Neonatal Mortality Risk Related to Birth Weight and Gestational Age in British Columbia

William J. Kierans, BA, MA,[1] Lorne A. Verhulst, MD, MPA,[2] Jemal Mohamed, BSc, MSc,[3] Leslie T. Foster, BSc, MA, PhD[4]

[1]British Columbia Vital Statistics Statistics Agency, Victoria BC

[2]Chronic Disease Management and Primary Health Care Renewal Branch, Medical Services Division, British Columbia Ministry of Health, Victoria BC

[3]Strategic Directions and Analysis Branch, Medical Services Division, British Columbia Ministry of Health, Victoria BC

[4]School of Child and Youth Care, University of Victoria, Victoria BC

Abstract

Objectives: To provide gender-specific neonatal mortality grids depicting relative risk in narrow birth weight ranges at each week of gestation. The grids will provide practitioners with clinically relevant information pertinent to pregnancy, delivery, and postnatal care in Canada.

Methods: Records from the British Columbia Vital Statistics Agency birth and death registries from 1981 to 2000 were deterministically linked and resulted in a 99.86% linkage rate. Risk ratios were computed by dividing percent neonatal mortality in 250 g birth weight categories at each week of gestation by the overall gender-specific mortality rates for the full period. We adjusted random rate fluctuations that were due to low frequencies in the narrow birth weight and gestational age strata.

Results: Females exhibited greater survival across the full spectrum of birth weight by gestational age strata, but their mortality configurations were noticeably different from those of males. In addition, there were demarcations in both grids that depicted relatively abrupt changes in risk ratios. Although the crude mortality rates in BC decreased during the study period, the use of risk ratios reduced the disparity in crude rates over time.

Conclusion: These gender-specific mortality grids refine and enhance previously available comparisons by portraying neonatal mortality risks in narrow birth weight ranges at each week of gestation.

Résumé

Objectifs : Fournir des grilles de mortalité néonatale par sexe décrivant le risque relatif, en ce qui concerne d'étroites plages de poids de naissance à chaque semaine de la gestation. Ces grilles fourniront aux praticiens des renseignements cliniques pertinents au sujet de la grossesse, de l'accouchement et des soins postnatals au Canada.

Méthodes : Les dossiers des registres des naissances et des décès de la *ritish Co umbia Vita Statistics gency* , couvrant la période de 1981 à 2000, ont été liés de façon déterministe, ce qui a mené à un taux d'appariement de 99,86 %. Les risques relatifs ont été calculés en divisant la mortalité néonatale (en %) dans les catégories de poids de naissance de 250 g à chaque semaine de gestation par les taux globaux de mortalité par sexe pour l'intégralité de la période. Nous avons neutralisé l'effet des fluctuations aléatoires des taux qui étaient attribuables à de faibles fréquences au sein de la strate restreinte « poids de naissance et âge gestationnel ».

Résultats : Les filles ont présenté un taux de survie supérieur tout le long de la strate « poids de naissance par âge gestationnel », mais leurs configurations de mortalité étaient nettement différentes de celles des garçons. De plus, les deux grilles présentaient des démarcations décrivant des modifications relativement abruptes en ce qui concerne les risques relatifs. Bien que, en C.-B., les taux bruts de mortalité aient connu une baisse pendant la période d'étude, l'utilisation de risques relatifs a permis de réduire la disparité des taux bruts avec le temps.

Conclusion : Ces grilles de mortalité par sexe améliorent et rehaussent les comparaisons qui étaient disponibles auparavant, en décrivant les risques de mortalité néonatale en fonction d'étroites plages de poids de naissance à chacune des semaines de gestation.

J Obstet Gynaecol Can 2007;29(7):568–574

Key Words: Birth weight, gestational age, neonatal mortality, mortality grids

Competing Interests: None declared.

Received on November 27, 2006

Accepted on February 6, 2007

INTRODUCTION

Birth weight and gestational age are well recognized determinants of neonatal mortality. Changes in population-based neonatal mortality, related to birth weight and gestational age, have been quantified regularly in reports from government vital event registries. However, those reports provide only a cursory understanding of the interaction of both factors on mortality risk. Grids showing greater detail have rarely been reported.[1–5]

Mortality grids provide pertinent information for medical practitioners when they are considering the possibility of postnatal problems, whether to induce delivery or prolong gestation, when to carry out in utero therapy, or when to transfer a pregnant patient to a higher care hospital. They

are also a useful educational tool, because they graphically portray changes in risk in relation to intrauterine growth and gestational age. They may serve as a useful public health measure by providing detailed comparisons among populations.

