there were three times more out-patient attendances than in-patients. Therefore, a comparative analysis of both in-patient and out-patient records could provide valuable insights into the differing experiences and outcomes between these two groups.

## 2. Background

The eighteenth and nineteenth centuries witnessed a remarkable proliferation of hospitals across London. In the early eighteenth century, only a handful of general hospitals and a few specialized institutions served the city, as documented in Owen (1964). However, by the close of the 19th century, London had over 380 hospitals, a significant increase from its earlier count of just a few general and

[7] The General Lying-in Hospital studied by Woods (2009) was the next largest hospital after Charlotte's and the City of London and, like the two hospitals, had a nursing and midwifery school. In addition, although the patients accepted were mainly married women, unmarried women were also accepted on some occasions, with the ratio being just between Charlotte's and City of London Hospitals. In the case of Charlotte Hospital, around 60% of patients were unmarried in 1880, compared to 40% in 1905.
[8] Woods (2009) , p.92-93.

specialized hospitals. Notably, according to Prochaska (1992), among the 54 charitable hospitals in the city, ten were dedicated to addressing childbirth and women's health needs.

As highlighted by Woods (2005), the marital status of mothers was a significant factor influencing child survival rates during this period. Unmarried maternal status was found to correlate strongly with elevated stillbirth and infant mortality rates, particularly in urban settings. Consequently, the analysis of maternity hospitals providing primarily to impoverished women in London assumes considerable importance. By analysing the carefully maintained records of these hospitals, encompassing both married and unmarried patients, offers invaluable insights into the demographic trends and healthcare outcomes experienced by women of varying marital statuses.

The study examines records from two maternity hospitals in London: Queen Charlotte's Lying-in Hospital (QCH) and City of London Lying-in Hospital (CLH). These hospitals stand out due to their substantial annual revenue and expenses, as well as the large number of patients they served[9]. Moreover, the patient demographics at each hospital are distinct. While CLH exclusively admitted married women, QCH admitted both married and unmarried women. Patients admitted to QCH were primarily in their teens or twenties, and most were experiencing their first pregnancies.

In contrast, CLH admitted patients of all ages, adhering strictly to the policy of admitting only married women. The range of births at this hospital varied from first-time pregnancies to cases where women had already given birth multiple times, sometimes up to the twentieth child. Additionally, CLH maintained records of stillbirths for outpatients, enabling a comparative analysis of trends between outpatients and inpatients.

## 3. Data

For this analysis, I will utilize the in-patient registry records, containing over 5400 data, from QCH and annual reports spanning from 1880 to 1910 for each hospital[10]. These records include essential information such as the date of admission, discharge, and delivery, along with the patients' address, marital status, and pregnancy history whenever available.

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[9] Burdett, Henry. (1889) *Burdett's Hospitals and Charities: being the year book of philanthropy and the annual* shows a list of hospitals in London and suburbs including their number of patient addmission, income, expenditure and other statistical data. According to the year book, among 93 Hospitals in London, there were four lying-in hospitals: British Lying-in Hospital, City of London Lying-in Hospital, General Lying-in Hospital, and Queen Charlotte's Lying-in Hospital. CLH and QCH were the oldest and the largest hospitals of the four with substantial amount of historical documents remaining.

[10] London Metropolitan Archives, City of London, H27/QC/B/01/003 - H27/QC/B/01/0014, H27/QC/A/27/014 - H27/QC/A/27/043, H10/CLM/A/06/001- H10/CLM/A/06/004, H10/CLM/B/01/003-H10/CLM/B/01/008.

At QCH, additional data include the birth weight and height of newborns from 1880, along with details on whether they were born full term or premature. In some cases, the records also indicate the number of weeks at birth, the condition at birth, and the health status at discharge. While outpatients may not be documented in many cases, CLH records outpatient stillbirths, providing insights into how well inpatient records represent the broader dataset.

Patient addresses are listed adjacent to their names in the records. Many patients at QCH were residents of Marylebone, where the hospital is situated. However, a significant portion of addresses belonged to convalescent homes, accounting for about 7% between 1880 and 1910[11]. Apart from Marylebone, addresses from Kilburn, Paddington, Kensington, and St. John's Wood were prevalent, primarily concentrated on the west side of London.

Notably, over 30% of in-patients at QCH were employed as general servants, with domestic roles such as cooks, housemaids, or kitchen maids constituting around 66% of the total. This suggests that young women serving in affluent households in West London were frequently admitted to QCH. On the contrary, CLH had a higher proportion of patients from eastern areas such as Islington and Hoxton, both among in-patients and out-patients.

In the case of out-patients, Bethnal Green witnessed a surge in patient numbers during the latter half of the 19th century. Moreover, unlike patients at QCH, virtually all patients at CLH were married, with their husbands' occupations being documented. The most common occupation listed was "labourer," often accompanied by "out of work," indicating that wives of unskilled manual labourers or those with unemployed husbands were frequently admitted.

