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Low Childhood IQ and Early Adult Mortality: The Role of Explanatory Factors in the 1958 British Birth Cohort

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Low Childhood IQ and Early Adult Mortality: The Role of Explanatory Factors in the 1958 British Birth Cohort

WHAT'S KNOWN ON THIS SUBJECT: Low childhood IQ has been shown to predict increased risk of early adult mortality; but the mechanisms behind this association have not been established.

WHAT THIS STUDY ADDS: Parents' interest in their child's education and adult education and psychosomatic symptoms accounted for part of the IQ-mortality association. However, common sociodemographic risk factors and health behaviors may not be sufficient to completely explain the association between IQ and early mortality.

abstract

OBJECTIVE: To examine whether the association between childhood IQ and later mortality risk was explained by early developmental advantages or mediated by adult sociodemographic factors and health behaviors.

PARTICIPANTS AND METHODS: Participants were 10 620 men and women from the 1958 British Birth Cohort Study whose IQ was assessed at the age of 11 years and who were followed up to age 46. Childhood covariates included birth weight, childhood height at 11 years of age, problem behaviors, father's occupational class, parents' interest in child's education, family size, and family difficulties. Adult risk factors were assessed at ages 23, 33, and 42 years, and they included education, occupational class, marital status, smoking, BMI, alcohol use, and psychosomatic symptoms.

RESULTS: Between ages 23 and 46 years, 192 participants died. Higher childhood IQ was related to lower mortality risk (standardized odds ratio [OR]: 0.80 [95% confidence interval (CI): 0.69–0.93]) with no gender differences (OR: 0.81 [95% CI: 0.67–0.98] [men] and 0.79 [95% CI: 0.63–0.98] [women]). Adjusting for parents' interest in child's education attenuated the IQ-mortality association by 15% to 20%, and adult education and psychosomatic symptoms both attenuated the association by 25%. Other covariates were less influential.

CONCLUSIONS: In a cohort of British men and women, the most important explanatory factors for the lower mortality rate among individuals with high IQ were parental interest in child's education, high adult educational level, and low prevalence of psychosomatic symptoms. However, common sociodemographic risk factors and health behaviors may not be sufficient to explain the association between IQ and early mortality completely. *Pediatrics* 2009;124:e380–e388

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KEY WORDS

intelligence, IQ, premature mortality, education, health behavior, parental monitoring

ABBREVIATIONS

OR—odds ratio

CI—confidence interval

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Cognitive ability (referred to here as IQ) has been identified as a potentially important psychological predictor of mortality.[1–19] However, crucially, the explanation for the IQ-mortality association has not yet been established. High IQ may represent a marker of early developmental advantages. For example, low birth weight and short stature are related to worse cognitive development and increased mortality risk.[20–23] In addition, children with a high IQ are perhaps more likely to enjoy a protective family environment, for example, high parental socioeconomic status, fewer social problems, and parents who are more concerned for the child's well-being. Such family characteristics can be related to the IQ-mortality association via environmental pathways but also via shared genetic background of the parent and child. In previous studies, however, birth weight,[5] childhood illness,[6] and parental socioeconomic status[5,6,11,19] have only had modest impact on the IQ-mortality relationship.

Another plausible pathway via which IQ may influence mortality risk is its impact on a person's own adult predictors of mortality, such as socioeconomic status, marital status, smoking, obesity, psychosomatic symptoms, and alcohol consumption, among others. IQ has been shown to predict many of these outcomes,[24–30] but whether they explain the IQ-mortality association is unknown. Previous studies have demonstrated adult socioeconomic circumstances to statistically mediate the IQ-mortality association partly or completely,[6,12,17,19,27,31] but most of these studies have not included detailed data on behavior-related risk factors.

The aim of the present study was to assess the pathways linking childhood IQ with early adult mortality in men and women. The 1958 British Birth Cohort Study is unique in capturing the social, behavioral, and physical characteristics of a large cohort of men and women by serial data collection from birth through to middle age. Thus, these data allowed us to test more thoroughly than has previously been possible whether childhood factors (birth weight, childhood height, problem behavior, father's occupational class, parents' interest in child's education, family size, and family difficulties) or adult characteristics collected serially into middle age (education, occupational class, marital status, smoking, BMI, alcohol use, and psychosomatic symptoms) accounted for any of the IQ-mortality association.

