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Preface

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Estimating child mortality from information on previous birth: data from a Portuguese birth cohort.

Neir A. Paes¹; Cristina Teixeira²; Henrique Barros³

¹ Department of Statistics of the Federal University of Paraíba, Cidade Universitária, João Pessoa, PB, Brazil (E-mail: antunes@de.ufpb.br)

^{2,3} Institute of Public Health, University of Porto, Porto, Portugal and Department of Clinical Epidemiology, Predictive Medicine and Public Health, University of Porto Medical School, Porto, Portugal (E-mail: cristina.teixeira@ipb.pt; hbarros@med.up.pt).

Abstract: A whole range of techniques have been developed for estimating infant and child mortality from the information routinely recorded in maternity registers on age and reproductive history of delivering mothers. Among them, the best-known and most widely applied indirect technique was developed by William Brass. Using the baseline information from a birth cohort (Generation XXI) assembled in the period 2005-2006 in the metropolitan area of Porto, North of Portugal, we addressed in this paper the following objectives: (1) to estimate the child mortality rates based on information about previous births and their survivorship among women recruited for this birth cohort; (2) to compare these indirect estimates with direct values retrieved from Portuguese vital statistics; (3) to analyse the potential of this birth cohort to generate plausible estimates of life-table indicators. We retrieved data on mother's age, previous live births prior to the current one, and number of surviving and deceased children from a group of multiparous women ($n=3521$). The data was divided into seven 5-year groups by maternal age and survival and death probabilities were computed for each group. Through the Brass method, we obtained estimates of probability of dying before attaining certain exact childhood ages, $q(x)$, by using the multipliers $k(i)$ as proposed by Trussel. Then, a logit life-table system was used to derive life-table indicators. Accordingly, probabilities of dying between birth and 2, 3, 5 and 10 years were respectively: 4.1; 6.7; 9.4 and 13.1 per 1,000 children ever born, which were allocated in time-period. These indirect estimates compared with the direct ones obtained from Portuguese vital statistics revealed that they were very similar. The life expectancy at birth was 77.6 years for both

sexes, and the implied infant mortality was 4.0 per 1000 live births for Grand Porto during the period 2005-2006. The use of indirect method to analyze the potential of the Generation XXI cohort data in provide relevant information on reproductive issues, not available in the vital statistics, seems to be an important and effective tool, and promissory for analyzing the follow-up studies of this cohort held in 2009 and 2012.

Keywords: Child mortality, Brass' Method, Preceding Birth Technique.

1 Introduction

The 5th stage of demographic transition, which many call postmodern demographic regime, already occurs in some of the more developed countries of the world where death rates, although low, begin to exceed birth rates, which results in a negative crude rate of natural increase [1]. Portugal went through all stages of the Demographic Transition Model. According to the Portuguese vital statistics [2], since 2007 the number of deaths ($n=103,512$) has exceeded the number of live births ($n=102,492$). In the recent years Portugal went into the 5th phase; the fertility rate is around 1.3 and infant mortality rate reached 3.4 per 1000 live births which are among the lowest rates in Europe [3].

Tracing the evolution of child health indicators is essential for evaluating the availability and quality of health care in a community. Infant and child mortality [4,5] have been used for this purpose. The accurate estimation of the probabilities of dying before certain age, particularly under-five years old, are largely used by international agencies to monitor development progress [6] and, is one of the principal input parameters used to develop estimates of life expectancy at birth and other summary indicators of mortality [7,8].

In the face of dramatic reduction in absolute level of infant and child mortality in developed countries, the challenge is to document disparities across groups concerning such deaths. The evaluation of potential efficacious interventions to reduce adverse neonatal and childhood outcomes should take into account a set of characteristics, namely demographic, social and obstetric factors in order to

perceive the decline of disparities rather than the decrease of crude mortality rates. The estimates of demographic and health indicators available in Portugal are based on census data and vital statistic registration [2]. From the latter the infant and child mortality rates can be directly obtained. However, Portuguese vital statistics has no information about a set of demographic characteristics such as parity, social factors as education, adverse maternal behaviours and obstetric complications; medical records are usually more detailed than vital statistics concerning such information.

