Early life circumstances and mortality among older adults in Latin America, the Caribbean, Asia and Africa

Mary McEniry
University of Wisconsin

Extended Abstract

Introduction

The aim of this paper is to examine the degree to which there is evidence to support the conjecture that differences in the evolution of mortality in the developing world during the 20th century have important implications for older adult mortality. Because the relatively compressed schedule of aging in countries (for example, in the Latin American and Caribbean region) can in part be traced to the medical and public health revolution that triggered the mortality decline over half a century ago (Preston, 1976; Palloni et al., 2007), it may be possible to observe differences in older adult mortality patterns according to the nature of (timing and speed) and reasons for mortality decline. These particular characteristics of mortality decline may have created cohorts with differential mortality experiences leading to different health patterns later in the life course.

Mortality began to decline in the early twentieth century in some countries of the developing world and by the 1930s-1960s many countries experienced rapid mortality decline. The primary reasons for mortality decline was a mixture of improvements in standards of living, public health interventions and medical technology (Preston, 1976) and countries differed according to the timing and pace of their health transition. Thus, different patterns of mortality decline emerged. Countries in the Latin American and

Caribbean (LAC) region such as Argentina and Uruguay experienced a more graded mortality decline at the start of the 20^{th} century which was mostly attributable to improvements in standard of living (Palloni et al., 2007). Other countries such as Chile and Costa Rica experienced an early mortality decline but less graded over the course of the first part of the 20th century due to a combination of improvements in the standard of living and public health interventions. Countries such as Brazil began a late and rapid mortality decline during the 1930s-1960s while other countries such as Indonesia and China began to experience a significant mortality decline during the 1950s. The mortality decline during the 1930s-1960s was primarily due to public health interventions and improved medical technology (Preston, 1976), the gains of which were concentrated early in the life of individuals, between birth and age 5 or 10. However, while most countries experienced improvements in life expectancy during this period, the magnitude of the mortality decline at younger ages differed across countries according to the nature of (timing and pace) and reason for the mortality decline that had occurred.

The relevance of the different mortality patterns experienced during the early 20^{th} century to the health of today's aging population in the developing world is due to the increasing evidence of the importance of early childhood conditions on adult health. Exposure to poor nutrition during pregnancy can lead to adult chronic conditions such as diabetes and heart disease (Barker, 1998; Eriksson et al., 2001). Both poor childhood socioeconomic conditions (SES) and childhood health can also have substantial impacts on adult health and chronic conditions (Lundberg, 1991; Hertzman, 1994; Wadsworth et al., 2002; Wadsworth & Kuh, 1997; Davey Smith & Lynch, 2004; Elo & Preston, 1992). Chronic conditions such as heart disease and diabetes are projected to dramatically increase in the developing world (Murray & Lopez, 1996). There are important public health ramifications regarding services for older adults and programs for mothers and children if poor early life exposures are important determinants of heart disease or diabetes which then impact adult mortality.

The mid-paced (Costa Rica, Chile, Puerto Rico, Taiwan, South Africa) to late (Mexico, Brazil, Barbados) and very late, rapid (China, Bangladesh, India) mortality decline experienced by some cohorts born during the 1930s-1960s is of particular interest because it produced a larger cohort of individuals who survived poor early childhood conditions, many of whom may also have reached older adult ages. These cohorts are more at risk of having been affected by harsh early childhood experiences while at the same time had larger probabilities of surviving. Prior to the mid 1940s, the mid-paced regimes experienced important increases in infant and child survival whereas it was only after the 1940s that the later regimes experienced major improvements. Thus, older adults born in mid-paced cohorts prior to the mid 1940s may be able to provide some insights into whether early childhood experiences are indeed important in later life because they were less affected by mortality-driven selection than the group of cohorts who preceded them (those aged 75 and older) but were also less affected than cohorts who were born in very late regimes during the same period.

If the Barker hypothesis (or any other hypothesis regarding the importance of childhood conditions) has merit, we would expect to observe that the adult health of these cohorts (and in particular the mid-paced regimes prior to the mid 1940s) has been unduly influenced by poor early childhood conditions. In this paper, we examine the health of older adults born during the late 1920s and early 1940s to test the conjecture that countries which most probably produced a larger number of survivors of poor early childhood conditions as a result of public health interventions and medical technology largely in the absence of improvements in standard of living are also countries with older obese adults and adult with heart disease and diabetes who on average exhibit higher excess of relative risk of mortality. This we achieve by constructing a series of Waaler-type mortality surfaces using mortality data from several countries to (1) estimate and compare overall expected relative risk of mortality and risk by health condition (obesity, heart disease and diabetes) across countries and then to (2) calculate and compare excess of relative risk of mortality using actual mortality data (where available) for these same types of health conditions.