PARTICIPANTS AND METHODS

Participants

The participants were from the nationally representative 1958 British Birth Cohort Study, also known as the British National Child Development Study.[32,33] The original participants were 17 634 individuals born in England, Wales, and Scotland during 1 week in March 1958. Data have been collected in follow-up phases at ages 7, 11, 16, 23, 33, 42, and 46 years. The main sample of the present study included all 10 620 participants (5309 men and 5311 women; 60.2% of the original sample) for whom data on cognitive ability at age 11 years were available and who participated in the follow-up at age 23 years. As a sensitivity analysis, we also fitted models including only childhood measures for all of the 14 132 participants who had data on IQ but did not necessarily participate in the data collection waves after age 11 years. Written informed consent was obtained from the parents for childhood measurements, and ethical approval for the study was obtained from the South East Multi-Centre Research Ethics Committee.

Childhood IQ

At age 11 years, childhood IQ was measured using a general ability test composed of 40 verbal and 40 nonverbal items.[34,35] Children were presented with an example set of 4 words, shapes, or symbols that were linked logically, semantically, or phonologically, and they were then given another set of 3 words, shapes, or symbols with a blank space. Participants were required to select the missing word from a list of 5 alternatives.

Childhood Risk Factors

Birth weight (measured at birth in ounces) and childhood height (measured in a medical examination at age 11 years) were used as indicators of early physical development. Previously, problem behaviors have been shown to predict increased mortality risk,[36] so we included this measure to assess potential comorbidity between problem behaviors and IQ. Problem behaviors at age 11 years were assessed by the participants' teachers using the standardized Bristol Social Adjustment Guide.[37] Because externalizing and internalizing subscales were shown to increase mortality risk,[36] we used the total standardized score here (mean: 0; SD: 1).

Characteristics of childhood family environment were assessed with 4 factors. Father's occupational class (based on Registrar General's occupational class categorization, where 1 represents unskilled or no father; 2, semiskilled; 3, skilled manual; 4, skilled nonmanual; 5, managerial; and 6, professional) and family size (number of persons living in the household) at age 11 years were reported by the parents. Parent interest in the child's education were reported by the child's teacher (0 indicates "very interested/overconcerned"; 1, "some interest"; 2, "little interest"; and 3, "can't say") at age 11 years. Family difficulties were assessed by the health visitors carrying out the home interviews with the parents at the child's age 7 years. After the home interview, the health visitor completed a 13-item scale that queried whether the family was having difficulties because of housing, finances, physical illnesses, mental illnesses, mental subnormality, father's death, mother's death, divorce or separation, domestic tension, "in-law" family conflicts, unemployment, alcoholism, or for other reasons (0 indicates no and 1 indicates yes). Because there were few families with very high scores, we top-coded the scale into a 5-point scale ranging from 0 to ≥4 reported difficulties.

Adult Risk Factors

Adult covariates were reported by the participants at ages 23, 33, and 42 years and included the following variables: educational qualifications (1 indicates less than O level; 2, O level; 3, A level/occupational qualifications; and 4, higher education); occupational class (based on Registrar General's occupational class categorization: 1 indicates unskilled; 2, semiskilled; 3, skilled manual; 4, skilled nonmanual; 5, managerial; and 6, professional); marital status (0 indicates married; 1, never married; and 2, divorced/widow); smoking (0 indicates nonsmoker and 1 indicates smoker); alcohol consumption (units of alcohol per week, top coded at 50 units); BMI (calculated from self-reported height and weight); and psychosomatic symptoms (assessed with the 30-item Malaise Inventory).[38,39] Because we had repeated measurements of all of the adulthood covariates, they were all coded as time variant (see below).

All-Cause Mortality

Deaths were ascertained through receipt of death certification or notification to the study team.[33] In the data sets currently available to researchers, mortality status has been coded on the basis of participant death between follow-up phases at ages 7, 11, 16, 23, 33, 42, and 46 years (rather than continuously on the basis of specific age at death). Thus, the timing of death in the survival analyses was assessed by age intervals between follow-up phases (see below). The main sample of the present study included participants who were alive and participating in the study at ages 11 and 23 years.

