Childhood intelligence and adult health: The mediating roles of education and socioeconomic status

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ABSTRACT

The longitudinal relation between childhood intelligence and various health outcomes in adulthood is now well-established. One mediational model that accounts for this relation proposes that intelligence has cumulative indirect effects on adult health via subsequent educational attainment and adult socioeconomic status (SES). The aim of the present study was to examine whether and the extent to which educational attainment and SES mediate the impact of childhood intelligence on three dimensions of adult health in Luxembourg, a country with high-quality universal public health care. We used data from 745 participants in the Luxembourgish MAGRIP study. At the age of 12, participants completed a comprehensive intelligence test. At the age of 52, they reported their educational careers, SES, and functional, subjective, and physical health status. Using structural equation modeling, we investigated the direct and indirect effects (via educational attainment and adult SES) of childhood intelligence on adult health. We found that higher childhood intelligence predicted better functional, subjective, and physical health in adulthood. These effects were entirely mediated via educational attainment and SES. The mediational processes differed depending on the health dimension under investigation: Whereas SES was crucial in mediating the effect of intelligence on functional and subjective health, educational attainment was crucial in mediating the effect on physical health. These findings held up when considering adult intelligence and were similar for women and men. Our results suggest that even excellent public health care cannot fully offset the cumulative effects of childhood intelligence on adult health. Further studies are needed to investigate the relative importance of different mediators in the intelligence–health relation while including a broader set of objective health measures.

1. Introduction

General intelligence (*g*) is a powerful predictor of important outcomes across the lifespan. For instance, intelligence predicts socioeconomic outcomes such as educational attainment, occupational success, and income (Deary & Johnson, 2010; Deary et al., 2005; Johnson, Brett, & Deary, 2010; Kuncel, Hezlett, & Ones, 2004; Schmidt & Hunter, 2004; Strenze, 2007). Further, intelligence predicts many health outcomes such as mortality, physician-diagnosed diseases, and health behaviors (Calvin et al., 2011; Deary, Weiss, & Batty, 2010). To account for the positive effects of intelligence on health, several mediational models have been proposed. This paper focuses on one model that proposes that intelligence is the origin of a "chain reaction" (Gottfredson, 2002, p. 369) and has cumulative effects on

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subsequent health outcomes via socioeconomic outcomes. Several studies have investigated this proposed mediation model (Batty, Deary, Schoon, & Gale, 2007a, 2007b; Batty, Deary, et al., 2008; Batty, Gale, et al., 2008; Batty, Shipley, et al., 2008). However, studies investigating the "chain reaction" model with a prospective cohort design over several decades and with multiple health dimensions are still rare. Nevertheless, such studies are greatly needed as they (a) contribute to more substantive theories about the interplay between intelligence and key life outcomes and (b) pinpoint possible targets and stages for interventions to improve individuals' health. The major objective of the present study was therefore to examine whether and the extent to which education and socioeconomic status (SES) mediate the impact of childhood intelligence (at age 12) on adult health (at age 52).

1.1. Childhood intelligence and adult health

The systematic investigation of intelligence as a predictor of different health outcomes just began in the last decade of the 20th century (Deary, 2012). Mortality was probably the first health outcome studied in relation to intelligence. In an early article, Whalley and Deary (2001) showed that lower IQ scores at age 11 were significantly associated with an increased risk of mortality up to age 76. Since this publication, the number of studies linking intelligence measured early in life to adult mortality and nonmortality outcomes—a research field labeled *cognitive epidemiology* (Intelligence, 2009)—has increased steadily. Today, the link between intelligence and all-cause and cause-specific mortality is well-established (Calvin et al., 2011; Deary et al., 2010). In addition to mortality, intelligence in childhood and early adulthood has been linked to various physical diseases. For instance, several studies have replicated the relation between higher intelligence in early life and a lower risk of cardiovascular disease (Modig Wennerstad, Silventoinen, Tynelius, Bergman, & Rasmussen, 2009). Moreover, early intelligence has been related to risk factors for cardiovascular and other chronic diseases such as hypertension and obesity (Batty et al., 2007a). Intelligence also predicts health-relevant behaviors such as smoking (Batty et al., 2007a), alcohol intake (Batty, Deary, et al., 2008), physical activity, and diet (Batty et al., 2007b). Beyond cardiovascular disease, early intelligence predicts additional diagnosed diseases and self-reported physical health problems (Der, Batty, & Deary, 2009) as well as mental health outcomes and psychiatric diseases (Gale et al., 2008). Beyond the effects on the individual level, intelligence has been shown to be an important predictor of health at the national and international levels. For instance, Reeve and Basalik (2010) showed that the average state IQ in the 50 U.S. states was substantially associated with a range of health indicators even after controlling for differences in health care expenditures and state wealth.

