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Brief Report

Childhood intelligence predicts premature mortality: Results from a 40-year population-based longitudinal study

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ABSTRACT

Childhood intelligence has been shown to predict mortality risk in adulthood. This relation has never been investigated in a Central European country with universal health care. The present study investigated whether childhood intelligence predicts mortality risk across 40 years in Luxembourg. 2543 participants completed an intelligence test at age 12 in 1968, and the mortality rate in this sample until 2008 was recorded. Our results showed that higher childhood intelligence predicted a lower risk for mortality, even when childhood socioeconomic status was controlled for. This effect was strongest in men belonging to the group of the lowest 20% in intelligence. These results indicate that even universal access to health care cannot fully offset the cumulative effects of intelligence on mortality.

1. Introduction

In recent years, various studies have suggested that lower childhood intelligence is predictive of an increased mortality risk across the adult life span (Calvin et al., 2011; Deary, Weiss, & Batty, 2010; Hart et al., 2005; Kuh, Richards, Hardy, Butterworth, & Wadsworth, 2004; Lager, Bremberg, & Vagerö, 2009). The present study addresses three open questions regarding the relations between childhood intelligence and mortality. (1) Does childhood intelligence predict the risk for mortality until middle age in Luxembourg? Many previous studies have investigated later life mortality (Calvin et al., 2011). A replication of intelligence-mortality effects among younger individuals before the regular onset of chronic diseases would highlight the importance of intelligence as a predictor of mortality across the entire life span. Moreover, all previous studies have been conducted in English-speaking or Scandinavian countries (Calvin et al., 2011). It remains to be shown whether these findings can be generalized to Luxembourg, a country with a unique multicultural background). Crucially, whereas Luxembourg offers universal access to quality health care, it has a level of social mobility below many other Western societies (Organisation for Economic Co-operation and Development, 2010).

(2) Previous research has demonstrated that the shape of the intelligence-mortality relation is unclear (Batty, Deary, & Gottfredson, 2007). Does this relation exist across the entire spectrum of the intelligence distribution as some studies suggest (Lager et al., 2009), or is there a high-risk group at the lower end of the intelligence distribution with elevated mortality, thus pointing to a potential threshold effect (Hart et al., 2005; Kuh et al., 2004)? Identification of a specific group with an elevated mortality risk would provide information about who should be targeted in particular by health care interventions and preventive measures.

(3) Does the intelligence-mortality relation differ between women and men? Few studies have investigated gender differences in the relation between intelligence and mortality. The results seem inconclusive as some studies have found gender differences and others have not (Calvin et al., 2011; Lager et al., 2009). The examination of gender differences is important for formulating explanatory models for the intelligence-mortality relation. Universal effects for women and men may indicate that intelligence predicts mortality because it may be a marker of a healthy body in general (Batty et al., 2007; Lager et al., 2009). Differential effects for women and men may be indicative of environmental and behavioral factors that may be modifiable and thus targeted by interventions.

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2. Method

2.1. Participants

Participants were individuals enrolled in a longitudinal prospective cohort study (the MAGRIP study) initiated in 1968 in Luxembourg. The MAGRIP study was a school-based study designed to investigate the determinants of children's school careers. In 1968, detailed data on intelligence and socioeconomic family background were collected on a randomly selected nationally representative sample comprised of 2824 children at the end of their primary education (M_{age} = 11.9 years; *SD* = 7.2 months; 50.1% male).

2.2. Measures

2.2.1. Childhood intelligence

In 1968, children completed a standardized, objective, and comprehensive German intelligence test, the Leistungsprüfsystem (L-P-S, [Performance Test System]; Horn, 1983), in classroom sessions. The L-P-S encompasses 14 subtests that provide measures of various intellectual abilities. To obtain a measure of childhood intelligence, we summarized children's performance on the 14 subtests in terms of a total intelligence score, which was then standardized for the entire 1968 sample (*M* = 100, *SD* = 15). The reliability of the total score was satisfactory with $\alpha = .85$. Previous research has shown that this total score has excellent psychometric properties (e.g., retest reliability across a time span of 32 months = .83; Horn, 1983).