Defining the terms “stillbirth” and “neonatal” is a subject of ongoing debate. According to the NHS, the definition of “stillbirth” underwent a significant change in 1992. Previously, it referred to the delivery of a dead fetus after 28 weeks of gestation. The current definition classifies a fetus as stillborn if delivered dead after 24 weeks of gestation, while a “miscarriage” pertains to fetuses less than 24 weeks old[12]. The evolving definition of “stillbirth” underscores its controversial nature, with recent revisions warranting caution in its interpretation.

Historically, parish registers, as utilized in prior studies, often categorized deaths shortly after birth as stillbirths[13]. In contrast, hospital registration records typically document the condition at birth

[11] Mary Magdalene's House opened in Paddington in 1865 as a place for unmarried women to rest before and after childbirth. It was affiliated with Charlotte's Hospital and basically accepted those who were accepted to QCH. In 1890, Queen Charlotte's Convalescent Home was opened in Kilburn and patients from there increased towards the end of the 19th century.

[12] “Stillbirth.” *NHS Choices*, NHS, Retrieved May 10, 2023, from www.nhs.uk/conditions/stillbirth/.

[13] Strange, J-M. (2005), *Death, Grief and Poverty in Britain, 1870–1914*, Cambridge, p. 242.

separately from discharge, providing detailed accounts of birth complications. Consequently, the likelihood of misrecording in hospital records is relatively low.

Regarding the definition of "neonate", the widely accepted modern criterion is "an infant within 28 days of birth." However, studies concerning stillbirths primarily focus on “early neonates”, typically within one week after birth[14]. In this paper, data for “early neonates” up to two weeks after birth—corresponding to the hospitalization period—is utilized. Notably, the margin of error is considered minimal, as the vast majority of infant deaths during hospitalization occurred within one week to 10 days post-birth. Therefore, the following definition is adopted in this paper; stillbirth = a record of “still”, and neonatal = alive at birth but dead at discharge.

## 4. Analysis

Before proceeding with specific analysis, it is important to first address the utilization of maternity hospital in-patient records for analyzing stillbirth rates. This is particularly significant regarding the distinction between hospital and home deliveries. Contrary to prior assumptions, the analysis suggests that these limitations may be less substantial than previously perceived.

The archives of the CLH contain records of outpatient deliveries. Since the establishment of the outpatient department in 1873, there was a notable surge in outpatient admissions, surpassing the number of inpatient admissions twofold. For instance, in 1900, while approximately 600 inpatients were recorded, the number of home births reached 1,700. However, due to uncertainty surrounding the inclusion of neonatal deaths recorded after birth, our comparative analysis focuses solely on stillbirth rates.

Figure 1 illustrates a graphical comparison of stillbirth rates among inpatients and outpatients. Notably, the stillbirth rates exhibit no statistically significant variance, consistently ranging between 0.01 and 0.06. This observation implies a comparable incidence of complications and related factors contributing to stillbirths across both hospital and home delivery settings. Consequently, the perceived limitations associated with utilizing maternity hospital in-patient records for analyzing stillbirth rates, particularly concerning the distinction between hospital and home deliveries, appear to be less substantial than previously assumed.

[14] “Newborn Health.” *World Health Organization*, World Health Organization. Retrieved Mar 19, 2024, from www.who.int/westernpacific/health-topics/newborn-health.

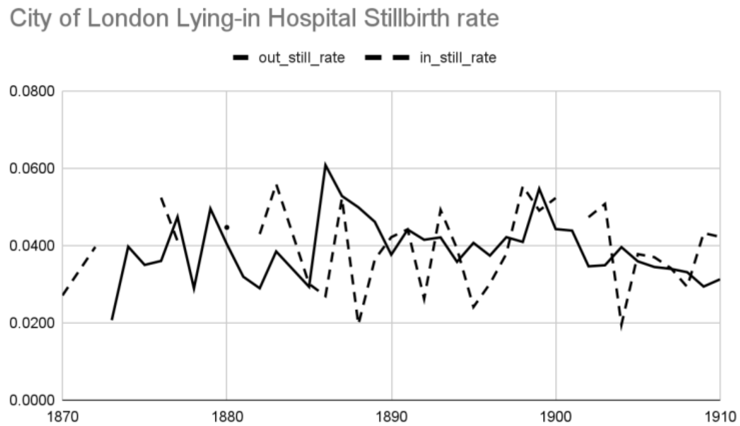


Figure 1: CLH Stillbirth Rate for in and out patients (1870-1910)

Moving on to the mortality rates of each hospital, neonatal mortality rates and stillbirth rates are depicted in Figures 2 and 3. Both hospitals exhibit a higher stillbirth rate compared to neonatal mortality, with stillbirths ranging from approximately 30 to 60 per 1000 live births. These figures align closely with Woods' (2005) estimates for England and Wales, which fall within the range of 25 to 65 per 1000 live births[15].