A whole range of indirect techniques have been developed for estimating infant and child mortality based on the information retrieved from medical records of women delivering a child, or based on sample surveys, on age and reproductive history of delivering mothers [7-9]. These indirect estimation techniques could be useful to provide childhood mortality rates when a set of maternal characteristics is not available in vital statistics. They also offer potential estimates for continuous follow-up studies over time.

One of the largest birth cohort ever assembled in Portugal was established between 2005 and 2006 in the Porto Metropolitan Area, North of Portugal (Generation XXI). We addressed in this paper the following purposes: (1) to estimate the child mortality rates based on information about previous births and their survivorship among women recruited for this birth cohort; (2) to compare these indirect estimates with direct values retrieved from Portuguese vital statistics; (3) to analyse the potential of this birth cohort to generate plausible estimates of life-table indicators.

2 Methods

In Portugal, nearly all deliveries occur within hospitals and 90% of them occur in public hospitals free of charge for all childbearing women and their offspring. The participants of the present study were recruited in five public hospitals level III, while assembling a birth cohort in Porto Metropolitan Area, in the north of Portugal (Generation XXI). Between April 2005 and August 2006, 70% of all

pregnant women delivered at those five public hospitals were invited as participants on the basis of “first come first served” and only 8% of those invited refused to participate. This approach allowed a representative sample. The final sample comprised 8495 women who delivered live infants (>24 weeks). Information on social and demographic characteristics, obstetric and gynaecological history, lifestyles and current pregnancy events was obtained using a structured questionnaire. Individual interviews were performed 24 to 72 hours after delivery by trained interviewers. Information on pregnancy complications, delivery circumstances and data on newborn characteristics were abstracted from patient medical records.

From all mothers enrolled in this cohort only multiparous women with at least a previous child before the current delivery ($n=3520$) were included in the present analysis. We retrieved data on mother's age, previous live births prior to the current one and number of deceased children.

In this work we used the method developed by William Brass [7], the best-known and most widely applied indirect technique for estimating child mortality rates. Accordingly, women were stratified by five-year age groups from 15-19 to 45-49. The procedure converts proportions dead children ever born, $D(i)$, reported by women's age group into estimates of the probability of dying before attaining certain exact childhood age, $q(x=1, 2, 3, 5, 10, 15$ and 20 years old), by using the multipliers $k(i)$ as proposed by Palloni-Heligman, assuming that Far Eastern family in the United Nations model life tables system is an adequate representation of the pattern of mortality of Porto [7].

We computed also the reference time-period, $t(x)$, which represents an estimate of the numbers of years before the survey date to which the child mortality estimates, $q(x)$, refer. The values of the coefficients to estimate $t(x)$ were retrieved from the United Nations Report [7].

We assumed that the pattern of fertility by age of the women and the childhood mortality have remained without important changes during the recent past. Indeed, between 2000 and 2006 the total fertility rate varied from 1.36 and 1.41 live births per woman and infant mortality rate varied between 5.5 and 3.6 infant

deaths per 1000 live births. We assumed also a similar pattern of fertility by age of the multiparous in the Generation XXI and the Portuguese women as a whole. We obtained the direct estimates of child mortality from Portuguese vital statistics [2], taking into account the reference period and we compared the values of direct and indirect estimates.

Once $q(x)$ is estimated, its complement $l(x)$, the probability of surviving from birth to exact age x , is readily obtained as $l(x) = 1.0 - q(x)$, which was converted in logit function, $Y(x)$. According to the logit life-table system as proposed by Brass [7], the Portugal (2009-2011) life table was used as a standard model to derive the adjusted life table to Porto for ages under 10 [2].

3 Results and Discussion

Table 1 shows the basic data and the main results on the application of the Brass's method according to five-year age group of mother. In Portugal, increasing numbers of women are delaying childbearing into their thirties and early forties, making the consequences of older maternal age for the infant an important public health concern. Grand multiparity, by contrast, is now exceedingly rare in this country. There were 3521 multiparous women in the present analysis; only 24% (n=829) of those women reported to have 2 or more children previously to the current birth. The mean age of women was 32 years (standard deviation ± 5.26). The total number of children ever born was 4651; 1.2% (n=55) of those children died.