1.2. Mechanisms that explain the link between childhood intelligence and adult health

Several nonexclusive mechanisms have been proposed to account for the relation of early intelligence with morbidity and mortality in adulthood. First, the link between early intelligence and adult health could be mediated by health behaviors (e.g., smoking, alcohol intake, dietary choices, or physical activity; Deary, 2010, 2012) that are tied to risk factors for diseases. Second, early intelligence could contribute to the acquisition of health-related knowledge. Higher knowledge could then lead to better health behaviors, and in the case of illness, to the ability to communicate effectively with medical staff and to understand medical instructions (Johnson, Corley, Starr, & Deary, 2011). Higher intelligence may thus help a person to successfully manage the "job of being a patient" (Gottfredson, 2004, p. 175).

A third possible mediational pathway—which is at the center of the present paper—links early life intelligence to adult health via favorable educational and socioeconomic outcomes (see Fig. 1), as Gottfredson's (2002) "chain reaction" model suggests. In this model, higher intelligence in early life leads to higher educational attainment (Path 1). Educational attainment then facilitates access to higher adult socioeconomic status (SES; Path 3), which includes a higher income and a safer work environment (Deary, Strand, Smith, & Fernandes, 2007; Deary et al., 2005; Johnson et al., 2010). Higher adult SES is related to good health (Path 5; Deary, 2010). Statistical adjustment for socioeconomic outcomes substantially attenuates and sometimes nullifies the relation between early intelligence and later health (Batty et al., 2007a; Deary, 2010; Deary et al., 2010), highlighting the importance of socioeconomic variables as mediators. Thus, in the case of complete mediation, the direct effect of childhood intelligence on adult health (Path 6) would be expected to be zero.

Despite considerable evidence that has emphasized the relevance of education and socioeconomic status as potential mediators, previous research has yielded mixed results regarding the extent of mediation in the relations of early intelligence with adult mortality and morbidity. With respect to mortality, Batty and Deary (2005) reported that adjusting for educational attainment leads to inconsistent results, with some studies reporting pronounced mediation and others reporting little or no mediation. Likewise, in their meta-analysis, Calvin et al. (2011) reported varying degrees of mediation of the intelligence–mortality relation via educational attainment and subsequent SES. Moreover, the extent of mediation might depend on the time in life when intelligence is measured. For instance, one study that found complete mediation of the intelligence–mortality relation investigated intelligence measured in early adulthood after participants had already completed their educations. Thus, the intelligence–mortality relation could have been confounded by education (Calvin et al., 2011). Measuring intelligence before participants have completed their educations may therefore be important for detecting unique effects of intelligence and education. With respect to morbidity, results have also been inconsistent. For instance, Batty, Gale et al. (2008) reported a negative association between higher intelligence in early adulthood and the metabolic syndrome in middle adulthood that was barely affected when adjusting for education, income, and social prestige. Further, Batty et al. (2007b) reported positive associations of higher childhood intelligence with a healthy diet and physical activity in adulthood. These associations were reduced when adjusting for indices of socioeconomic position in adulthood; however, they remained statistically significant in some analyses. In sum, studies investigating the extent to which educational