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Chapter 1

GENERAL INTRODUCTION
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INTRODUCTION

This thesis entails research on the compression and plasticity of old-age mortality during the epidemiologic transition. The first chapters study the start of the epidemiologic transition in rural Ghana and describe the changes in mortality. This is followed by chapters on the compression of mortality and morbidity during the transition in Japan and the Netherlands. Finally, the last chapters concern the plasticity of mortality at old age. Studying old-age mortality during the epidemiologic transition is of great importance now that an increasing number of people reach old-age.

Life expectancy has increased all over the world from an average life expectancy of approximately 40 years before the epidemiologic transition to an average life expectancy that exceeds 80 years in post-transitional countries today.[1] This major success in improving life expectancy was accompanied by a shift from child to old-age mortality and from infectious to non-infectious diseases.[2] The process of these mortality changes are described in the epidemiologic and demographic transition theories.

In 1971, it was Omran who first extensively described the different stages of the epidemiologic transition. He defined three classical stages, the first with high and fluctuating mortality, with an average life expectancy at birth varying between 20 and 40 years. This was followed by the second stage, when mortality declined at first gradually and then accelerated as soon as epidemic peaks became less frequent. This induced an increase in life expectancy at birth of 30 to 50 years on average. During the last stage mortality declined further, resulting in an average life expectancy that first exceeded 50 years. The first two stages were dominated by infectious diseases, whereas in the last stage the major cause of death was due to chronic diseases. The epidemiologic transition has been described as a sequential process of mortality changes.[2]

Now that mortality rates at old age are continuously on the decline, it is questioned whether the extra years are lived in good or in ill health.[3,4] How patterns of health and disease have evolved in the past and will evolve in the future is studied extensively. Part of this debate is centred around the compression of mortality and morbidity at old age.

The compression of mortality at old age indicates the distribution of the age at death in a population.[5] A population with no mortality compression at all would have completely age independent mortality risks. By contrast, maximum mortality compression would imply that a whole population would die simultaneously at the same age. Over the last
decades, there has been compression of old-age mortality, however, it is debated if the compression of mortality will reach a limit.[6,7] There is even more debate about the compression of morbidity, which precedes mortality. Some argue that our longer lives bring worsening health with an expansion of morbidity.[6,10,11] On the contrary, others believe that morbidity has also been compressed, even at old age.[9,10]

Finally, it is disputed whether mortality at old age is biologically fixed. The role of early life environment on old-age mortality is well documented. Infectious diseases and poor nutrition early in life have been linked with mortality in old age.[11-13] By contrast, there is controversy about the role of direct or late life effects on old-age mortality. Old-age mortality is often still thought to be fixed and it is generally believed that no significant reduction in mortality can be expected from environmental improvements later in life. [14] Some studies however, did show a direct health benefit and mortality reduction when introducing interventions at old age.[15-17] The debate of the plasticity of old-age mortality is of prime importance for the growing population of elderly and public health.

Aim of this thesis
To study the compression and the plasticity of old-age mortality during the epidemiologic transition.

Outline of this thesis
Chapter one provides a general introduction to the research in this thesis and describes the three main topics of this thesis: the epidemiologic transition, the compression of mortality and the plasticity of old-age mortality. The next two chapters are related to the epidemiologic transition. In chapter two we study the role of socioeconomic status and drinking water source on mortality and fertility decline at the start of the epidemiologic transition in rural Ghana. In addition we studied cause-specific mortality trends by making use of Verbal Autopsies. Chapter three covers a study on seasonal variation in mortality and cause-specific mortality in rural Ghana during the epidemiologic transition. We examine variation in mortality depending on the season and on the month of death. In the following chapter four we study the compression of mortality at old age during the epidemiologic transition in Japan and the Netherlands. Next to the compression of mortality, we study the compression of morbidity in chapter five. We decompose the trends in old-age mortality into trends of different morbidity measures. We examine the sex differences in these different measures of healthy life expectancy and discuss the compression of morbidity during the epidemiologic transition in the Netherlands. Following on the previous chapter, we argue that the increase in life expectancy is
accompanied by improved health in chapter six. In the final chapters we study different determinants of the plasticity of mortality at old age. First, in chapter seven, we study the plasticity of old-age mortality, in an experiment of nature in Japan which experienced an accelerated epidemiologic transition. Next, we examine another example of the plasticity of old-age mortality in a study on the effect of high intensive physical exercise on mortality risk in late life. We challenge the view that more physical activity is always better when it comes to health benefits. In chapter eight we test this hypothesis in a cohort of former Olympic athletes from different disciplines with various levels of physical intensity. Furthermore in chapter nine, we study the life expectancy of various historical artists compared to the elite in the Low Countries. Finally, we summarize the implications of our main findings concerning the compression and plasticity of old-age mortality and morbidity in chapter ten.
REFERENCE LIST