Proportions deceased are quite instable in age group 15-19 due to the very small numbers of births. On the other hand, for the last age group, no dead was reported, and the proportion of the age group 40-44 is out of line probably due to the age composition of the sample. Therefore, mortality estimates based on the reports of women for these age groups were disregarded. Proportions deceased were also instable in age group 25-29 and 35-39, which demanded some adjustments. Since there is no evidence that the proportion of death

provided by the age group 20-24 and 30-34 are unreliable, the obtained estimates for the adjacent age groups (25-29 and 35-39) was performed by linear interpolation. As presented in Table 1, the indirect estimates of the probability of dying (mortality rates) between birth and age 2, 3, 5 and 10 years old were 4.0, 5.7, 7.3 and 9.6 per 1000 children ever born, respectively. Assuming that Porto has a little lower mortality rates compared with the country as whole, and considering the reference time-period to which child mortality $q(x)$ refer, in general the mortality rates presented similar values when indirect and direct estimates of child mortality are compared.

Calculation of logit transformation of the estimated survivorship probabilities, $l(x)$, and the corresponding logit transformation of the standard life-table used (Portugal 2009-2010) showed a reasonable degree of coincidence between one set and the other for multiparous women. Notably deviant points were those associated with the $l(5)$ and $l(10)$ estimate. On the basis of these observations, the level indicated to match with the standard life-table was $q(2)$, which correspond to a more recent period. In this way, the adjusted pattern was obtained by assuming an value for a level of $\alpha = 0.050$ and standard $\beta = 0.979$ according to the Brass's logit life table system.

Table 1. Data required to compute child mortality according to the Brass' method and indirect and direct estimates of mortality rates under 2, 3, 5 and 10 years old to Porto Metropolitan Area, Portugal.

Women's Age Group (years)	Average parity per women	Number of children ever born	Proportion of children dead	Index x	Generation XXI		Portuguese vital statistics	
					Prob. of dying	Reference time-period	Prob. of dying	Reference time-period
15 – 19	1,0000	35	0.0286	$q(1)$	-	-	-	-
20 – 24	1,1682	382	0.0052	$q(2)$	0,0040	2001	0,0057	2000/01
25 – 29	1,2247	894	0.0179	$q(3)$	0,0057	1999	0,0060	2000/01
30 – 34	1,2592	1681	0.0071	$q(5)$	0,0073	1997	0,0073	1999/00
35 – 39	1,4651	1279	0.0149	$q(10)$	0.0096	1997	0.0860	1999/00
40 – 44	1.7438	354	0.0141	$q(15)$	-	-	-	-
45 – 49	2,3636	26	0.0000	$q(20)$	-	-	-	-

The construction of a life table based on the estimated level (α) and pattern (α) derived from the application of the Brass's logit life table system, implied in a life expectancy at birth of 77.7 years and, an infant mortality of 3.7 per 1000 live births for both sexes for Grand Porto during the period 2005-2006. These life table estimates seem very plausible, since the official estimate of life expectancy at birth for the Grand Porto in the year 2005 using direct vital registration data was 78.0, and infant mortality of 3.7 per 1000 live births [2].

Conclusions

As other European countries, Portugal witnessed a dramatic decline in crude rates of child mortality [3]. The challenge nowadays is to document disparities in child mortality rates. A set of characteristics should be take into account in order to perceive the decline of these disparities. However, important demographic, social and obstetric factors are not available in the vital statistics. Thus indirect estimation of child mortality based on information about previous births retrieved from medical records of women, could be a useful tool.

We evaluated the appropriateness of the Brass' method to estimate the probability of dying of dying before attaining certain exact childhood ages based on information about previous births, and their survivorship collected in the north of Portugal from a group of multiparous women, when registering a current birth. Accordingly, we observed that the obtained indirect estimates were generally consistent with direct estimates for child mortality rate under 10 years. But don't add substantial insight beyond direct estimates when vital statistics is available. However, the use of indirect method to analyze the potential of the Generation XXI cohort data in provide relevant information on reproductive issues, not available in the vital statistics, seems to be an important and effective tool, and promissory for analyzing the follow-up studies of this cohort held in 2009 and 2012.

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