Method

Data

The data used to test the conjecture come from comprehensive national representative surveys of older adults or household surveys. From Latin America there are the Mexican Health and Aging Study (**MHAS**, first wave, n=7171), Puerto Rican Elderly: Health Conditions (**PREHCO**, first wave, n=4291), Study of Aging Survey on Health and Well Being of Elders (**SABE**, n=10,597), and Costa Rican Study of Longevity and Healthy Aging (**CRELES**, first wave, n=2827). From Asia there are the China Health and Nutrition Study (**CHNS**, n=5772), Indonesia Family Life Survey (**IFLS**, wave 2000, n=3998), the Bangladesh Matlab Health and Socio-Economic Survey (**MHSS**, n= 3721), WHO Study on Global Ageing and Adult Health Study in India (**WHO-SAGE**, first wave, n=6559) and Social Environment and Biomarkers of Aging Study (**SEBAS**, n=1023). From Africa there are the WHO Study on Global Ageing and Adult Health Survey in Ghana (**WHO-SAGE**, pre-test, n=507) and South Africa (**WHO-SAGE**, first wave, n=3150). From the developed world there are the Health and Retirement Study (**HRS**, wave 2000, n=12,527), Wisconsin Longitudinal Study (**WLS**, wave 2004, n=7265), English Longitudinal Study of Ageing (**ELSA**, second wave, n=8780), and Survey of Health, Ageing and Retirement-Netherlands (**SHARE-Netherlands**, first wave, n= 2979).

Measures and Analysis

In previous work we developed a reasonable classification of countries into different demographic regimes reflecting the speed of mortality decline, timing of the onset of mortality decline, the degree to which mortality decline was due to exposure to public health interventions and medical technology, and the degree to which mortality decline was due to improvements in standard of living (McEniry, 2009a). The resulting classification is: (A) very early, mortality decline (Netherlands, UK, US); (B) early, graded mortality decline (e.g. Argentina, Uruguay); (C) early, less graded mortality decline (e.g. Chile, Costa Rica, Puerto Rico, South Africa, Taiwan); and (D) late, rapid mortality decline (e.g. Barbados, Mexico, Brazil); (E) little or no mortality decline prior to 1950 (Bangladesh, China, Indonesia, India, Ghana).

We have also estimated the effects of childhood conditions (height, knee height, SES, child health) and adult risk behavior on adult mortality (McEniry, 2009b) and thus this work is not repeated in this paper. However, in several instances, data collected on elderly populations do not contain mortality data. For these countries (in addition to the countries with mortality data), we use height and weight to construct Waaler-type surfaces to estimate **expected relative mortality risk** and where possible estimate excess of relative risk of mortality using observed relative risk. Waaler-type surfaces have been shown to be useful in depicting mortality risk and linking early life circumstances to adult mortality (Fogel, 2004; Palloni et al. 2007). The surfaces are estimated using a standard such as Waaler mortality data (1984) or mortality data on older adults from developing countries to model the following relationship:

Ln(relative risk of mortality)=f(height, weight)

In the surfaces (Figure 1 & 2 are illustrative examples), expected mortality risk for a particular gender, age group and height-pair is defined in relation to the group's overall expected mortality risk. Each curve in the graph shows a similar height-weight-relative risk association for a particular mortality risk. The lowest risk shown on the graph is found among taller individuals, the highest risk is in the lower right hand corner for individuals with shorter height and higher weight and plotted is an optimal line which marks the points at which expected mortality risk is minimized for a particular weight and height.

In this paper we construct and compare Waaler-type surfaces using several standards (1) Waaler data (1984) and (2) mortality data from individuals in countries where panel data are available (Costa Rica and China are of particular interest) assuming that the **relative risk using these standards can be applied to other countries**. Waaler data (1984) is descriptive of a relatively healthy population and a high income country in the 1980s and has been used as a standard in Waaler surfaces (Fogel, 2004). Costa Rica is a small, upper middle income country, mid-paced demographic regime with high life expectancy at older ages and a quality primary health care system and was deemed to be a suitable standard or benchmark. China is a large country and a very late regime which nevertheless experienced large transformations in health care and could also be deemed a suitable standard.