Statistical Analysis

The association between IQ and mortality was assessed with discrete-time survival analysis, which is the appropriate survival analysis method when time is assessed discretely rather than continuously. Time was coded by dummy variables for age periods 34 to 42 and 43 to 46 years, with age period 24 to 33 years as the reference category. The statistical estimates were expressed as the odds ratio (OR) difference in the hazard function associated with 1 unit difference in the predictor. Given the low absolute rates of mortality in the sample, the ORs can also be interpreted as relative risk ratios. All of the results are presented for a standardized IQ scale (mean: 0; SD: 1).

In the main analyses, we examined the association between IQ and mortality rate between ages 23 and 46 years, adjusted for childhood and adult covariates. Childhood covariates were used as time-invariant variables (ie, assessed only 1 time), whereas adult risk factors were used as time-lagged, time-varying variables, so that risk factors assessed at ages 23, 33, and 42 years were used to predict mortality at ages 24 to 33, 34 to 42, and 43 to 46 years, respectively. To avoid loss of statistical power because of categorization, continuous and ordinal covariates were treated as continuous variables. Parent interest in the child's education was coded as a categorical variable because of the "can't say" response option. The models were fitted for men and women together, and, to test whether adjustments for covariates differed by gender, gender × IQ interaction effects were assessed in each model. As a sensitivity analysis, we examined the IQ-mortality association between ages 11 and 46 years in the total sample with data on childhood IQ (n = 14 132).

Finally, to illustrate the IQ-mortality association and to examine its dose-response pattern, we plotted the cumulative mortality function (ie, 1-survival function) by 3 IQ levels (low: below 1 SD of mean, n = 2556; average: within 1 SD of mean, n = 9152; and high: above 1 SD of mean, n = 2424) based on sample life tables (95% confidence intervals [CIs] were calculated using the Greenwood approximation). All of the analyses were conducted with Stata 9.2 (Stata Corp, College Station, TX).

Missing Data Imputation of Covariates

The availability of mortality data did not depend on the participants' participation in the follow-ups, but there were missing values in childhood and adult covariates. Given the relatively small number of deaths in the sample, we imputed missing data of childhood and adult risk factors (but not IQ or mortality data) in order not to lose too many participants. For the main analyses we included participants who had data on childhood IQ and who participated in the follow-up at age 23 years and applied multiple multivariate imputation using all of the covariates (except IQ) to impute missing values. We used switching regression, as described by Royston,[40] and conducted 10 cycles of regression switching and generated 10 imputation data sets. This created 10 copies of the data, each of which has missing values imputed on the basis of available data with an appropriate level of

TABLE 1 Descriptive Statistics of Childhood Covariates and Their Associations With Childhood IQ in Men and Women ($N = 10\,620$)

