Common adult longevity and compression of mortality: the M Project

Jean-Marie Robine,[a] Siu Lan K. Cheung,[a] Shiro Horiuchi,[b] and A. Roger Thatcher[c]

[a]INSERM, Health and Demography, [b]Program in Urban Public Health at Hunter College and CUNY Institute for Demographic Research, [c]Former Director of the Office of Population Censuses and Surveys, London

Correspondence: robine@valdorel.fnclcc.fr

Short abstract (150 words): The M Project - M for Mode - started in 2005 with the aim of studying the adult longevity to better understand the lengthening of adult life duration in contrast with the fall of infant and child mortality and the increase in life expectancy at birth. Specific targets deal with the assessment of the occurrence of the scenario of mortality compression, the shape of the distribution of adult life durations, their dispersion around the modal age at death (M), and the extreme values such as the maximum reported ages at death. Disentangling socio-economic inequalities (SES) in adult longevity from "limit" variability may be an important target in the future of the M-Group. Several papers have already been published; others are in press or in progress. They deal with actual data, formal demography and mechanisms of the compression of mortality. We propose to summarize our results for the general IUSSP conference (150 words).

Long abstract (4 pages): The M Project - M for Mode - started in 2005 with the aim of studying the adult longevity to better understand the longevity revolution defined as the lengthening of adult life duration in contrast with the fall of infant and child mortality and the increase in life expectancy at birth. Specific targets deal with the assessment of the occurrence of the scenario of compression of mortality, the shape of the distribution of adult life durations, their dispersion around the modal age at death (M), and the extreme values such as the maximum reported ages at death. Disentangling socio-economic inequalities (SES) in adult longevity from "limit" variability may be an important target in the future of the M-Group. Several papers have already been published; others are in press or in progress. We propose to summarize our results for the general IUSSP conference.

Actual data: Using mortality statistics from several countries as well as data gathered by the Human Mortality Database (HMD), we closely monitored changes in adult longevity and proposed a number of new indicators

Formal demography: The modal age at death (M) appears to be useful in understanding and applying major mathematical models of mortality trajectory (i.e. the Gompertz, logistic, Weibull, Lexis models), using M as a parameter and investigating characteristics of M-related measures in those models.

Causes and mechanisms of the compression of mortality: Changes in the modal age of death and in the compression are shown to be driven by the way in which age-specific death rates fall at ages 70 and over.

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M-Projet or M-Project related papers published, in press or in progress:

PAA 2006: What can be learnt by studying the adult modal age at death? By Jean-Marie Robine, Siu Lan Karen Cheung, Roger Thatcher, Shiro Horiuchi

ABSTRACT: Taking all the data available in the Human Mortality Database (HMD), this study illustrates the interest of a mode-oriented approach to longevity research, focusing on the most common longevity. Several indicators built from the adult modal age at death (M) are introduced to describe the adult longevity and its changes over time, examining whether an increase in the most frequent age at death is always accompanied by a compression of the mortality occurring above it.

Comparative analysis with standard mortality measures (i.e. life expectancy at birth (e(0)), median, life expectancy at age 65 and the logarithm of the geometric mean of age-specific death rates between ages 65 and 99) is also presented. In this study, we show that M is useful not only as a measure of longevity but also in understanding and applying major mathematical models of mortality trajectory (i.e. the Gompertz, logistic, Weibull, Lexis models), using M as a parameter and investigating characteristics of M-related measures in those models.

Demography (2007): Increase in common longevity and the compression of mortality: The case of Japan by Siu Lan Karen Cheung and Jean-Marie Robine

ABSTRACT: This study shows a strong increase in the modal age at death (M) in Japan over a period of 50 calendar years, accompanied by a clear decrease in the standard deviation of ages at death above M (SD(M+)) until the 1990s for men and the mid-1980s for women. For the most recent periods SD(M+) appears to have stopped decreasing, even though M has continued to increase linearly. This stagnation in SD(M+) has been accompanied by stagnation in q(M). The number of deaths at M (d(M)) and the number of deaths at and above M (d(M+)) have increased, but significantly more slowly since the period 1975–79. Since the 1980s an acceleration in the increase of M+kSD(M+), our indicator of the longest life durations, has been essentially due to the pause in SD(M+). Our data do not suggest that we are approaching an upper limit in human longevity.

PAA 2008: The compression of deaths above the mode. By A. Roger Thatcher, Siu Lan K. Cheung, Shiro Horiuchi and Jean-Marie Robine.

ABSTRACT: The frequency distribution of ages at death has been shifting to the right, but it has not retained exactly the same shape. The ages of deaths above the mode have become more compressed. The paper investigates the reasons for this phenomenon. One of the simple models of mortality is found to be appropriate and mathematically tractable. Changes in the modal age of death and in the compression are shown to be driven by the way in which age-specific death rates fall at ages 70 and over. Both can be predicted from the death rates. Results are illustrated by data from the English Life Tables and Interim Life Tables, and these are confirmed by extensive data for six countries (including England and Wales) using the Human Mortality Database. Amongst other things, the paper illustrates how it is possible for the slope of the mortality curve to steepen while people are living longer, thus implying that the traditional ageing rate is not a valid measure of senescence.