The few available grids have not been particularly applicable in Canada because the reported mortality rates were higher than Canadian rates.[1–5] Therefore it is uncertain whether the relative risks associated with babies that are large for dates or small for dates could be extrapolated to the Canadian context. There are few actual neonatal deaths in the relatively smaller samples in published reports.[1,2,4] These reports were based on regional or in-hospital samples,[1–4] and thus were not representative of the entire population of newborns. Published grids were not gender-specific.[1,2,4,5] Females are at lower risk for mortality and morbidity than males after accounting for lower birth weight at the same gestational age.[3,6] To our knowledge, the first population-based grid in Canada was published by the British Columbia Vital Statistics Agency (BCVSA),[7] and the BCVSA subsequently published the first gender-specific grids.[8]

Most reports published in the last 10 years that analyzed gestational age-specific neonatal mortality were focused on small for gestational age (SGA) neonates.[9–14] Studies that included immediate and longer term outcomes related to large for gestational age (LGA) neonates other than macrosomia are much less common.[15–17] However the studies were not in a Canadian context, with the exception of the reports of Anath and Wen[9] and Wen et al.[17] Our data quantify the relative risk of neonatal death at both the upper and lower extremes of weight at all gestational ages in a large Canadian dataset.

This report presents updated gender-specific, population-based mortality grids based on deliveries in the context of Canadian obstetrical care. They have been modified from previous versions[8] to show clinically relevant estimates of relative risk. We used data provided by BCVSA because of the virtually complete linkage rate between birth and death records and the established quality of gestational age estimates.

METHODS

The data were based on live birth and death registrations and notices of birth detailing events from January 1, 1981 to December 31, 2000. The full BCVSA data file contained 882 390 records of live births to residents of British Columbia. The analyses file was restricted to live births at between 22 and 44 completed weeks of gestation and birth weights between 500 g and 6000 g. Records in which the weight, gestational age, or gender were missing, and four cases in which the weight was grossly at variance with the gestational age (see below), were excluded. Those missing birth weight and gestational age values comprised < 0.25% of births in the full data file and were proportionally distributed across gestational age. The BCVSA makes a particular effort to include birth weight and gestational age values on all records. If either measure is not recorded on the notice of birth, the source is contacted before the record is processed. There were only nine cases with missing gender values. Births to BC residents occurring in Alberta were also included because previous work indicated the potential for skewed results if those events were not included,[18] although such events were few (< 1%) and would not have affected the results reported here. This study was designed to provide reference charts that are representative of all live births; therefore, non-standard births (e.g., births with complications, multiple deliveries, or congenital anomalies) were not excluded from the analyses. That has also been the practice in other mortality grid studies.[2–4]

Infant death registration records from the BCVSA death registry were linked and added to the birth records (including any infant deaths in 2001 that occurred to infants born in 2000). There were 3661 neonatal deaths in the BCVSA death file for the period 1981 to 2000.[19] Comprehensive searching yielded 3656 (99.86%) links to the birth file. Links were deterministically based on birth registration number, which appears on the infant death record. Subsequent exclusions reduced the number of neonatal deaths included in the final grids. In the case of infant deaths to former residents of British Columbia, inter-provincial agreements ensured that the death record was available for linkage. The confidentiality of BCVSA records was protected according to approved practices.

Neonatal mortality (< 28 days) was calculated as a percentage of live births in birth weight groups of 250 g at each week of gestation for males and females separately. However, the narrow birth weight and gestational age ranges resulted in low birth and death frequencies in individual grid cells, which in turn produced random mortality rate fluctuations. To compensate for those random rate fluctuations in individual grid cells, a calculation strategy was used to produce the final male and female grids. In this strategy, cells with fewer than five births were excluded from further calculations. Mortality in percentage for each remaining cell was averaged with the percentage in the four cells immediately surrounding it. If four cells were not available (such as on the margins of the grid), excluding unavailable cells would produce a negative bias in the upper grid cells and a positive bias in the lower cells, so in those cases the percentage in the specific cell was averaged with the percentage in the cell immediately to the left and below (i.e., one week and birth weight stratum lower), and the percentage in the cell