Measures	Men ($N = 5309$)			Women ($N = 5311$)			Correlation With IQ[a]	
	Age A	Age B	Age C	Age A	Age B	Age C	Men	Women
Childhood measures								
Father's occupational class, mean (SD)	—	—	3.1 (1.4)	—	—	3.1 (1.4)	0.26	0.29
Family difficulties, mean (SD)	—	0.4 (0.8)	—	—	0.4 (0.8)	—	−0.20	−0.21
Family size, mean (SD)	—	—	5.1 (1.7)	—	—	5.1 (1.6)	−0.22	−0.24
Problem behavior, mean (SD)[b]	—	—	0.1 (1.0)	—	—	−0.2 (0.8)	−0.31	−0.28
Birth weight, mean (SD), g	3412 (519)	—	—	3265 (504)	—	—	0.10	0.11
Height, mean (SD), cm	—	—	144.0 (6.8)	—	—	144.7 (7.3)	0.17	0.19
Mother's interest in child's education, %								
Very interested/overconcerned	—	—	38.8	—	—	42.8	Ref	Ref
Some interest	—	—	35.9	—	—	34.5	−0.19	−0.22
Little interest	—	—	13.7	—	—	11.5	−0.44	−0.50
Can't say	—	—	11.6	—	—	11.2	−0.29	−0.36
Father's interest in child's education, %								
Very interested/overconcerned	—	—	30.8	—	—	31.1	Ref	Ref
Some interest	—	—	27.6	—	—	26.0	−0.19	−0.21
Little interest	—	—	17.9	—	—	14.5	−0.42	−0.45
Can't say	—	—	23.8	—	—	28.4	−0.25	−0.25
Adult measures								
Education (qualifications) , mean (SD)	2.2 (1.0)	2.2 (1.0)	2.3 (1.0)	2.1 (1.0)	2.1 (1.0)	2.2 (1.0)	0.55	0.55
Occupational class, mean (SD)	3.4 (1.2)	3.7 (1.4)	3.9 (1.3)	3.7 (1.1)	3.6 (1.4)	3.8 (1.3)	0.40	0.36
Marital status, %								
Married	40	68.9	79.9	60.7	72.9	79.7	Ref	Ref
Never married	57.6	21.3	10.4	34.3	13.9	7.4	0.02	0.04
Divorced/widowed	2.4	9.9	9.7	5	13.2	12.9	−0.11	−0.10
Psychosomatic symptoms, mean (SD)	2.0 (2.5)	2.1 (2.5)	3.2 (3.3)	3.4 (3.2)	2.8 (3.1)	4.0 (3.6)	−0.17	−0.22
Smoker, %	41.5	32.4	31.4	40	31.4	29.8	−0.16	−0.17
Alcohol consumption, mean (SD)	12.7 (12.5)	10.1 (10.1)	15.2 (16.3)	5.0 (6.3)	4.4 (5.9)	8.8 (13.3)	0.02	0.05
BMI, mean (SD)	23.1 (2.8)	25.6 (3.8)	26.6 (4.1)	22.1 (3.2)	24.5 (4.5)	25.3 (4.8)	−0.08	−0.11

Ages A, B, and C at assessment for childhood measures were birth, 7 years, and 11 years, respectively. Ages A, B, and C at assessment for adult measures were 23, 33, and 42 years, respectively. Ref indicates reference; —, no data were collected.

[a] Values are correlations between childhood IQ and covariate (averaged over the 3 follow-up phases). Correlations with categorical variables are calculated as point-biserial correlation with the reference category.

[b] Data show the standardized covariate (mean: 0 and SD: 1).

randomness using chained equations. The final estimates were obtained by averaging across the estimates from each of these 10 data sets using Rubin's rules and taking into account the uncertainty in the imputation, as well as uncertainty because of random variation. Of the 10 620 participants included in the analysis, 8314, 7508, and 6421 had complete data on all of the covariates at ages 23, 33, and 42 years, respectively. For childhood measures, 7% to 14% of the observations were imputed, and for adulthood measures 21% to 26% of the observations were imputed. Missing childhood covariates were imputed by using the same method in the larger sample ($n = 14\,132$) used in the sensitivity analyses.

RESULTS

Table 1 shows the descriptive statistics for the sample. IQ was especially strongly associated with problem behavior, father's occupational class, parents' interest in the child's education, family size, family difficulties, and adult educational achievement and occupational class. The associations between covariates and mortality risk are shown in Table 2. During the age periods of 24 to 33, 34 to 42, and 43 to 46 years, there were 55, 54, and 83 deaths, respectively (36, 28, and 47 deaths in men and 19, 26, and 36 deaths in women), resulting in 192 deaths in total (111 in men and 81 in women). In the sensitivity analysis sample ($n = 14\,132$) the number of deaths was 329 between ages 11 and 46 years (213 in men and 116 in women). Higher mortality risk was predicted by problem behavior, parents' disinterest in child's education, low adult education, high psychosomatic symptoms, smoking, and high alcohol consumption. Most of the childhood measures were slightly more strongly associated with mortality between ages 11 and 46 years than between 23 and 46 years.

