A New Approach to Indirect Estimation of Crisis Mortality Associated with Armed Conflict & Famine

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Abstract

Armed conflict and famine often have large-scale population consequences. Yet the measurement of the mortality consequences of such crises is challenging, given that accurate data at the population level before, during and after such crises is often lacking and classical demographic methods and model life tables are ill-suited for such situations. In this paper, I explore the flexible, two-dimensional mortality model recently proposed by Wilmoth et al. (2012) and consider its adaptation to crisis mortality situations. Specifically, I draw on high quality data from a diverse array of demographic surveillance sites, population censuses, longitudinal surveys, and series from the Human Mortality Database to explore the suitability of this mortality modeling approach to famine and armed conflict situations. These situations include a diverse array of armed conflict and famine situations from both contemporary and historical populations. I contrast this approach with existing approaches used by the United Nations Population Division and the World Health Organization and conclude with an assessment of this indirect mortality modeling approach and outline future research directions to advance crisis mortality estimation approaches.

1 Introduction

Armed conflict and famine often have severe population consequences (Dyson and O'Grada 2002; Brunborg et al. 2006). The mortality impacts of such crises can vary considerably across different types of conflict, famines and environments (Guha-Sapir and D'Aoust 2010) Further, the mortality impact of such crises usually involves both short-term consequences (in the form of direct and indirect deaths during or immediately after the onset of conflict or famine) and long-term consequences (in the form of later-life effects of the crisis on the health and longevity of those who survive the crisis period) (Curlin et al. 1976; Mielke and Pitkanen 1989; Menken and Campbell 1992; Bongaarts and Cain 1982; Razzaque et al. 1990; Lee 1990; Doblhammer et al. 2011).

The accurate estimation of mortality from such crises is important. First, such estimates are an important factor in understanding the demographic consequences of famine and armed conflict (Brunborg et al. 2003; Tabeau et al. 2009; Dyson 1993). Second, better mortality estimates of such phenomenon provide a stronger empirical basis for demographic projections of future population size and growth and vital rates. Third, as mortality rates are a useful summary indicator of population health, they are widely used in comparative analyses of the health situation during different famines and armed conflicts (Burkle 2006).

Despite their importance and wide recognition as an important measure of impact, the systematic measurement of mortality levels and trends during armed conflict and famine crises remains challenging (Guha-Sapir and Ratnayake 2009; Checchi 2010). This is mainly due to the paucity of high quality demographic data sources before, during and after war and famine, as well as the somewhat ad-hoc nature of estimation methods and inadequacy of mortality models used in these situations.

This paper reviews the main approaches used by academic demographers and the World Health Organization (WHO) to estimate age specific mortality rates during armed conflict and famine. I review the types of data used by these various approaches as well as the strengths and limitations of the various methods. I then assess the performance of a new indirect estimation method, developed by Wilmoth et al. (2012), in estimating age-specific mortality rates in a diverse array of armed conflicts and famines. Comparisons are made with vital registration data, when available, and/or alternative estimation methods.

2 Objectives

Most recent approaches to the measurement of the mortality consequences of armed conflict and famine have mainly focused on the estimation of either the magnitude of excess mortality or crude death rates (Spiegel and Salama 2000; Checchi and Roberts 2005). The other main strand of literature on the demography of armed conflict and famine has focused mainly on estimation and analysis of summary measures, such as under-five mortality rates, crude death rates or adult mortality rates (Hill 2004; Obermeyer et al. 2008). This paper aims to complement and extend these efforts by evaluating the performance of a new 2-dimensional mortality model in estimating age-specific mortality rates during two broad types of mortality crisis. By exploring a diverse set of case studies that cover a broad range of famine and armed conflict situations, I seek to examine how well this 2-dimensional model describes the age-specific mortality rates across a collection of famine and armed conflict situations that have high quality vital registration or longitudinal survey data. Further, I examine the scope for improvement of this model via the addition of third-order adjustments for such speiclal cases as armed conflict and famine situations.

