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A meta-analysis of education effects on chronic disease: The causal dynamics of the Population Education Transition Curve

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ABSTRACT

As the Epidemiological Transition progresses worldwide, chronic diseases account for the majority of deaths in developed countries and a rising proportion in developing countries indicating a new global pattern of mortality and health challenges into the future. Attainment of formal education is widely reported to have a negative gradient with risk factors and onset of chronic disease, yet there has not been a formal assessment of this research. A random-effects meta-analysis finds that across 414 published effects more education significantly reduces the likelihood of chronic disease, except for neoplastic diseases with substantial genetic causes. Some studies, however, report null effects and other research on infectious disease report positive education gradients. Instead of assuming these contradictory results are spurious, it is suggested that they are part of a predictable systemic interaction between multiple mediating effects of education and the Epidemiological Transition stage of the population; and thus represent one case of the Population Education Transition Curve modeling changes in the association between education and health as dependent on population context.

1. Introduction

As the Epidemiological Transition (hereafter, ET) progresses worldwide, chronic diseases account for the majority of deaths in developed countries and a rising proportion in developing countries forming a new global pattern of mortality and health challenges into the future. The ET is the historical change in primary causes of morbidity and mortality from infectious diseases to chronic diseases, progressing through four stages of disease burden: pestilence and famine, receding pandemics, chronic and man-made diseases, and delayed chronic diseases (Yusuf et al., 2001). In developed nations well into advanced stages of the ET, growing obesity, tobacco use, sedentary occupations, and other risk factors coupled with lowering of deadly infectious diseases yield high prevalence of chronic and degenerative diseases (Lopez and Mathers, 2006; Reddy and Yusuf, 1998). At the same time, an unprecedented number of national populations are moving rapidly across ET stages and confronting growing levels of these diseases (Fogel and Grotte, 2011; Omran, 1971, 1983). The pace of the ET is particularly challenging for less-developed countries transitioning from lower to the middle stages as rising prevalence of chronic disease adds to the already substantial disease burden from infectious diseases. For example, although incidents of HIV/AIDS and tuberculosis are in decline in Africa, Latin America, and East Asia, growing chronic disease adds to the high disease burden (Amuna and Zotor, 2008; Jamison and Mosley, 1991). The advancing ET is a major worldwide health trend, so understanding the interaction between it and social factors is essential, and chief among these is attainment of formal education.

Exposure to formal education is often reported as associated with increased life expectancy, and hence is often referred to as a leading "social vaccine," meaning a social intervention that provides resources that can protect individuals and elevate the health of populations (Baker et al., 2009; Ubaidullah, 2005). Education as a "social vaccine" is indicated by a negative gradient between educational attainment and disease with the term used in

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education research for over forty years (Smith et al., 2012). The relationship between education and health is complex as formal education is a dynamic process that provides individuals with multiple resources (i.e. material, status, cognitive skills, psychological empowerment, information), and while usually these resources act in a concerted salutary fashion, there are reports of harmful and inconsistent effects of education on health. For example, early in the communicable HIV/AIDS pandemic in Sub-Saharan Africa, higher educational attainment among males, winning them higher average income and status, was associated with promiscuity and likelihood of HIV infection for them and their partners (Smith et al., 2012; Coombe and Kelly, 2001; Fortson, 2008; Hargreaves et al., 2008). As the pandemic progressed and accurate public health information was distributed, cognitive resources from schooling likely led to better understanding about the disease and reduced risk taking and infection among the more educated. Analyses from late in the pandemic found that educated sexually active adults were more likely to understand and use effective prevention strategies against infection (Smith et al., 2012, Baker et al., 2009). A similar pattern is reported for tobacco use and its related chronic diseases over the second half of the 20th century in the U.S.; and evidence is emerging of the same pattern between education and the worldwide obesity epidemic and other diseases over time (Jeon et al., 2013; Cutler and Lleras-Muney, 2010; Pi-Sunyer et al., 1999; De Walque, 2004).