Table 3 shows the association between childhood IQ and mortality risk, adjusted for childhood and adult covariates. For mortality between ages 23 and 46 years, the nonadjusted OR per 1-SD increase in IQ was 0.80 (95% CI: 0.69−0.93), with no difference

TABLE 2 Predicting Mortality Risk According to Childhood and Adult Covariates

Measures	Mortality Between Ages 23 and 46 y, OR (95% CI)	Mortality Between Ages 11 and 46 y, OR (95% CI)
Childhood measures		
Father's occupational class	0.99 (0.90–1.09)	0.94 (0.87–1.01)
Family difficulties	1.14 (0.96–1.34)	1.24 (1.12–1.37)
Family size	1.06 (0.96–1.17)	1.09 (1.02–1.16)
Problem behavior	1.14 (0.99–1.30)	1.22 (1.11–1.32)
Birth weight (per 100 g)	0.99 (0.97–1.02)	1.00 (0.98–1.02)
Height (per 10 cm)	0.84 (0.69–1.03)	0.86 (0.72–1.01)
Mother's interest in child's education		
Very interested/overconcerned	Reference	Reference
Some interest	1.12 (0.79–1.60)	1.29 (0.98–1.70)
Little interest	1.47 (0.95–2.28)	1.98 (1.45–2.72)
Can't say	1.77 (1.16–2.72)	1.74 (1.23–2.46)
Father's interest in child's education		
Very interested/overconcerned	Reference	Reference
Some interest	1.14 (0.76–1.72)	1.34 (0.97–1.87)
Little interest	1.72 (1.12–2.62)	2.20 (1.59–3.04)
Can't say	1.41 (0.95–2.09)	1.50 (1.08–2.07)
Adult measures		
Education	0.82 (0.70–0.95)	—
Occupational class	0.95 (0.84–1.09)	—
Marital status		
Married	Reference	—
Never married	1.17 (0.50–1.82)	—
Divorced/widowed	1.48 (0.92–2.37)	—
Psychosomatic symptoms	1.09 (1.05–1.14)	—
Smoking	1.75 (1.30–2.36)	—
Alcohol consumption	1.01 (1.00–1.03)	—
BMI	0.98 (0.94–1.02)	—

Univariate discrete-time survival analysis models were fitted separately for mortality between ages 23 and 46 years and ages 11 to 46 years. Values are ORs (and 95% CIs) of discrete-time survival analysis indicating differences in mortality risk associated with 1 unit difference in the predictor (continuously coded variables) or when compared with the reference category (categorically coded variables). Childhood covariates were assessed at age 7 or 11 years; adult covariates were assessed repeatedly at ages 23, 33, and 42 years. — indicates no data.

between men (OR: 0.81 [95% CI: 0.67–0.98]) and women (OR: 0.79 [95% CI: 0.63–0.98]). Again, the association was somewhat stronger when assessing mortality between ages 11 and 46 years (OR: 0.76 [95% CI: 0.68–0.85]). Although most childhood covariates had relatively little influence on the IQ-mortality association, mother's and father's interest in child's education attenuated the association by 15% and 20%, respectively. Adjusting for all of the childhood covariates attenuated the IQ-mortality association by 30% (from OR: 0.80 to OR: 0.86). In univariate analyses of adulthood covariates, education and psychosomatic symptoms each attenuated the association by 25%. Adjusting for all of the adult covariates together attenuated the IQ-mortality association by 35% (from OR: 0.80 to OR: 0.87). When all of the childhood and adult covariates were adjusted for, the unadjusted association was attenuated by 45% (from OR: 0.80 to OR: 0.89). Gender × IQ interaction effects were not statistically significant in any of the adjusted models (all *P* values were >.80), indicating that the adjustments did not influence the IQ-mortality association differently in men and women.

In a previous study in the US National Longitudinal Survey of Youth,[19] the IQ-mortality association was shown to depend on parental education, so that IQ was not associated with mortality in individuals with low parental education but did predict mortality in others. We tested for interaction effects between IQ and family characteristics, but none of these were statistically significant (all *P* values were >.23).

Finally, we plotted the sample cumulative mortality rates by IQ levels (Fig 1). By the end of the follow-up period, 3.4% of participants in the low-IQ group had died compared with 1.7% of those in the high-IQ group. The association was slightly stronger for IQ below rather than above the mean, but a quadratic effect of IQ in the survival analysis was not statistically significant ($P = .18$), indicating a linear association between IQ and mortality.

