Comparing regional neonatal mortality rates: the influence of registration of births as live born for birth weight &lt;500 g in Taiwan

Liang-Yi Wang,1 Yu-Shan Chang,2 Fu-Wen Liang,3 Yung-Chieh Lin,2 Yuh-Jyh Lin,2 Tsung-Hsueh Lu,4,5 Chyi-Her Lin2


ABSTRACT

Objective To investigate regional variation in the registration of births (still+live) as live born for birth weight &lt;500 g and the impact on the city/county ranking of neonatal mortality rate (NMR) in Taiwan.

Design Population-based cross-sectional ecological study.

Setting 20 cities/counties in Taiwan.

Participants Registered births for birth weight &lt;500 g and neonatal deaths in 2015–2016.

Main outcome measures City/county percentage of births &lt;500 g registered as live born and ranking of city/county NMR (deaths per 1000 live births) including and excluding live births &lt;500 g.

Results The percentage of births &lt;500 g registered as live born ranged from 0% in Keelung City (0/26) and Penghu County (0/4) to 20% in Taipei City (112/558), 24% in Hsinchu County (5/21) and 28% in Hualien County (9/32). The change in city/county ranking of NMR from including to excluding live births &lt;500 g was most prominent in Taipei City (from the 15th to the 1st) followed by Kaohsiung City (from the 18th to the 14th).

Conclusions The city/county NMR in Taiwan is influenced by variation in the registration of live born for births with uncertain viability. We recommend presenting city/county NMR using both criteria (with or without minimum threshold of gestation period or birth weight) for better interpretation of the findings of comparisons of city/county NMR.

INTRODUCTION

Comparing regional neonatal mortality rates (NMR) is the most commonly used method to identify the health problems and to assess the quality of maternal and child care of a particular region. However, scholars have reminded of ensuring the true ‘like for like’ comparison.1–4 Studies in Canada, the UK and the USA have shown regional variations in registration of live born for previable or periviable births and their associations with infant or neonatal death rates.5–17 However, no study has been performed in Asian countries. Taiwan is an East Asia country showing drastic decline in total fertility rate, from 1.770 in 1997 to 1.125 in 2017, which was the lowest one among 195 countries and territories in 2017.18

According to the Taiwan government report, the percentage of births (still+live) for birth weight less than 500 g increased from 0.39% (848/217,386) in 2004 to 0.58% (1207/207,837) in 2016 (online supplementary table 1).20 Furthermore, the percentage of births registered as live born for birth weight &lt;500 g also increased from 7.7% (65/848) in 2004 to 10.0% (121/1207) in 2016 (online supplementary table 2).20 However, little is known on regional variations in the registration of births as live born for birth weight &lt;500 g and their impact on the regional ranking of NMR in Taiwan.

In Taiwan, the criteria of live birth followed the definition set by the WHO as ‘the complete expulsion or extraction from its mother of a product of conception, irrespective of the duration of the pregnancy, which, after such separation, breathes or shows any other evidence of life—for example, beating of the heart, pulsation of the umbilical cord or definite movement of voluntary muscles—whether or not the umbilical cord has been cut or the placenta is attached. Each product of such a birth is considered live born.”21 Theoretically, healthcare providers in every city/county in Taiwan use the same definition of live birth. Realistically, as indicated by Joseph et al, several factors will affect the registration of live birth for these previable or periviable births, such as financial compensation and healthcare culture.4 We sought in this study to investigate city/county variation in percentage of births registered as live born for birth weight &lt;500 g and compare the city/county ranking of NMR including versus excluding live births &lt;500 g in 2015–2016. We hypothesise that the percentage...
of live born registration for birth weight <500g will be higher in cities than in counties. Cities are more urbanised than counties and have more level 3 medical centres with neonatal intensive unit (NICU), therefore are more likely to register births <500g as live born.

