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ORIGINAL ARTICLE

The association between childhood educational attainment and adult mental health and status: A thirty-year longitudinal follow up study

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Abstract

Background and objectives: Prior research and theories are predicated on the assumption that childhood education has a potentially significant effect on long-term adult mental health and status achievement, but there is little empirical data to support this view. Using a longitudinal birth cohort from birth to age 30, we investigated the association between childhood educational attainment and adult status achievement, including mental health in an American inner city population.

Methods: 1820 infants (born between 1960 and 1965) were followed prospectively as part of the Collaborative Perinatal Project (CPP) and the Johns Hopkins Pathways to Adulthood Study, with multiple observations of development and an extensive adult interview. Childhood intelligence and educational ability were measured using the Wechsler Intelligence Scale for Children (WISC) and the Wide Range Achievement Test (WRAT) at age 7. Adult mental health was measured with the General Health Questionnaire (GHQ) when the infants reached age 27–33. During the adult follow up interview, status achievement data was collected including employment, personal income, and education.

Results: There were significantly negative associations between age 7 WRAT scores and all the issues regarding adult mental health, positive associations between age 7 WRAT scores and years of school completed, personal income, and employment status. There were positive associations between childhood IQ and all status achievement variables, but no association recorded between childhood IQ and adult mental health.

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Conclusions: Childhood education was significantly associated with adult mental health and status achievement more than 25 years later. Low scores of WRAT significantly predict poor outcomes as an adult, both in terms of mental health and status achievement. The study findings have potentially strong implications for the enactment of policy changes around the world.

What's known on this subject

Prior research and theories are predicated on the assumption that childhood education has a potentially significant effect on long-term adult mental health and status achievement, but there is little empirical data to support this view.

What this study adds

Our work provides such data within the confines of a large population cohort as a part of the well-designed, prospective, and collaborative pathways to adulthood study.

Introduction

The events that occur during the developmental period of childhood have important repercussions later in life.[1–3] Previous research showed that children who experience adversity in their early years are much more likely to experience negative sequelae as an adult including incarceration, anxiety, mood disorders, disruptive behavior, and substance abuse.[1] If childhood experiences are so important in determining adult outcomes, then certainly one of the most lengthy and important of childhood experiences, education, must play a significant role in determining adult outcomes. There have been studies indicating poor academic performance predicts subsequent alcohol and drug use, lower physical health performance, and even mortality.[4–6]

Data collected by Brown University was used to demonstrate that those with low educational attainment (under 9 years) have a greater than fifty percent higher risk of recurrent depression.[7] Further study revealed that educational underachievement is significantly associated with major depression in adulthood.[8] Poor reading ability has been indicated to significantly increase the likelihood that a youth will drop out of school as well as experience suicidal ideation.[9] Recently, in 2017, a study demonstrated the negative relationship between childhood reading problems and employment status in early adulthood.[10]

Is it education or intelligence?

Certainly, how students perform in the classroom during their early years has some effects on adult outcomes, but it is not completely clear what drives student performance in the classroom. While a student with very high intelligence is likely to succeed in school, a student with lower intelligence that works hard may do just as well or even better. Whether intelligence or other factors are dominant in driving student success is the subject of much debate. Intelligence is classically measured by IQ score. Childhood IQ has been the subject of significant examination, especially in terms of its association with various childhood status measures and adult outcomes. While some researchers believe that childhood IQ is an important and accurate measure of a child's cognitive ability,[8,11] as a whole research findings have been varied and contradictory. In a study with outcomes of career attainment, the authors compared indicators of mental ability, academic ability and career attainment in two young men groups namely low-IQ and average-IQ. The results even showed a range of differences in these groups relating to all issues mentioned, but after regression analyses, career attainment was similar in both groups.[12]