DISCUSSION

In the nationally representative 1958 British birth cohort, low childhood IQ assessed at age 11 years predicted increased mortality risk, so that 1-SD difference in IQ score was associated with a 20% increase in the odds of dying at a given age before midlife. Mother's and father's interest in child's education attenuated the IQ-mortality association by 15% to 20%, and adult education and psychosomatic symptoms each attenuated it by 25%. Other factors, such as birth weight, childhood height, father's occupational class, family size, and family difficulties, as well as adult occupational class, marital status, smoking, BMI, and alcohol use, were less influential.

This is one of the few studies to examine multiple childhood and adult covariates possibly linking childhood IQ to later mortality risk in both men and women. The only previous comparable study including multiple covariates seems to be the Vietnam Experience Study of US veterans,[31] in which socioeconomic measures accounted for 21% to 52% of the IQ-mortality association, whereas several health measures (eg, blood pressure, BMI, smoking, and psychiatric and somatic illnesses) had modest or negligible influence (ie,

TABLE 3 Predicting Mortality Risk According to Childhood IQ

Measures	Mortality Between Ages 23 and 46 y, OR (95% CI)	Mortality Between Ages 11 and 46 y, OR (95% CI)
No adjustments	0.80 (0.69–0.93)	0.76 (0.68–0.85)
Childhood measures		
Adjusted for father's occupational class	0.79 (0.68–0.92)	0.76 (0.68–0.85)
Adjusted for family difficulties	0.81 (0.70–0.94)	0.79 (0.71–0.88)
Adjusted for family size	0.81 (0.70–0.94)	0.77 (0.69–0.87)
Adjusted for problem behavior	0.82 (0.70–0.95)	0.80 (0.71–0.89)
Adjusted for birth weight	0.80 (0.69–0.93)	0.76 (0.68–0.84)
Adjusted for height	0.81 (0.70–0.94)	0.77 (0.69–0.86)
Adjusted for mother's interest in child's education	0.83 (0.71–0.97)	0.81 (0.72–0.91)
Adjusted for father's interest in child's education	0.84 (0.72–0.99)	0.82 (0.73–0.92)
Adjusted for all childhood covariates	0.86 (0.72–1.02)	0.86 (0.76–0.98)
Adult measures		
Adjusted for education	0.85 (0.72–1.01)	—
Adjusted for occupational class	0.79 (0.67–0.93)	—
Adjusted for marital status	0.81 (0.70–0.93)	—
Adjusted for psychosomatic symptoms	0.85 (0.74–0.99)	—
Adjusted for smoking	0.83 (0.72–0.97)	—
Adjusted for alcohol consumption	0.80 (0.69–0.92)	—
Adjusted for BMI	0.79 (0.69–0.92)	—
Adjusted for all adult covariates	0.87 (0.73–1.03)	—
Adjusted for all childhood and adult covariates	0.89 (0.73–1.07)	—

Multivariate discrete-time survival analysis models were fitted separately for mortality between ages 23 to 46 years and ages 11 to 46 years, adjusted for childhood and adulthood covariates. Values are ORs (and 95% CIs) of discrete-time survival analysis indicating differences in mortality risk associated with 1-SD difference in childhood IQ. All of the models are adjusted for age. Childhood covariates were assessed at ages 7 and 11 years; adult covariates were assessed repeatedly at ages 23, 33, and 42 years. — indicates no data.