SOA 2008: Is There a Limit to the Compression of Mortality? By Jean-Marie Robine, Siu Lan K. Cheung, Shiro Horiuchi, and A. Roger Thatcher

ABSTRACT: With the fall of mortality, the frequency distribution of ages at death has been shifting to the right, but it has not retained the same shape over time. The distribution of ages at death has become more compressed around the mode, which is consistent with the prediction of mortality compression proposed by James Fries in 1980. In this paper we investigate trends in the age distribution of deaths at old ages using historical data from European countries (i.e. England and Wales, France, Italy, Sweden, and Switzerland), the United States of America, and Japan. The results, especially for recent decades in Japan, prompt us to reconsider the validity of the mortality compression scenario. This paper discusses the notion of limit for the compression of mortality and examines alternative hypotheses such as the shifting mortality model.

SOA 2008: Is the Compression of Morbidity a Universal Phenomenon? By Jean-Marie Robine, Siu Lan K. Cheung, Shiro Horiuchi, and A. Roger Thatcher

ABSTRACT: Recent reviews of national health trends show conflicting results. It is clear today that the various health dimensions follow different trends over time. For instance an expansion of morbidity may accompany a compression of disability. What do we measure when we observe a decline in disability? Is the elderly population intrinsically healthier or are individuals more independent and less helped by children, using more technical devices in a more favorable environment? The recent OECD study, reviewing trends in ADL disability at age 65 and over in 12 OECD countries during the 1990s,

demonstrates that there is clear evidence of a decline in disability among elderly people in only five of the twelve countries studied: Denmark, Finland, Italy, the Netherlands, and the United States. Three countries (Belgium, Japan and Sweden) report an increasing rate and two countries (Australia, Canada) a stable rate. In France and the United Kingdom, different surveys show different trends in ADL disability (OECD, 2007). These results suggest that a decline in ADL disability may be less universal than expected. More importantly, the OECD study shows that ADL disability at age 65 and over ranges widely from a low 7.1% in the Netherlands (HIS) to a high of 18% in the United Kingdom (GHS survey). This paper reviews available evidence about the compression of morbidity and the disability decline and discusses the context in which they occur: initial level of disability, initial value of life expectancy and trend in life expectancy.

La Revue économique (in press) Nouvelles observations sur la longévité humaine. Jean-Marie Robine et Siu Lan K. Cheung

ABSTRACT: New facts in the human longevity: *With the fall of mortality, the frequency distribution of ages at death has been shifting towards older ages. The ages at death around the mode have become more compressed illustrating the scenario of compression of mortality proposed by James Fries in 1980. However, this homogenization of the adults' life durations could not prevent the explosion in the numbers of oldest-old, nonagenarians and centenarians, which we have witnessed in recent decades. Some reasons for this phenomenon are investigated, and results are illustrated by historical data from European countries (i.e. England and Wales, France, Italy, Sweden, and Switzerland), the United States of America, and Japan. The most recent results, especially for Japan, prompt us to re-examine the scenario of compression of mortality. It seems to us that the homogenization of adults' life durations, which is the driving force of the compression of mortality, may meet limits today – beyond remaining social inequalities – inherent in all biometric quantities. Such a scenario – shifting the whole distribution of adults' individual life durations towards older ages without decreasing their dispersion – would increase more and more the number oldest-old as well as the number of centenarians and persons 105 or 110 years old. Is the lengthening in healthy life duration able to follow such a rate of increase? The few studies available abroad suggest not. It thus becomes an urgent need to appreciate the evolution of the health status of centenarians whose number has multiplied by nearly three in the last 10 years in France, from 7 175 individuals on 1st January 1998 to 20 115 on 1st January 2008. The consequences of such a demographic change may be of considerable importance for financing and organizing the burden of dependency if the new nonagenarians and centenarians are frailer and have a poorer functional health status than their elders.*

Genus (in press): The use of cohort and period data to explore changes in adult longevity in low mortality countries. By Siu Lan Karen Cheung, Jean-Marie Robine, Graziella Caselli

ABSTRACT : This paper aims to specify the relationship between the increase in the late modal age at death and the decrease in the dispersion of the ages at death above it in low mortality countries (i.e. France, Italy, Japan and Sweden) by using cohort and period data. Using a quadratic fitting in the modal region allows a unique determination of the late modal age at death (M). A log-linear model is fitted to predict the values of the standard deviation of the ages at death occurring above the modal age at death (SD(M+)) when M is increasing to foresee future change in human longevity. These results cast doubt on several central arguments in the demography and biology of ageing: (i) whether the basic pattern of mortality follows the same unitary pattern at older ages in different populations, (ii) whether the decline in SD(M+) is proportional to the increase in M, and (iii) whether no definite longevity limit is at sight. (159 words)

Comptes Rendus Biologie (in press) La démographie de la longévité en France et dans le monde Demography of longevity in France and over the world. Jean-Marie Robine

ABSTRACT: During the 20th century, the frequency distribution of ages at death has been shifting to older ages, but it has not retained exactly the same shape. In Japan and in Western Countries ages at

death have compressed around the mode, illustrating the scenario of compression of mortality which has not prevent an important increase in the number of oldest old.

From now on some countries seem to move towards a new model of evolution of longevity where the modal length of life increases when the standard deviation remains unchanged, which will accelerate the increase in the number of centenarians.