Overall, stillbirths at QCH from 1880 to 1910 averaged 47.6 per 1000 live births, while the CLH averaged 39.4 per 1000 live births. This finding is consistent with previous studies highlighting the elevated trend of illegitimate stillbirth rates, given QCH's propensity to admit unmarried women[16].

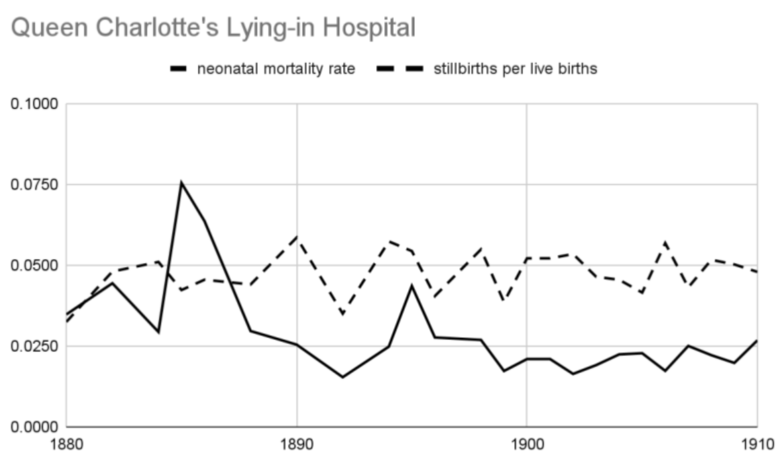


Figure 2: Neonatal Mortality Rate of QCH and CLH (1880-1910)

[15] Woods (2005), p. 154

[16] Woods et al (1988), p. 353. Data derived from Registrar General's *Sixty-Fifth Annual Report*.

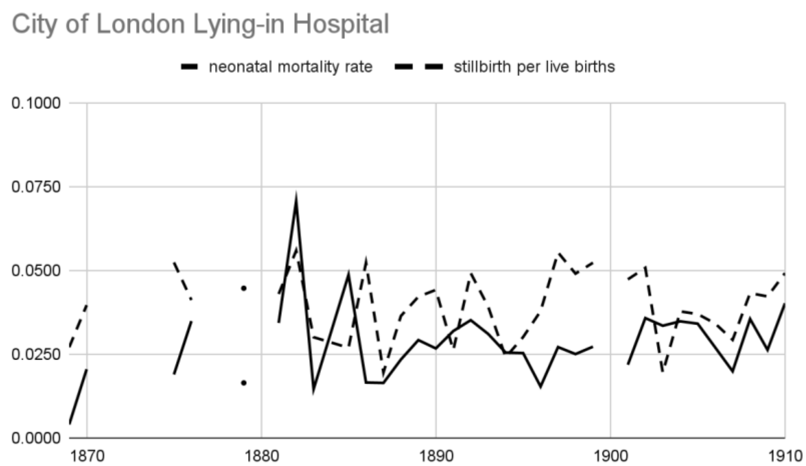


Figure 3: Still Birth Rates of QCH and CLH (1870-1910)

In contrast, there is no significant disparity in early neonatal mortality rates between QCH (0.0298) and the CLH (0.0288) respectively. According to Woods (2005), the mortality rate estimate for infants at 2 weeks of age in England and Wales in 1891 was 0.0298, which coincides with the neonatal mortality rate at QCH. Although the data presented by Woods (2005) encompasses more than just London, the correspondence observed implies a degree of generalizability for QCH data.

However, according to Woods et al. (1988), there were differences in neonatal mortality rates between legitimate and illegitimate births. Woods et al. (1988) reported a 1902 London mortality rate of 0.0406 for legitimate births and 0.0616 for illegitimate 4 weeks after birth, which diverges from the experience in QCH and CLH. The data analyzed in this paper cover a two-week period during hospital admission, before exposure to external environments such as living conditions. This suggests that mortality rates for infants who survived delivery and were born healthy did not significantly differ between mothers of married and unmarried status when external factors were eliminated[17].

Records from QCH yield similar findings. Figure 4 illustrates early neonatal mortality rates by marital status for patients admitted to QCH, revealing no significant difference between married and unmarried patients. In contrast, stillbirth rates exhibit distinct trends. Figure 5 shows stillbirth rates according to marital status, indicating a higher rate for married women at QCH. Moreover, when comparing the age of stillbirths and live births among married women, a statistically significant difference

[17] Wrigley et al. (1997) calculated stillbirth rates by focusing on the difference between endogenous and exogenous infant mortality.

is observed, as depicted in Table 1. Conversely, no age difference is evident between stillbirths and live births among unmarried women, suggesting that maternal age plays a role in stillbirth rates among married women. Additionally, the history of previous pregnancies among married women shows a propensity for increased pregnancies with age, with many having five or more pregnancies after the age of 30, and often exceeding 10 pregnancies. While no direct causal relationship between pregnancy history and stillbirth rates is established, it is plausible to suggest that this is associated with the socio-economic impact of bearing multiple children or with high fertility rates and increased stillbirth rates due to poverty.

