The World-Wide Physiological Revolution: Dysregulation in Cardiovascular and Metabolic Functioning

Eileen Crimmins, Sarinnapha Vasunilashorn, Jung Ki Kim

Abstract

In examining physical change with industrialization, Fogel described the technophysio evolution of health capital that accompanied the industrial revolution. An increase in human capital was evidenced by an increase in height linked to improvements in nutrition. This paper examines the physiological revolution that has accompanied reductions in infection, increases in calorie consumption, and decreases in manual labor, characteristic of most populations. While virtually all populations have experienced increases in weight, hypertension, and dyslipidemia, dysregulations in physiological functioning indicators are related to socioeconomic, medical and cultural circumstances as well as differences in early life circumstances. We use recent biomarker data (NHANES, HRS, ELSA, CHARLS, SEBAS, IFLS, and MxFLS) to examine these differences. Weight is highest in the U.S., Mexico, and England and considerably lower in Asian countries; however, several Asian countries have some of the highest levels of hypertension while it is relatively low in the US because of medication use.

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Introduction

Major changes in human physiology have accompanied the demographic transition. The decline in mortality and the reduction in infection, which has resulted in large increases in life expectancy, has been accompanied by major changes in dysregulation in a number of physiological systems. Humans evolved in a world that was highly infectious, scarcely provisioned, and demanding of significant physical labor. That world began to change with the industrial and scientific revolutions of the nineteenth century and continued to change with the technological advances in medicine and food production of the twentieth century. In examining physical change with industrialization, Fogel (2005) described the technophysio evolution of health capital that accompanied the industrial revolution. During this time increase in human capital was evidenced by an increase in height linked to improvements in nutrition. Medical and technical advances over the last century have changed living circumstances in most countries of the world so that many more people are able to avoid and control infections and consume sufficient food. The result has been a decline in malnutrition and an increase in overnutrition as evidenced by obesity and overweight; an increase in dyslipidemia linked to higher consumption of calories and fat; and an increase in hypertension.

Methods

This paper examines the physiological revolution that has accompanied the reduction in infection, increase in calorie consumption, and decrease in manual labor that has characterized most populations of the world in the last 50 years. While virtually all populations have experienced increases in weight, hypertension, and dyslipidemia, levels of dysregulation in indicators of physiological functioning are related to current socioeconomic, medical and cultural circumstances as well as differences in early life circumstances. This paper uses recently collected data on measured biomarkers from the US National Health and Nutrition Examination Survey (NHANES) 2001-2006, Health and Retirement Study (2006 and 2008) , English Longitudinal Study of Ageing (ELSA) 2004, China Health and Retirement Longitudinal Study (CHARLS) 2008, Social Environment Biomarkers of Aging Study (SEBAS) in Taiwan 2000, Indonesian Family Life Survey (IFLS) 2007-2008, Mexican Family Life Survey (MxFLS) 2002, and the Tsimane of Bolivia (2003-2007) to examine these differences.

All of these surveys include measured biomarkers including anthropometric indicators of weight and height, measured blood pressure, and blood lipid markers. They also include extensive information on social, economic, and behavioral circumstances. Comparisons are based on indicators that are deemed to be measured in comparable

fashion (or adjusted for comparability). The paper will include indicators of weight, stunting, blood pressure, and total and high-density lipoprotein cholesterol.

Results

Figures 1a and 1b show the percent with a body mass index (BMI) ≥ 25 kg/m^2 in each country for males and females, respectively. Overweight is highest in the U.S., Mexico, and England and considerably lower in a number of Asian countries. When the U.S. and England are compared to other Northern and Western European countries, they tend to have relatively high weight. This puts Mexico, a country which underwent demographic transition in the last half of the last century, among the heaviest countries of the world. Clearly, the Asian countries in this figure have fewer overweight people. Some of these countries have had a relatively recent demographic transition and some have spanned a good part of the last century. Japan, the leader in world life expectancy, has a level of overweight for men that is above that in Indonesia and China but below that in Taiwan. However, women rank differently. Japanese women appear to be lighter than other women at ages up to late middle age.