Research linking childhood IQ and adult mental disorders found that a lower childhood IQ was associated with an increased risk of schizophrenia, adult depression, and adult anxiety.[13] Both Scottish and Danish studies had similar findings.[14–16] More recently however, the validity of IQ as an accurate measure of cognitive ability has been questioned. Findings showed that IQ is subject to a number of confounders that made it, at best, an incomplete measure of educational ability, as well as a flawed predictor of adult status and behavior.[17] IQ has been shown to be partially a product of genetics, and it runs into significant problems when it is used as a predictor of childhood educational ability due to its ''focusing on the memorization of previously learned facts, and its inability to differentiate the contributions of distinctive neurocognitive systems''.[18]

The aim of this study is to explore the relationship between educational attainment in childhood and adult mental health and status achievement by using a 30-year prospective cohort in a unique population from Baltimore, MD, USA.

Methods

The NCPP data set

Data for this analysis was taken from the Johns Hopkins branch of the National Collaborative Perinatal Project (NCPP). The NCPP was a multidisciplinary, prospective investigation across 10 University Medical Centers over 15 years, enrolling between 50,000 and 60,000 pregnant women from 1959 to 1965. Women and their surviving children were followed until their children reached age 7 or 8. The aim was to study how prenatal factors affect later events such as infant

mortality and neural development. Over the study period, information was collected through interviews, physiological exams, and psychological exams from first generation mothers (G1) and their second generation children (G2).

The Johns Hopkins Pathways study

The Johns Hopkins branch of the NCPP included the Pathways to Adulthood Study. Researchers at Johns Hopkins sought out participants from their portion of the NCPP study 30 years later in an attempt to examine how factors earlier in life may have affected development into adulthood. Data was collected from G2 participants using retrospective interviews.

The final sample had a full interview and data set from 1552 G1 mothers and 1758 G2 children. Our study was primarily concerned with data from the G2 participants, whose general characteristics are described in Table 1. 826 (47%) subjects were male, while 932 (53%) were female. The sample was predominantly African-American, with 82% Blacks and 18% Whites. The mean personal income of the sample was $16,486, and participants had completed an average of 12 years of school (through high school). At the time of the pathways interview, nearly 80% of the sample was employed.

Sample attrition and missing data

The original CPP sample was obtained via the recruitment of pregnant women who entered the Johns Hopkins University Hospital in search of obstetrical care in 1959 or 1960. Beginning with an eligible sample of 4025 G1 mothers, all giving birth to G2 children, a number of children were unable to be part of the follow up as a result of their death either during the neonatal period, before the 4 month exam, or after the 4 month exam, cutting the sample size to 3838. Of these remaining participants, those born in 1959 were excluded (most likely to limit confounders between participants born in 1960). Those who were unable to complete the 7 or 8 year psychological exams were also excluded. After the exclusion of these subjects, 3007 eligible participants were enrolled in the Pathways study. Of the 3007, a small additional group of participants was further selected for exclusion due to budgetary constraints. Appendix 1a displays the final sample included in the Pathways study: 2694 G2 children from 2306 G1 mothers.

Follow up of the 2694 G2's and 2306 G1's, as expected, proved somewhat difficult. A number of participants were unable to be located, were out of the country, were deceased, or refused follow up. As a result, the final sample had full interviews and data sets from 1552 G1 mothers and 1758 G2 children (Appendix 1b).

Our study was primarily concerned with data from the G2 participants, whose general characteristics are displayed in Appendix 1c. Four subjects, less than .01% of the sample, were excluded due to race (non-White, non-African American subjects).

In a longitudinal study extending more than 30 years (1960–1994) the potential for bias is substantial. The potential bias, attrition, and missing data have been discussed elsewhere,[19,20] and the authors found that attrition and missing data were not major problems as discussed below.

Differences at birth were found between the G2 children with completed interviews, partial data, and those not located.[21] G2's not interviewed were born to mothers who were somewhat younger, had less educational attainment, and were more likely to be at or below the poverty level (47.9% vs 43.1%) at the time of the birth of the G2. Those who were located but did not complete full interviews had mothers with characteristics generally similar to those who were interviewed. This evidence suggests that attrition in this follow-up study is likely to result in underestimation of the effect of both low SES and adverse birth conditions, since it is those with poorer outcomes who tend to be lost to follow-up.