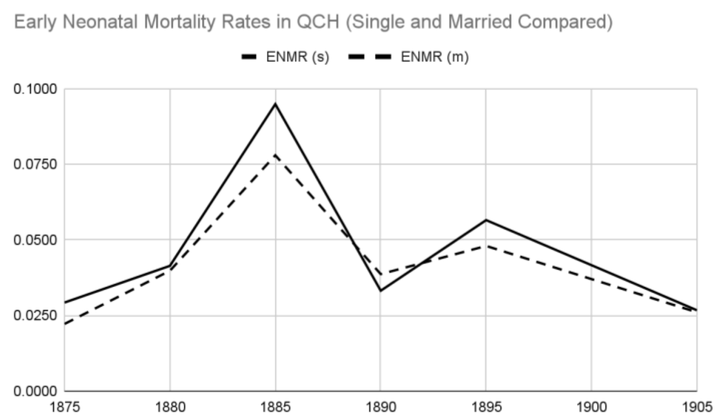


Figure 4: Early Neonatal Mortality (death within 2 weeks after birth) Rates in QCH (Single and Married Compared)

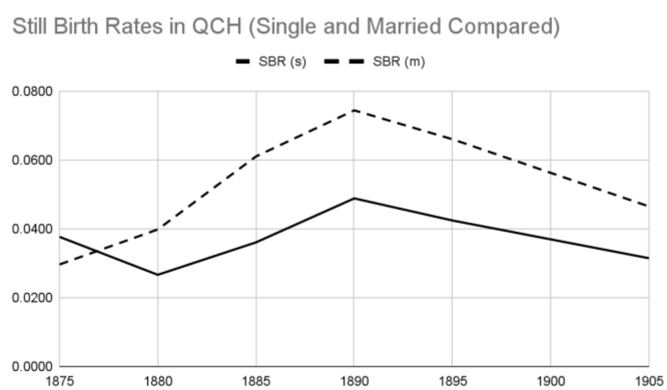


Figure 5: Still Birth Rates of Single and Married in QCH (1875-1905)

| Group | Min | Max | Mean | Median | SD | n |
|---|---|---|---|---|---|---|
| Married & Liveborn | 17 | 48 | 25.10 | 27.00 | 14.34 | 2349 |
| Married & Stillborn | 18 | 48 | 30.61 | 29.34 | 10.27 | 129 |
| Single & Liveborn | 12 | 44 | 24.26 | 22.28 | 10.65 | 2818 |
| Single & Stillborn | 14 | 35 | 23.17 | 22.52 | 6.91 | 106 |

Table 1: Age distribution of mothers according to married/unmarried and stillbirth/live birth in QCH.

## 5. Stillbirths, early neonatal deaths, and "prematurity"

"Premature birth" has emerged as a major contributor to stillbirths and early neonatal deaths. In the early 20th century, concerns regarding strenuous physical labor and heavy work during the final trimester of pregnancy began to surface, highlighting the heightened risk of miscarriage and prematurity, ultimately resulting in low birth weight[18]. This concern is reflected in the Registrar General's Annual Report, which documented an increase in recorded infant deaths attributed to "premature birth" from the mid-19th to the early 20th century[19].

Maternity hospital records show a similar trend in terms of prematurity. Figure 8, derived from data at City of London Hospital, illustrates shifts in factors contributing to early neonatal deaths. There is a significant increase in "prematurity" between 1880 and 1890 while there is a notable decline in deaths attributed to inanition. The term "inanition" referred to extreme weakness in newborns, often used interchangeably with "marasmus". It is challenging to ascertain whether this weakness stemmed from prematurity or other factors, given the fragile condition of the newborns. Additionally, it is noteworthy that "convulsions" should be considered as a distinct cause of death rather than an underlying factor. Previous research has associated "convulsions" in infant mortality with symptoms resulting from dehydration due to diarrhea[20]. However, focusing on early neonatal mortality in this study suggests that convulsions likely stemmed from premature birth[21]. Neonatal seizures are prevalent among pre-term newborns, reflecting the immaturity of the developing brain. Recent studies indicate that low birthweight

[18] Garrett et al. (2001), pp.131-132.
[19] Woods (2000), p. 271, 274.
[20] Reid, A., & Garrett, E., (2012). "Doctors and the causes of neonatal death in Scotland in the second half of the nineteenth century." *Annales de Démographie Historique*, 123(1), 149–179.; Williams, N. (1996). "The reporting and classification of causes of death in mid-nineteenth-century England." *Historical Methods: A Journal of Quantitative and Interdisciplinary History*, 29(2), 58–71.
[21] Spagnoli, Carlotta, et al. (2018)

infants have a higher incidence of seizures due to incomplete brain development, with a 9% rise in seizure rate for every week of reduced gestational age[22]. Thus, despite being categorized as convulsions, prematurity likely underlies such cases. Moreover, the proportion of premature births has increased alongside declines in occurrences of "inanition" and "convulsions". It is plausible to infer that over time, neonates previously attributed to other causes gradually came to be classified as “premature”.