2.2.2. Childhood socioeconomic status

In 1968, children reported their parents' current occupation. These occupations were mapped onto the International Socio-Economic Index of occupational status (ISEI; Ganzeboom & Treiman, 1996). The ISEI scale takes the income and educational levels of occupations into account. It has interval scale properties and a theoretical range from 16 (e.g., cleaners) to 90 (e.g., judges). The ISEI scale is internationally comparable and has been demonstrated to be a reliable and valid indicator of socioeconomic status in many international large-scale assessments (e.g., PISA; Organisation for Economic Co-operation & Development, 2004). In the present study, we used the highest ISEI value in a family as an indicator of childhood socioeconomic status. Interrater reliability of the ISEI coding was tested for two independent groups of raters and was satisfactory at .72.

2.2.3. Mortality

In 2008, a second wave of the MAGRIP study was initiated. The mortality rate among the MAGRIP participants in the period between 1968 and 2008 was obtained from the social security agency of Luxembourg. Of the 2824 former participants, 2377 (84%) were alive, and 166 (6%) had died by 2008. The remaining 281 (10%) former participants could not be traced by their social security ID. The analyses for the present study were based on those 2543 individuals for whom data on mortality were available.

2.3. Statistical analyses

To quantify how childhood intelligence predicted mortality, we ran two series of logistic regression models. In the first series, we applied logistic regression models using the full range of the continuous intelligence score as a predictor. In Model 1, we used a bivariate logistic regression model to study how this intelligence score would predict mortality. In Model 2, we included gender as an additional predictor and controlled for childhood socioeconomic status. To investigate gender differences in the relations between childhood intelligence or socioeconomic status and mortality, we added the interaction between gender and intelligence and between gender and socioeconomic status in a third model (Model 3). All models were computed with mean-centered intelligence and socioeconomic status variables.

To explore the shape of the intelligence-mortality relation, we divided all participants into equal-sized groups according to their intelligence scores. This resulted in five groups with increasing mean intelligence scores (i.e., quintiles), with each group comprising 20% of the participants of our total sample.[1] In the second series of logistic regression models, we then explored whether individuals with low levels of intelligence would exhibit a particularly increased mortality risk. To this end, we repeated the logistic regression Models 1–3 using an intelligence grouping variable as a predictor (Models 4–6). This dichotomous grouping variable was based on the five intelligence groups and coded whether a participant belonged to the lowest 20% or to the remaining 80% of the intelligence distribution.

We included all 2543 participants for whom data on mortality were available. To account for missing data in childhood intelligence (3% missing data, n_{miss} = 87) and childhood socioeconomic status (1% missing data, n_{miss} = 14), we applied multiple imputation. We conducted 10 cycles of imputations using the Amelia II package for the R software (Honaker, King, & Blackwell, 2011). In each cycle, the missing values were estimated based on the available data in the predictors. This process resulted in 10 imputed data sets, each one containing slightly different versions of the imputed values. We then used the software Mplus 7 (Muthén & Muthén, 1998–2007) to conduct the logistic regression analyses. Mplus allows for the combination of the results from imputed data sets to obtain overall parameter estimates and standard errors that reflect uncertainty in the imputation as well as uncertainty due to random variation (Schafer & Graham, 2002).

3. Results

In a first step, we investigated the descriptive statistics for the entire MAGRIP study sample in 1968 (*N* = 2824), for all participants included in the present study (*n* = 2543), and separately for those participants in the present study who were still alive in (*n* = 2377) or who had died (*n* = 166) by 2008. Mean childhood intelligence (M_{IQ} = 100), mean childhood socioeconomic status (M_{ISEI} = 39), the ratio of men to women (50:50), and the percentage of native Luxembourgers (84%) were similar across the entire 1968 study population, the sample in the present study, and the survivors in 2008. These results indicate that the sample in the present study was representative of the original sample. However, those 166 participants who had died by 2008 had a lower mean childhood intelligence (M_{IQ} = 96, Cohen's *d* = 0.22) and childhood socioeconomic status (M_{ISEI} = 37, *d* = 0.19). Further, a substantial majority of the deceased were men (70%, $\varphi = .10$). These results indicate that lower childhood intelligence, lower socioeconomic status, and being a man could be risk factors for premature mortality in adulthood.

3.1. Childhood intelligence and mortality: General and gender-specific relations

Table 1 (upper panel) shows the results of the first series of logistic regression models that investigated the impact of the full-range childhood intelligence predictor on mortality risk.

[1] Using quintiles is a standard technique applied when a major goal of the grouping process is to retain as many of the properties of the original variable's distribution as possible (Austin, 2011).