Educational attainment

The G2's scores on the Wide Range Achievement Test (WRAT),[22] which was administered when they were 7 years old, was used as the main measure of educational attainment.

The Wide Range Achievement Test (WRAT) is a three section standardized test that measures students' abilities in various areas ranging from mathematics to reading comprehension. It was originally developed in 1941 and can be administered to test takers of any age greater than 5 years old. Students are scored based on how they deviate from a normalized score.

From the aggregate WRAT scores we derived two variables: low and high. Children who scored in the upper 25th percentile comprised the high scoring group, while children who scored in the lower 25th percentile comprised the low scoring group. Those who scored in the 25th–75th percentiles were kept as the reference group.

IQ measurement

The children's IQ scores were also obtained, as measured by the Wechsler Intelligence Scale for Children (WISC). This scale was first published in 1949, which was used for children from 5 to 15 years of age. It comprises 12 subtests with 10 out of them were routinely used for assessment. The raw score of each in 10 subtests would be converted to the scale scores (Intellectual development of youths as measured by a short form of Wechsler Intelligence Scale, United State. Data from the National Health Survey).[23] WISC has mean score at 100, standard deviation 15, and include three dimensional IQ scores namely Full scale IQ, Verbal IQ, and Performance IQ. Children assessed by WISC would be classified as normal intelligence when their scores are more than 85, or developmental delay for scores 84 or below.[24]

Adult outcomes

To measure adult mental health outcomes, the General Health Questionnaire (28 item version) was administered during the Pathways follow-up study. The General Health Questionnaire (GHQ) is divided into four different subscales, namely somatic symptoms (items 1–7), anxiety/insomnia (items 8–14), social dysfunction (item 15–21), and

Table 1 Characteristics of G2[a] children.

	Total G2[a] sample	White males	White females	African American males	African American females
Total (*n*)	1820	161	171	695	793
Aggregate WRAT scores (*n*)	1775	157	170	675	773
Mean score	72.8	73.8	74.84	69.7	74.9
Low scoring group (lower 25th)	472	40	43	170	199
High scoring group (upper 25th)	452	41	43	173	206
GHQ scores (*n*)	1748	149	170	650	778
Aggregate caseness (%)	424 (24.2)	35 (23.5)	64 (37.6)	114 (17.5)	210 (27)
Symptomatic somatic disorder (%)	160 (9.1)	14 (9.4)	29 (17.1)	33 (5.1)	83 (10.7)
Symptomatic anxiety and insomnia (%)	245 (14)	27 (18.1)	41 (24.1)	53 (8.2)	124 (15.9)
Symptomatic social dysfunction (%)	138 (7.9)	17 (11.4)	16 (9.4)	50 (7.7)	55 (7.1)
Symptomatic major depression (%)	58 (3.3)	7 (4.7)	21 (12)	17 (2.6)	21 (2.7)
Pursued college (*n*)	1820	161	171	695	793
Yes (%)	559 (31.8)	24 (14.9)	16 (9.4)	186 (26.8)	353 (44.5)
No (%)	1199 (68.2)	137 (85.1)	155 (90.6)	509 (73.2)	440 (55.5)
Employed (*n*)	1791	157	169	679	786
No (%)	1422 (79.4)	20 (12.7)	45 (26.6)	120 (17.7)	184 (23.4)
Yes (%)	369 (20.6)	137 (87.3)	124 (73.4)	559 (82.3)	602 (76.4)
Personal income (*n*)	1465	132	150	573	610
Mean income	$16, 486	$21,228	$12,235	$16,907	$16,097
Above the 75th percentile (>$25,000) (%)	367 (20.9)	132	150	573	610
Below 25th percentile (<$5274) (%)	353 (20.1)	132	150	573	610

	Total G2[a] sample
Maternal education	
n	1780
Mean years completed	9.8
Below high school (%)	512 (28.8)
Some high school (%)	767 (43.1)
High school graduate (%)	379 (21.3)
Some college (%)	122 (6.9)
Full scale IQ	
n	1809
Mean	92.49
Standard deviation	12.2
Range	37–132

[a] G2 children: the children from the mother denoted as G1 in the sample of National Collaborative Perinatal Project (NCPP), Johns Hopkins.

depression (item 22–28). According to GHQ scoring, scores above a 4 are indicative of a potential mental disorder.[25] In addition, we examined the GHQ's disorder specific subscales to determine the prevalence of certain types of psychiatric symptoms in each group.