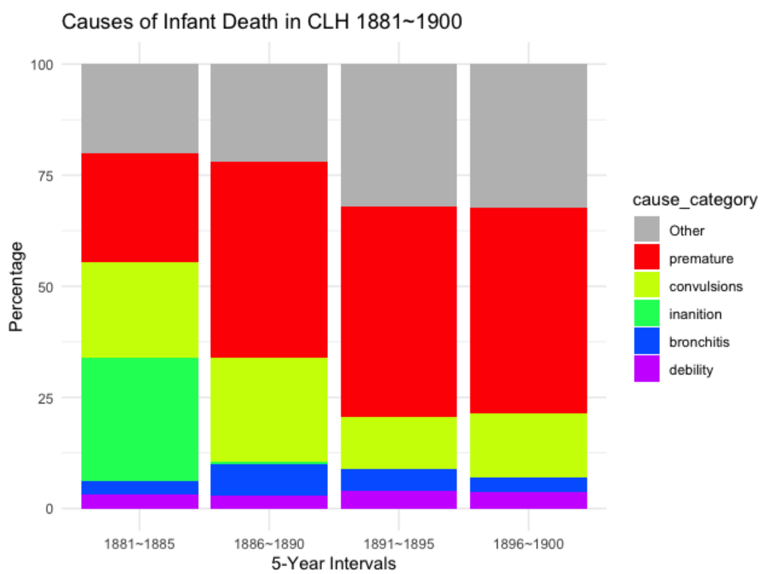


Figure 8: Causes of Early Neonatal Death in CLH (1881-1900)

To explore whether this trend was also evident in QCH, Table 2 categorizes births at QCH in 1880, 1885, 1890, 1895, and 1905 according to “stillbirth” and “live births”, as well as “full-term birth” and “premature birth”. Out of 5379 total births, 5253 were live births and 126 were stillbirths. Significantly, there is a notable difference between the stillbirth rate for those classified as “full term” (1.4%) compared to those classified as “premature” (15.1%). This rate of 15.1% surpasses the index of 25-65 per 1000 live births, as considered a “reasonable” estimate in Woods (2005), indicating a substantial impact of “prematurity” on stillbirths. Therefore, “prematurity” emerges as a significant factor contributing to stillbirths even in QCH.

[22] Kohelet, David, et al. (2004)

| | Full | Premature | Sum |
|---|---|---|---|
| Alive birth | 4994 | 259 | 5253 |
| Stillborn | 80 | 46 | 126 |
| Sum | 5074 | 305 | 5379 |

Table 2: Frequency of Alive Birth and Stillbirth depending on child age

Early neonatal mortality is presented in Table 3. For infants classified as “full term”, the early neonatal mortality rate was approximately 3.0%, whereas for those classified as “premature”, it surged to approximately 30.3%. This stark contrast, almost tenfold, is statistically significant, mirroring the disparity observed in stillbirth rates. Furthermore, the survival rate for neonates categorized as “premature” is notably lower than that for “full-term” births. This finding aligns with existing studies, underscoring the significant role of “premature births” as a contributing factor to neonatal deaths and stillbirths.

| | Full | Premature | Sum |
|---|---|---|---|
| Alive 2 weeks after birth | 4796 | 177 | 4973 |
| Neonatal death (alive when born but died within 2 weeks) | 148 | 77 | 225 |
| Sum | 4944 | 254 | 5190 |

Table 3: Frequency of early neonatal survival and death

Nevertheless, questions persist regarding the reliability of the classification of “premature birth”. Loudon (1992) highlighted the most common causes of neonatal mortality in the past as "prematurity (pre-term labour), congenital malformations, and birth injury"[23]. However, there is no mention of the contemporary definition of “prematurity” or how it was determined. According to the World Health

[23] Loudon (1992), p. 485.

Organization (WHO), currently, infants born before 37 weeks gestation are considered as "preterm" or "premature"[24]. In 1961, the WHO Expert Committee on Maternal and Child Health clarified the distinction between "premature" and "underweight", and in 1970, the Second European Congress of Perinatal Medicine defined "premature" as a newborn under 37 weeks[25]. At QCH, the 1920 Clinical Report stated that "A premature baby is taken to be one under 38 weeks gestation", whereas in 1943, it noted that infants "Birth weight 5.5 lb. and under" were recorded as "premature"[26].

In addition to the notes of "premature" in the hospital records, 50 data entries from 1880-1910 include terms such as "7 months", "8 months", and "5 to 6 months". This indicates that contemporaries relied on approximate months rather than weeks to assess the length of gestation and determine whether the baby was considered "premature" or "full term". However, accurately measuring gestational age would have been challenging at the end of the 19th century, especially considering that echocardiography was not yet available. In fact, there were two patient data entries containing "full?", suggesting ambiguity in classification. It is improbable that many women at the time, particularly those admitted to maternity hospitals, maintained precise records of the onset of their last menstrual period. Additionally, the absence of antenatal check-ups implies that the classification of "prematurity" was likely only a rough estimate.