The fact that formal education is such a potent factor in causes of mortality, yet the direction of its impact can vary from a risk factor (positive gradient) to a social vaccine (negative gradient) across time, suggests a more complex relationship than has been acknowledged in the past (Baker et al., 2011; Smith et al., 2012; Brown et al., 2012). Instead of assuming these contradictory results are inconsistent or spurious, it is argued here that they are likely part of a predictable systemic interaction among multiple mediating effects of education on individuals' health and the health environment of the population. The ET and the role of education in chronic disease across its later stages offer an empirical demonstration of this proposed interaction. This empirical investigation is undertaken in two parts. First, a random-effects meta-analysis is conducted from sampled scientific studies containing a large number of effect sizes of education's association with chronic diseases and their risk factors among over three million individuals from multiple countries. The second part proposes a causal hypothesis about the dynamic effects of formal education on risk of chronic disease across the ET as one case of the general Population Education Transition Curve model of historical changes in the association between education and health.

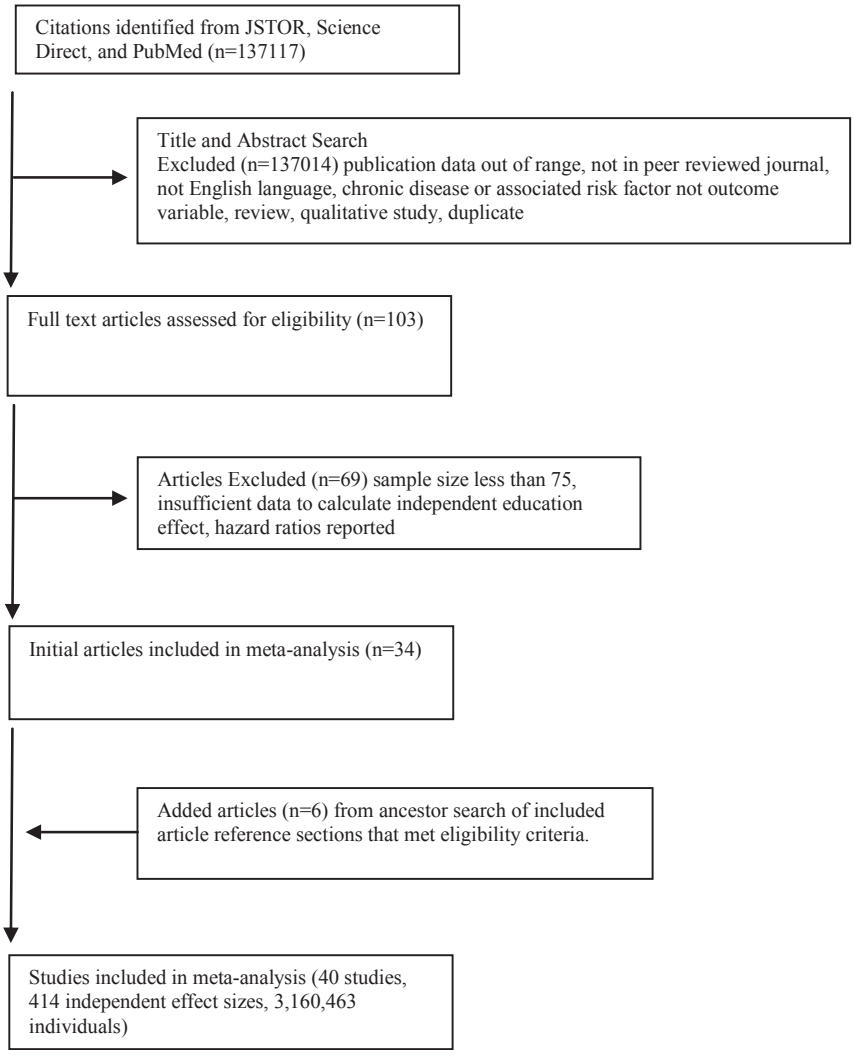

Fig. 1. Selection process for study inclusion.