To measure status achievement, we chose three achievement measures from the Pathways follow-up interviews: pursuit of higher education, employment status, and personal income.

Analyses

Multi-variable logistic regression was used to examine the relationships between the independent and dependent variables.

All models sought to control for the important confounders race, sex, and socioeconomic status. A number of previous studies have used maternal education at birth as a proxy for socioeconomic status, and we also included it as such in our regression analyses.[9,26] Maternal education at birth was felt to be an especially important factor to control for as our sample was predominantly African American, and, further research elucidated that maternal education plays a significant role in modulating outcomes for African American children.[27]

Results

The mean aggregate WRAT scores were highest in females. Aggregate WRAT scores were significantly associated with all mental health and status achievement variables. WRAT

Table 2 Correlation between aggregate WRAT score and independent variables/controls.

	Total G2[a] sample
Outcome variables	
GHQ total score	−0.07[*]
G2[a] years of school completed	0.34[*]
Personal income	0.30[*]
Covariate controls (continuous)	
G1 education at child's birth (maternal years of schooling completed)	0.27[*]
IQ score	0.63[*]

[a] G2 children: the children from the mother denoted as G1 in the sample of National Collaborative Perinatal Project (NCPP), Johns Hopkins.

[*] Significant at the 0.01 level (2-tailed).

Table 3 Odds ratios for models predicting GHQ outcome.

	GHQ overall Caseness
Predictors	
n	1671
WRAT score performance	
Low	1.36 (1.01–1.84)[*]
Middle (reference group)	1
High	.85 (.63–1.14)
Sex	
Male	1
Female	2.01 (1.59–2.56)[***]
Race	
African American	1
White	1.56 (1.18–2.06)[**]
IQ	1.00 (.96–1.01)
Maternal education	
Less than high school	1
Some high school	.99 (.76–1.30)
High school graduate	.70 (.50–.97)[*]
Some college	.91 (.56–1.48)

[*] Significant at the 0.05 level (2-tailed).
[**] Significant at the 0.005 level (2-tailed).
[***] Significant at the 0.001 level (2-tailed).

scores were also significantly associated with level of school completed by the G2 ($r = 0.34$) and personal income ($r = .30$) (Table 2).

The mean IQ score for the entire sample was 92.49, with a standard deviation of 12.2. The scores ranged from a high of 132 to a low of 37.

Based on GHQ scores, approximately 24% ($n = 424$) of the sample had symptoms of mental disturbances. GHQ symptom subgroup scores revealed that anxiety and insomnia were the most prevalent ($n = 245$, 14% each), followed by somatic disorders ($n = 160$, 9.1%), social dysfunction ($n = 138$, 7.9%), and major depression ($n = 58$, 3.3%).

In terms of status achievement, nearly 32% of G2 participants attended college ($n = 559$), while the other 1199 did not. 367 respondents had high incomes (above \$25,000), and 353 respondents had low incomes (below \$5274). The average income for the total sample was \$16,486. Nearly 80% of the total sample was employed at the time of the Pathways follow-up.

Most likely as a result of its sensitive nature, there were 355 missing responses to the item ''personal income in dollars'' in the Pathways interviews. In order to identify potential biases in the data, an independent samples *t*-test was performed to evaluate whether or not those who answered the question were significantly different from those who did not. Respondents that answered the question were significantly more likely to have higher WRAT scores (73.55 vs. 69.79), more years of schooling, better GHQ scores, and higher IQ scores (93.05 vs. 90.11). Additionally, their mothers had completed a significantly greater number of years of school at the time of their births.