Today, underweight and prematurity are clearly differentiated and defined, with some births occurring after 37 weeks being underweight, and conversely, some births below 37 weeks being under 2500 g (approximately 5.51 pounds). Nevertheless, it can be assumed that the weight of infants born prematurely is generally lighter than those born at full term[27]. Consequently, if there are no discernible differences in the weight trends between children classified as "premature" and those classified as "full-term", it raises suspicions of misrecording or differing perceptions of what constitutes "prematurity".

Figure 6 illustrates the weight distribution of newborns classified as "full" and "premature" by year. While there is some overlap, newborns classified as "premature" generally tend to have lower weights. Furthermore, the peaks of "premature" weights all fall below 2500 g (5.51 pounds), which is the standard for underweight. This suggests that there is unlikely to be significant misclassification of "prematurity" based on weight, although it should be noted that weight alone does not determine the actual number of weeks of gestation.

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[24] "Preterm Birth." *World Health Organization*, World Health Organization. Retrieved May 10, 2023, from www.who.int/news-room/fact-sheets/detail/preterm-birth.

[25] Quinn, Julie-Anne, et al. (2016)

[26] The average gestation weeks for all premature live births in 1947 was 36.2, median 37, min 28 and max 43 weeks. This suggests a strong reliance on birth weight when indicating prematurity.
*Clinical Report of Queen Charlotte's Maternity Hospital for 1922,* London, p. 28, Retreived from Wellcome Collection: https://wellcomecollection.org/works/ua3wur42; *Clinical Report of Queen Charlotte's Maternity Hospital for 1943*, London, p. 36, Retreived from Wellcome Collection: https://wellcomecollection.org/works/veswmjr8.

[27] Kiserud, Torvid, et al. (2021)

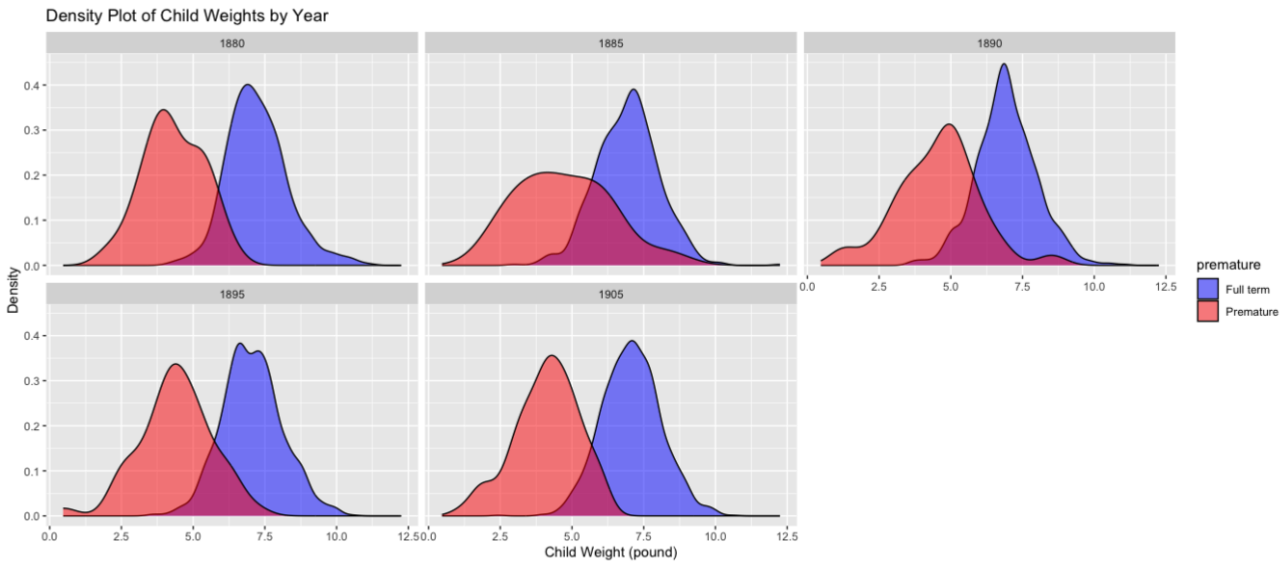


Figure 6: Density of child weights by year in QCH (1880, 1885, 1890, 1895, 1905)

Additionally, t-tests were conducted to determine if there is a difference in weight between stillbirths and preterm births (Table 4). The following discrepancies in weight between stillbirths and live births were identified:

| | min | mean | max | SD | n |
|---|---|---|---|---|---|
| Stillborn | 0.47 | 6.39 | 12.00 | 4.01 | 221 |
| Born Alive | 1.31 | 7.63 | 12.25 | 3.72 | 4819 |
| t = -10.461, df = 166.85, p-value < 2.2e-16<br>alternative hypothesis: true difference in means is not equal to 0<br>95 percent confidence interval:<br>-1.974811 -1.347745 | | | | | |