Using mortality data from these countries we construct separate surfaces for each gender and different age groups. Then using country-specific, gender-specific and age-specific data on height and weight we (1) estimate overall expected relative risk of mortality and then for different types of health conditions (e.g. obese and non-obese adults; adults with and without heart disease and with or without diabetes) for each country; (2) estimate excess of relative risk of mortality for those countries where mortality data are available using expected values and observed relative risk.

Expected Results and Discussion

If our supposition has merit, we expect to observe higher expected mortality risk in older adults as we move from cohorts that were born in countries characterized by early/graded mortality decline primarily due to improvements in SES to cohorts born in countries characterized by mid to late/rapid mortality decline due to public health and medical technology. We also expect to find that in some instances in this later group of countries older obese adults and/or adults with heart disease or diabetes exhibit a higher excess of relative risk of mortality. We compare the different Waaler surfaces and discuss their applicability and usefulness in helping to test the conjecture regarding early life conditions. We also discuss the strength of evidence for the conjecture and its implications if it has merit.

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Figure 1: Example of Waaler-type surface estimated using mortality data from Mexican men aged 60-74

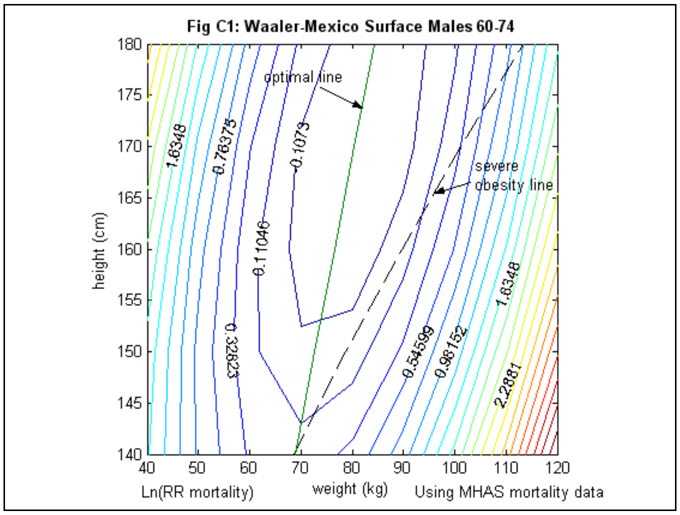
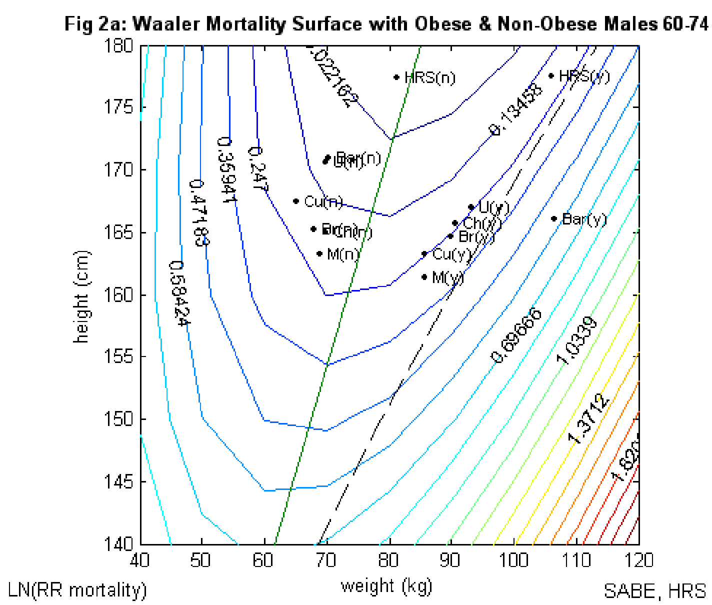


Figure 2: Example of Waaler-type surface estimated using Waaler data (1984) to compare expected relative mortality risk among obese and non-obese older Latin American and Caribbean men



(Note: Bar=Barbados, Br=Brazil, Ch=Chile, Cu=Cuba, M=Mexico, U=Uruguay, HRS=US; n=not obese, y=obese; the relative risk numbers express the LN(relative risk of mortality))