METHODS

Data source

City/county data on registered births (still+live) and neonatal deaths (death before 28 days of life) in Taiwan for 2015–2016 were obtained from open government data: Birth Report System (https://olap.hpa.gov.tw) and Mortality Data System (https://dep.mohw.gov.tw/DOS/cp-2519-3480-113.html), respectively.20 22 In Taiwan, all healthcare providers who delivered the babies are mandatory to report the birth-related information to Birth Report System regulated by the Administration of Health Promotion, Ministry of Health and Welfare.20

Patient and public involvement

This study used government open data and patients were not directly involved in the design of this study.

Analysis

There are five categories for gestational weeks (<28 weeks, 28–31 weeks, 32–36 weeks, 37–41 weeks and >41 weeks) and 11 categories for birth weight (<500g, 500–999g, 1000–1499g, 1500–1999g, 2000–2499g, 2500–2999g, 3000–3499g, 3500–3999g, 4000–4499g, 4500–4999g, ≥5000g). Because of more detail of information for birth weight categories, we thus used birth weight cut-offs for viability in this study.

As the number of births <500g which have been registered as live born increased prominently in 2015 and 2016 (online supplementary table 2) and some cities/counties had relatively small number of births for birth weight less than 500g, we therefore combined the 2 years’ data together in calculating the percentage of births <500g registered as live born in each city/county. Following previous studies,5–9 16 we compared the city/county ranking of NMR including versus excluding live births <500g. To test if cities had higher percentage of live born registration than counties, we listed the population density (population per km²) of each city/county as indicator of urbanisation level. Map and ranking slope-graph were used to illustrate the results in dashboard which can be accessed athttps://public.tableau.com/profile/robert.lu#!/vizhome/neonatalmortalityrate/Story. The users can move the cursor to a particular city/county and the percentage of births <500g registered as live born will pop out.

RESULTS

A huge city/county variation in percentage of births <500g registered as live born was noted (table 1 and figure 1). There were three cities/counties with percentage larger than 20%, that is, 28% in Hualien County (9/32), 24% in Hsinchu County (5/21) and 20% in Taipei City (112/558). On the contrary, there were seven cities/counties with percentage less than 5%. No birth <500g has been registered as live born in Keelung City (0/26) and Penghu County (0/26). We did not find an association between city/county percentage of births <500g registered as live born and city/county population density (table 1).

The range of city/county NMR including live births <500g was 3.27 deaths per 1000 live births, from 1.56 in Changhua County to 4.82 in Hualien County. The range decreased to 2.95 if we excluded live births <500g, from 0.88 in Taipei City to 3.83 in Pingtung County (table 1 and figure 2). The change in city/county ranking of NMR was most prominent in Taipei City (from the 15th to the 1st) followed by Kaohsiung City (from the 18th to the 14th).

DISCUSSION

The findings of this study indicate a huge regional variation in percentage of births registered as live born for perivable babies and had a great impact on regional ranking of NMR. Our hypothesis was not supported, that is, the percentage of registration of live born for perivable babies in cities was not higher than the percentage in counties. However, metropolitans (such as Taipei City and Kaohsiung City) with relatively higher percentage and larger number of perivable babies which have been registered as live born would have greater change in ranking of NMR.

Series of studies in Canada have indicated provincial variation in registration of live born for birth weight <500g and associated with variation in ranking of provincial infant mortality rates.5–10 For example, the registration of live births less than 500g and less than 24 weeks of gestation was more meticulous in Alberta than elsewhere in Canada, which resulted in an increase in infant mortality rate in Alberta.10

Two UK studies indicated higher proportion of very preterm infants registered as live born and transferred to NICU in Trent, UK, compared with those in Nord Pas-de-Calais, France, and New South Wales/the Australian Capital Territory, Australia, was the main reason for higher NMR in Trent. The authors reminded that information about very preterm babies (not usually included in routine statistics) is vital to avoid inappropriate interpretation of international perinatal and infant data.11 12

A study in the USA investigated the state-level variations in the classification of live birth or fetal death would be reflected in the fetal and infant mortality rates for this birth weight group. The findings of that study suggested that six states were more likely to classify outcomes as a live birth/infant death, while 14 states were more likely to classify as a fetal death, when compared with a large reference state. The authors concluded that fetal death and early infant death outcomes reported for babies less
Table 1 Percentage of births (still+live) registered as live born for birth weight <500 g and neonatal mortality rate (NMR) including (NMR1) and excluding (NMR2) live births <500 g by region in Taiwan, 2015−2016