Table 4: Infant weight according to born state QCH

The statistical analysis reveals a notable disparity in mean child weights between the stillborn and born alive groups. On average, children born alive exhibit a higher mean weight (6.93 pounds) compared to those who are stillborn (5.27 pounds).  Similarly, concerning neonatal deaths, the weight disparity with neonates who survived for two weeks was examined (Table 5): early neonates who remained alive after two weeks weighed, on average, 6.98 pounds, while those who succumbed weighed, on average, 5.75 pounds at birth. Again, the weight difference was found to be statistically significant.

| | min | mean | max | SD | n |
|---|---|---|---|---|---|
| Neonatal death | 1.31 | 5.75 | 10.13 | 1.90 | 213 |
| Alive 2 weeks after birth | 2.43 | 6.98 | 12.25 | 1.11 | 4606 |
| t = 9.0509, df = 207.1, p-value < 2.2e-16<br>alternative hypothesis: true difference in means is not equal to 0<br>95 percent confidence interval:<br>0.9556352 1.4878893 | | | | | |

Table 5: Difference in birth weight between dead and alive after 2 weeks of birth (for years 1880, 1885, 1890, 1895, 1905)

Thus far, the analysis has focused on neonatal deaths and stillbirths concerning “prematurity” and birth weight. As highlighted by Loudon (1997), “prematurity” significantly impacts neonatal mortality and stillbirths, a correlation further supported by birth weight. Now, attention turns to another puzzle: the rise in "prematurity" as a cause of death, as identified by Woods (2000). According to Woods (2000), both "infant mortality rates due to premature birth" and "the percentage of all infant deaths attributed to premature birth" exhibited a steady increase between 1880 and 1913 in England and Wales. Table 6 presents the “prematurity” rate of alive births that died before two weeks of age for QCH.

| | All neonatal death | Neonatal death (premature) | % of premature in all neonatal death |
|---|---|---|---|
| 1875, 1880, 1885 | 106 | 21 | 19.8% |
| 1890, 1895, 1905 | 119 | 58 | 48.7% |

Table 6: Prematurity rate of all neonatal death

Remarkably, the rate nearly doubled from 1875 to the early 1900s, mirroring the pattern documented by Woods (2000). However, previous studies have not elucidated the contributing factors behind this escalation. Hence, I conducted a deeper investigation into the classification of "premature births" to find out the contributing factors behind this increase.

| Years | Total Birth | Number of "Premature" | % of "Premature" |
|---|---|---|---|
| 1875, 1880 | 964 | 35 | 3.63 |
| 1885, 1890 | 1772 | 112 | 6.32 |
| 1895, 1905 | 2715 | 220 | 8.10 |

Table 7: "Premature" rate for all births QCH

Table 7 illustrates the "prematurity" rate for all newborns in each year: in 1875, approximately 36 out of every 1000 newborns were classified as "premature", while by 1905, this figure had risen to about 81. This indicates an overall increase in the number of children classified as "premature", irrespective of whether they were stillborn or born alive. There might have been alterations in the classification of "premature infants", or indeed, an actual surge in their numbers[28]. Historical records do not provide insights into the changes made in the classification of "premature infants" during that period[29]. However, if the proportion of premature infants did indeed rise, it would likely correspond to a downward trend in overall birth weight. To explore this further, Figure 7 has been generated.

[28] Galley (2021) responded to the increase in "premature" as a factor in infant mortality by stating that if there was indeed an increase in the number of "premature" newborns, then there should also be a "substantial decline in maternal health". However, given the decline in adult mortality in this period, that could not have been the case.
[29] According to Garett (2022), "Suggestions to Medical Practitioners respecting Certificates of Causes of Death" issued by the Registrar General stated that the term "premature birth" was prefered over indefinite terms such as "debility" when recorded to a death certificate, suggests a change in recording patterns among doctors. Although this was for infant mortalities and not stillbirths, it is likely that recording of stillbirths were also affected by these sorts of statements.