Mental health outcomes

Low score on the WRAT was significantly associated with mental disturbance in adulthood (odds ratio (OR) = 1.36, $p < 0.05$) (Table 3). Females also had a higher risk than males of developing mental disturbances as an adult (OR = 2.01, $p < 0.001$).

Symptom specific odds ratios are displayed in Table 4. Individuals with high WRAT scores had a lower chance of developing anxiety disorders (OR = 0.59, $p < 0.01$). Female gender increased the probability of developing an anxiety

disorder by more than two (OR = 2.15, $p < 0.001$). Further, those who scored higher on the WRAT had significantly lower rates of depression (OR = 0.41, $p < 0.05$).

None of the variables were significantly associated with the development of symptoms of social dysfunction. IQ was found to be unrelated to any mental health outcomes across all regression models.

Status achievement outcomes

Performance on the WRAT at age 7 was significantly associated with multiple measures of status achievement (Table 5). Children in the low scoring WRAT group were far less likely to attend college than children who scored in the reference group (OR = 0.54, $p < 0.001$), while those in the high scoring group were nearly twice as likely to attend college as those in the reference group (OR = 1.9, $p < 0.001$). Further, females were significantly more likely to attend college than males (OR = 1.70, $p < 0.001$).

Those in the low scoring WRAT group were significantly less likely to be employed (OR = 0.69, $p < 0.05$) and significantly more likely to have low personal incomes as adults (OR = 1.49, $p < 0.05$) (as well as significantly lower odds of having high personal incomes as adults (OR = 0.49, $p < 0.01$)). When compared to males, females were significantly less likely to fall into the high personal income category (OR = 0.57, $p < 0.001$) and significantly more likely to fall into the low personal income category (OR = 1.47, $p < 0.001$) as adults.

IQ scores were significantly related to adult status achievement in all models. Individuals with higher IQ scores were significantly more likely to attend college (OR = 1.04,

Table 4 Odds ratios for models predicting mental health-GHQ symptom specific subscales.

| | GHQ disorder subcategory | | | |
	Somatic	Anxiety	Social	Severe depression
Predictors				
n	1671	1671	1671	1671
WRAT score performance				
Low	1.46 (.93–2.23)	1.42 (.98–2.05)	1.43 (.91–2.25)	.99 (.50–1.96)
Middle (reference group)	1	1	1	1
High	.91 (.60–1.40)	.59 (.40–.87)**	.66 (.39–1.09)	.41 (.17–.96)*
Sex				
Male	1	1	1	1
Female	2.25 (1.56–3.23)***	2.15 (1.59–2.91)***	.99 (.69–1.41)	1.38 (.79–2.39)
Race				
African American	1	1	1	1
White	1.72 (1.18–2.52)**	1.98 (1.44–2.73)***	1.45 (.95–2.21)	2.64 (1.50–4.65)***
IQ	1.01 (1.00–1.03)	1.01 (1.00–1.03)	1.00(.99–1.02)	.99 (.96–1.02)
Maternal education				
Less than high school	1	1	1	1
Some high school	.79 (.54–1.15)	.84 (.60–1.17)	.91 (.61–1.38)	1.17 (.61–2.23)
High school graduate	.55 (.34–.90)	.76 (.51–1.14)	.66 (.38–1.12)	.86 (.38–1.94)
Some college	.58 (.27–1.26)	.85 (.47–1.56)	.80 (.36–1.75)	1.19 (.38–3.69)

* Significant at the 0.05 level (2-tailed).
** Significant at the 0.005 level (2-tailed).
*** Significant at the 0.001 level (2-tailed).