<table>
<thead>
<tr>
<th>Region</th>
<th>Population density*</th>
<th>Births &lt;500 g</th>
<th>Registered as live born</th>
<th>%</th>
<th>Neonatal deaths 1</th>
<th>NMR1</th>
<th>Neonatal deaths 2</th>
<th>NMR2</th>
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<td>Taiwan</td>
<td>653</td>
<td>2527</td>
<td>257</td>
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<td>2.50</td>
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<td>32</td>
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<td>28.1</td>
<td>26</td>
<td>4.82</td>
<td>17</td>
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<td>558</td>
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<td>20.1</td>
<td>162</td>
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<td>4.21</td>
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<td>41</td>
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<td>3</td>
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<td>17</td>
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<td>15</td>
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<td>2</td>
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<td>2.3</td>
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<td>0.0</td>
<td>0</td>
<td>1.61</td>
<td>8</td>
<td>1.61</td>
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<tr>
<td>Penghu County</td>
<td>810</td>
<td>4</td>
<td>0</td>
<td>0.0</td>
<td>5</td>
<td>2.61</td>
<td>5</td>
<td>2.61</td>
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</tbody>
</table>

*Population per km² as indicator of urbanisation.

than 500 g reflect differential classification, thus influencing the validity of these vital statistics data at the state level.13 Another US study further indicated that the birth hospital was an important predictor of whether the death was classified as a fetal or infant death. Among the 31 hospitals selected for study, there was a nearly 15-fold variation in the probability of events being classified as early neonatal versus fetal death.14

A recent US study assessed county-level variation in death event reporting at 17–20 weeks of gestation and associations with county infant mortality rates. Of 2391 counties studied, the percentage of deaths at 17–20 weeks reported as fetal ranged from 0% to 100% (mean 63.7%) and every 1 point increase in this percentage was associated with a 0.02 point decrease in county infant mortality rate. The authors suggested that the variation in the reporting of previable gestation deaths likely reflects a combination of legislative policy and hospital practices, cultural norms in attitudes towards pregnancy termination and neonatal resuscitation, as well as social, economic and religious views.15

A study of 147 primary care trusts (PCT) in England indicated wide between-PCT variation in percentages of births <24 weeks of gestation registered as live born with 90% central range from 26.3% to 79.5%. Excluding births <24 weeks led to significant changes in infant mortality rankings of PCTs, with a median worsening of 12 places for PCTs with low rates of live born preterm births <24 weeks of gestation compared with a median improvement of four ranks for those with higher live birth registration rates.16

The findings of this study are consistent with the findings of study in England. We noted prominent improvement in ranking of NMR after excluding live births <500 g in the largest metropolitan (Taipei City and Kaohsiung City). The two cities had relatively higher percentage and larger number of births <500 g registered as live born and consequently had a greater impact on ranking of NMR after excluding the live birth <500 g. We also identified several cities/counties showing relatively large increase in number of reporting live births <500 g in 2015 or 2016. Future research is needed to explore the possible reasons of the increase.

One possible explanation that our hypothesis was not supported was that many pregnant women with possible periviable births who resided in counties (eg, Nantou County, Miaoli County or Changhua County) nearby Taichung City (figure 1) might go to level 3 medical centres with NICUs in Taichung City for deliveries. These births were still registered in the counties in which these
What is known about the subject?

- Studies have shown regional variations in registration of live born for perivable babies and impacts on regional infant or neonatal mortality rates (NMR).
- However, little is known on this comparability problem in Asian countries.
What this study adds?

- Huge variations exist in registration of live born for births <500 g between cities/counties in Taiwan.
- Variation in registration practices impacts greatly on the ranking of regional NMR in Taiwan.
- It is recommended to present city/county NMR using both criteria for better interpretation of the findings of comparisons of city/county NMR.

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