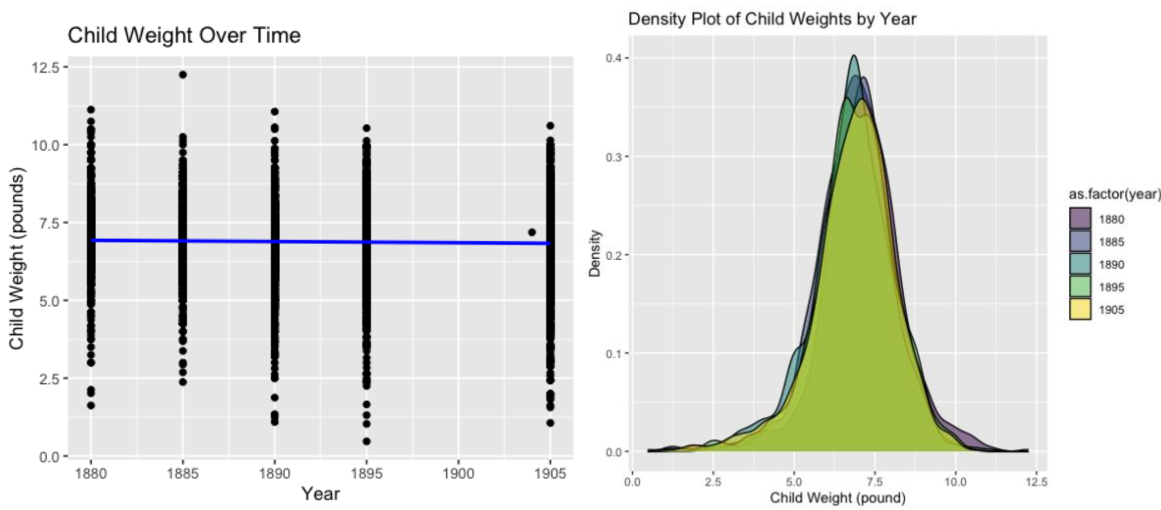


Figure 7: Change in Child Weight born in QCH (1880-1905)

Figure 7 depicts the trends in child birth weight over the years. The results of the linear regression analysis reveal that the coefficient for the “year” variable is approximately -0.0039. This coefficient represents the estimated change in child weight (in pounds) per one-unit increase in the “year” variable. The associated p-value for this coefficient is 0.0549. Given the borderline significance and the limited explanatory power of the model, it would be prudent to conclude that there is no strong linear trend in child weight over the years in the dataset. This implies that the rise in the number of births classified as “premature” is more likely due to changes in classification criteria over time, rather than an actual increase in the prevalence of “premature” infants.

Therefore, incorporating hospital records into research on neonatal mortality and stillbirths offers crucial insights into previously unexplored dimensions. By leveraging infant birth weight data, I aimed to verify whether the observed increase in “premature” classifications corresponded with actual birth weight trends. While previous studies lacked means to validate this classification's accuracy, the utilization of hospital records allowed for a thorough examination. Despite the upward trend in “premature” classifications over time, birth weight trends remained consistent. This suggests a potential shift in classification criteria, a significant finding not previously investigated in depth. Thus, integrating these datasets provides a clearer understanding of neonatal health dynamics, underscoring the importance of incorporating hospital records alongside traditional sources for more comprehensive and accurate research.

## 6. Conclusions

This paper delves into an analysis of neonatal deaths, stillbirths, and birth weight within the London area spanning from 1880 to 1910, with a primary focus on QCH and CLH as the pivotal case study. The key findings extracted from this analysis are as follows:

1. The stillbirth rates observed at QCH and CLH align closely with prior estimates for England and Wales. However, QCH's rates were marginally higher, likely attributable to a greater prevalence of illegitimate births.

2. Noteworthy is the absence of disparity in early neonatal mortality rates between legitimate and illegitimate births at QCH. However, it is worth noting that stillbirth rates were elevated for legitimate births, potentially linked to maternal age and pregnancy history.

3. No discernible discrepancies emerged in stillbirth rates between hospital and home births, indicating a consistency across both settings.

4. The classification of “premature” yielded a significant influence on both stillbirths and early neonatal deaths, with a consistent trend of lower birth weight at the time of death.

5. Over the period spanning from 1880 to 1905, there was a marked increase in the number of children classified as “premature”, irrespective of survival outcome. However, this surge did not coincide with any discernible shifts in birth weight trends, suggesting that the overall increase in “premature” designations may be attributed to record-keeping alterations rather than actual changes in prevalence.

The hospital registration records have been underappreciated as a source of evidence regarding stillbirth rates. Remarkably, the stillbirth rate observed in maternity hospitals falls within the anticipated range of estimates. Moreover, the stillbirth rates among in-patients do not exhibit significant deviations from those associated with out-of-hospital births. Additionally, the meticulous documentation present in hospital registration records, encompassing details such as birth conditions, causes of death, and even physical measurements, mitigates concerns regarding misrecording, in contrast to Parish Records. Thus, these records serve as invaluable historical evidence elucidating stillbirth occurrences at the close of the 19th century. Using the unique patient profiles of maternity hospitals can help reveal the specific details of individual experiences, preventing the oversimplification of diverse situations under the general labels of “England and Wales”. Certainly, each hospital has its own unique dimensions and capacities. Nonetheless, a more precise estimation of stillbirth and early neonatal mortality rates towards the end of the 19th century is possible when the distinctive attributes of each institution are comprehensively understood and leveraged.

While this study focused on a comparative analysis of two hospitals, a remaining task lies in identifying trends across other maternity facilities to understand the broader landscape. Furthermore, expanding the analytical scope beyond the five-year timeframe will furnish a more comprehensive understanding over an extended period. Delving into a more granular examination of patients' residential addresses would likewise offer insights into stillbirths and early neonatal deaths distributed across various districts in London.

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