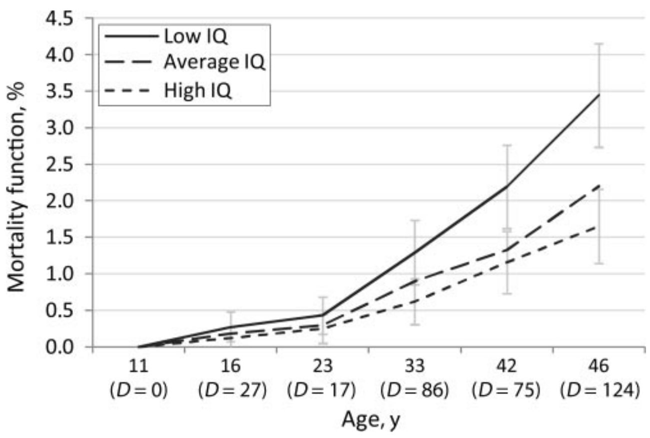

FIGURE 1
Sample cumulative mortality function according to age and childhood IQ group (low indicates <1 SD of mean; average, within 1 SD of mean; high, >1 SD of mean). Values of *D* on the x-axis (in parentheses) denote the number of deaths (number of participants = 14 132). For clarity, 95% CIs are shown only for the low- and high-IQ groups.

<20% attenuation). Repeated measures of adult covariates provided us with more accurate measurements than single measurements used in most previous studies, although missing values of the covariates had to be imputed in the analyses, which might have introduced some measurement imprecision. The inclusion of men and women also allowed us to assess potential gender differences; none were statistically significant.

We observed a lower risk of premature death among children with parents who, according to children's teachers, were highly interested in the child's education (compared with children with parents with little such interest or for whom teachers could not provide an assessment, which, on average, probably reflects little parental interest). This association was observed even for mortality in adulthood. Previous studies[41] have shown parental monitoring to correlate negatively with children's risky and delinquent behavior, but we are unaware of any previous studies showing that parental interest in a child's education (or a related measure of parental interest) predicts mortality. Children with little parental monitoring may be more likely to get involved in risky and delinquent activities and thereby become exposed to increased mortality risk. The measure may also function as a proxy of more general social/economic family background. However, parental interest predicted mortality even when other parental covariates were adjusted for (data available on request), suggesting that parental interest is unlikely to simply represent a surrogate measure of parental socioeconomic status.

Adjusting for parental interest attenuated the IQ-mortality association by ~20%. Furthermore, childhood problem behavior, which is also associated with later risky and antisocial behavior, accounted for 10% of the association. Together these observations suggest that delinquent behavior might be one pathway mediating the IQ-mortality association. Studies with more direct measures of delinquency and criminal behavior are needed to test this hypothesis. Other childhood measures than parental interest had almost negligible influence (ie, <10% attenuation) on the IQ-mortality association. This is in agreement with previous studies, including data on birth weight,[5] childhood illness,[6] or parental socioeconomic status.[5,6,11,19] On the basis of data this far, it thus seems that the association between childhood IQ and subsequent mortality risk is not substantially confounded by common childhood risk factors, although the possibility of residual confounding cannot be excluded.

In adulthood, education was the most important covariate to attenuate the IQ-mortality association, accounting for 25% of it. This is in agreement with many previous studies[6,12,17,19,27,31] identifying socioeconomic achievement as a plausible mediator of the IQ-mortality association. However, the interpretation of education level as a mediator of IQ is not straightforward; adult educational achievement may, in fact, represent a proxy measure of individual differences in cognitive ability that are not captured by specific IQ tests.[31] Hence, adjusting for education may result in an overadjustment of the effect of IQ. In addition to education, poor adult health (ie, psychosomatic symptoms) accounted part (25%) of the IQ-mortality association. Other adulthood covariates were less influential.

At least 3 limitations need to be considered when interpreting the findings. First, the importance of covariates in explaining the IQ-mortality association needs to be considered in the context of early mortality, because the participants were only 46 years of age at the end of the follow-up period. Despite the relatively young age of the sample, the observed effect size of IQ is closely in agreement with previous studies examining mortality at older ages.[17] Second, the study design was not genetically informative, so we could not determine whether the associations between parental characteristics and their children's outcomes reflected genetically or environmentally transmitted influences. Third, our analyses were limited to all-cause mortality, so cause-specific mortality patterns could not be assessed.

CONCLUSIONS

These findings from a nationally representative British sample of men and women provide new evidence that childhood IQ begins to influence mortality risk already before midlife. Childhood and adult factors, such as parental interest, own adult educational level, and psychosomatic symptoms, accounted part of this association. Additional research is needed to understand the association between IQ and mortality more comprehensively.

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