Wilmoth et al. (2012), when exploring the flexibility of their 2-dimensional indirect mortality model, examined the ability of their model to reproduce a wide range of age patterns of mortality. In particular, they investigated their model's performance for such crisis mortality cases as war mortality resulting from the second world war in England and Wales and also from the Spanish civil war, as well as the Spanish flu epidemic. In this paper, I use high quality data from a range of historical and contemporary populations that have experienced famine and armed conflict to evaluate the performance of the model. I also compare the model's performance with other formal demographic approaches - notably a different funtional form, by way of the modified Brass Logit System (Murray et al. 2003), and a model lifetable approach, by way of the crisis mortality model life table system developed using high quality survivorship data on Liberian slave returnees in the nineteenth century (Preston and McDaniel 1993).

3 Data & Methods

Data

To examine the applicability of the Wilmoth et al. (2012) model to crisis mortality situations, I examine the model's applicability to famines in Bangladesh, Ukraine, China, Madagascar, and Finland (where we have have high quality data on age-specific mortality rates) using the following data:

1. **The 1974-5 Bangladesh Famine** using data from the Matlab, Thana Demographic Surveillance Site (Razzaque et al. 1990; D'Souza and Bhuiya 1982),
2. **Famine crises in Liaoning, China in 1782-1789, 1813-1815, and 1831-1841** using data from the Chinese Multigenerational Panel Datatset (Lee and Campbell 2011),
3. **The urban famine in Antananarivo, Madgascar, 1984-5** using death registration data from the Municipal Hygeine Offices in Antananarivo (Waltisperger et al. 1998), and
4. **the Finnish famine of 1861-65** using Lutheran Parish records of baptisms, marriages and burials (Pitknen 1993).

These famine cases include cases of modern and historical famines, as well as urban famines as well as rural famine situations.

I also explore the model's aaplicability to armed conflict situations in Bangladesh, Afghanistan, Finland, Spain, and England & Wales:

1. **The 1971 Bangladesh War of Independence** using data from the Matlab, Thana Demographic Surveillance Site (Curlin et al. 1976),
2. **The 1978-1987 Afghan War** using population census and survey data (Khalidi 1993; Sliwinski 1988),
3. **The National 1808-09 war of Finland** using Lutheran Parish records of baptisms, marriages and burials (Pitknen 1993),

4. **The Spanish Civil War, 1936-39** using the Human Mortality Database (University of California and for Demographic Research Germany), and

Methods Description

Wilmoth et al. (2012) propose the following equation to describe the relationship between child and adult mortality

$$log(m_x) = a_x + b_x h + c_x h^2 + v_x k \tag{1}$$

where $h = log({}_5q_0)$. This model describes the log of mortality at age x (on the left) with a quadratic curve in units of $log({}_5q_0)$ (on the right) plus an extra term $v_x k$. The quadratic component describes the fundamental underlying relationship between mortality at ages older (and younger) than five to mortality between ages zero and five, and the extra $v_x k$ term allows some age-specific modification to that fundamental relationship. The $v_x k$ term is necessary because of the empirical observation that there is sometimes a slight age-specific deviation from the strong underlying shape of this relationship; the age schedule of v_x defines the general shape of this deviation with age, and k modulates the magnitude of the deviation. The exact form of the basic relationship is set by the values of the a_x, b_x, and c_x coefficients, and the exact nature of the age-specific deviation is defined by v_x.

In this paper, I examine the plausibility of this model to famine and armed conflict situations by analyzing the fit of the Wilmoth et al. (2012) model in the aforementioned crisis situations. I then examine the use of highly customized third-order adjustments to the v_x profiles for both famines and armed conflict situations and compare these empirical results with age-specific mortality schedules derived from the modified Brass-Logit system and the Preston & McDaniel model life table system.

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