Figures 2a and 2b show the prevalence of men and women (respectively) with hypertensive levels of systolic blood pressure. A number of Asian countries have some of the highest levels of hypertension observed, while the U.S. has relatively low hypertension because of extensive use of medication to control blood pressure. Mexico, Indonesia and Japan lead these countries in levels of hypertension. This is true in spite of significant use of antihypertensives in Japan.

Conclusions

These world wide changes in physiology occurring over the past century have significant health implications.

References

Fogel, Robert W. 2005. Changes in the Physiology of Aging During the Twentieth Century. NBER Working Paper No. W11233.

Figure 1a. Percent of men overweight (body mass index ≥25 kg/m^2) by country

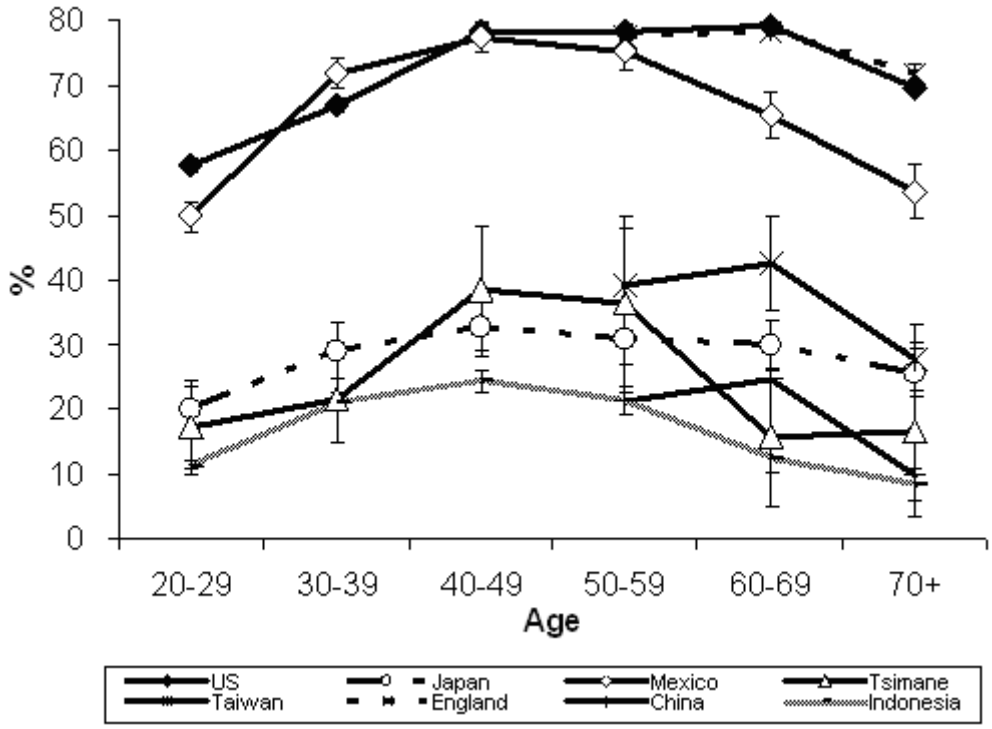

Figure 1b. Percent of women overweight (body mass index ≥25 kg/m^2) by country

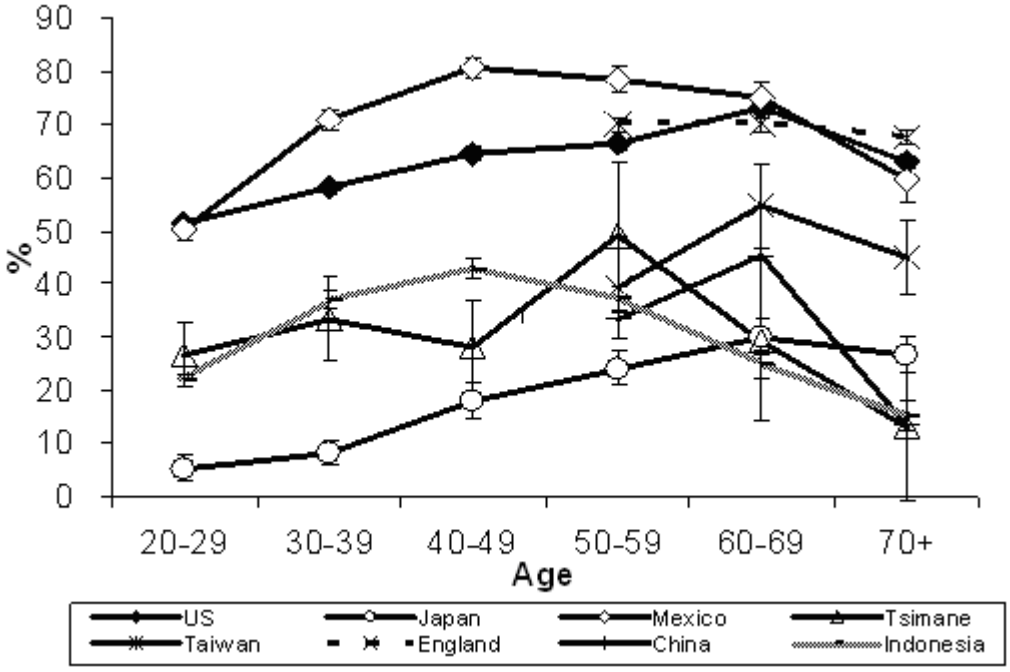

Figure 2a. Percent of men with hypertension (systolic blood pressure ≥ 140 mm Hg) by country

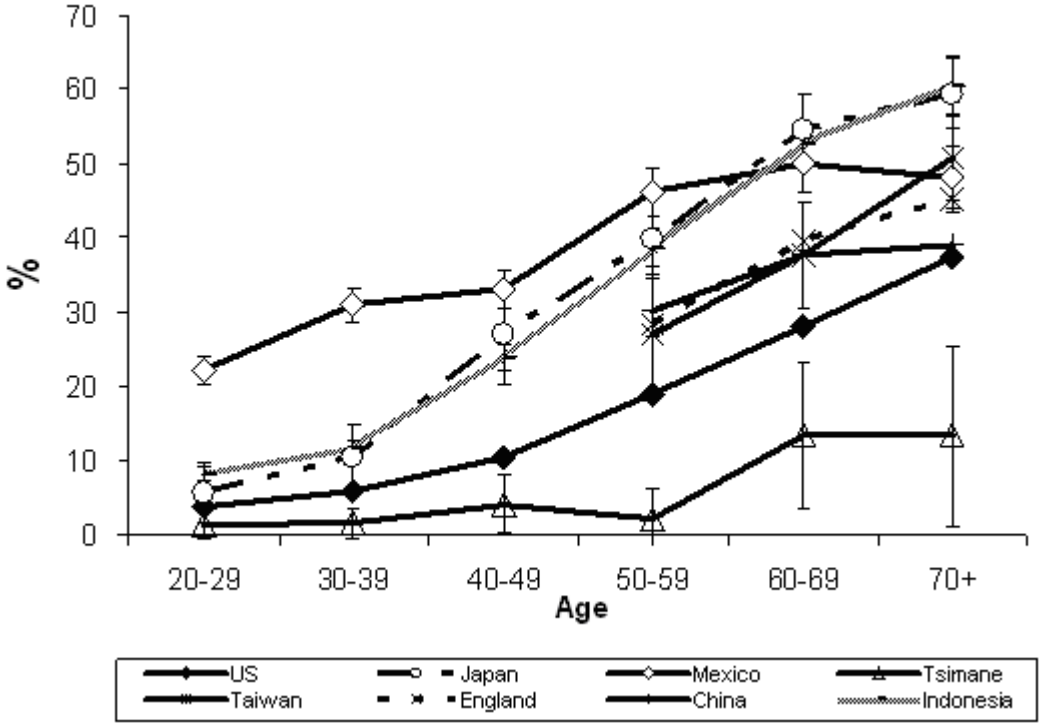

Figure 2b. Percent of women with hypertension (systolic blood pressure ≥ 140 mm Hg) by country