Table 5 Odds ratios for models predicting status achievement outcomes in adulthood.

| Predictors | Attended college | Employed | Personal income quartile | |
			Low	High
n	1734	1709	1400	1400
WRAT score performance				
Low	.54 (.39–.75)***	.69 (.51–.94)*	1.49 (1.09–2.06)*	.49 (.33–.74)**
Middle (reference group)	1	1	1	1
High	1.90 (1.47–2.47)***	1.31 (.93–1.84)	.60 (.42–.84)**	1.71 (1.29–2.29)***
Sex				
Male	1	1	1	1
Female	1.70 (1.36–2.13)***	.54 (.42–.70)***	1.47 (1.14–1.90)**	.57 (.44–.74)***
Race				
African American	1	1	1	1
White	.19 (.13–.27)***	1.00 (.73–1.37)	1.07 (.78–1.46)	.74 (.54–1.03)
IQ	1.04 (1.02–1.05)***	1.03 (1.02–1.05)***	.98 (.96–.99)***	1.03 (1.02–1.05)***
Maternal education				
Less than high school	1	1	1	1
Some high school	.86 (.66–1.12)	1.14 (.86–1.51)	.97 (.72–1.31)	.97 (.72–1.32)
High school graduate	.95 (.69–1.29)	1.41 (1.00–2.00)	.95 (.66–1.36)	1.00 (.69–1.43)
Some college	1.15 (.73–1.80)	1.13 (.68–1.90)	1.17 (.71–1.96)	1.32 (.81–2.15)

* Significant at the 0.05 level (2-tailed).
** Significant at the 0.005 level (2-tailed).
*** Significant at the 0.001 level (2-tailed).

$p < 0.001$), be employed (OR = 1.03, $p < 0.001$), and to have high personal incomes (OR = 1.03, $p < 0.001$).

Discussion

Our study suggests that childhood education (as measured by the Wide Range Achievement Test, WRAT) predicts mental health, employment status, and personal income in adulthood.

Those children who performed poorly on the WRAT at age 7 had significantly poorer outcomes as adults. Children who scored below the 25th percentile on the WRAT were nearly twice as likely to not go to college and were significantly more likely to have low personal incomes as an adult. Low WRAT scorers were less likely to be employed as well. Conversely, superior performance on the WRAT predicted significantly better mental health outcomes as an adult. Further, those who scored highly on the WRAT were significantly less likely to develop symptoms of anxiety, insomnia, and severe depression. They also were significantly more likely to have a personal income above the 75th percentile and to go to college.

Previous research using the WRAT evaluated extremely specific groups such as the learning disabled and the exceptionally gifted.[28–30] As such, these researchers divided their samples by the extremes of the distributions, some including only the top or bottom 6 or 7 percent in the high scoring or low scoring groups respectively. Others used the top or bottom 10, 15, or 20 percent. The decision on how to divide the sample varied slightly based on the focus of the study, but most studies divided the samples by greater than one standard deviation above or below the mean. Because we wished to characterize the children more extensively, not merely as intellectually gifted or intellectually disadvantaged, we defined the top 25th percentile as high scoring and the bottom 25th percentile as low scoring.

Despite the fact that IQ scores were highly associated with status achievement, they were not associated with mental health outcomes. Meanwhile, WRAT scores were highly associated with both status achievement and mental health outcomes. Such a finding verifies the importance of both intelligence and educational attainment in obtaining status achievement. Namely, both a bright child and a hard-working child can eventually achieve high status. Yet the finding also begs the question what is it about educational attainment that can fend off poor mental health outcomes, and why can IQ not do the same? Children with IQ scores are just as likely to develop mental problems as adults as children with low IQ scores, but why do high achieving children stave off mental disease? While intelligence is an inherent trait, achievement is a marker of hard work over lengthy periods of time and other educational environmental factors including quality of teaching and learning, curricular programs, and so on. Many theorists believe participation and performance in school at a young age sets the foundation for positive behavioral and emotional paradigms. Therefore, achievement says much more about an individual's mindset than intelligence does, and it is certainly mindset over time that determines, or at the very least, plays a role in determining mental health.

A study looked at three data sets of children with ages 5 to 18 – the Avon Longitudinal Study of Parents and Children (13,901 British children), the National Institute of Child Health and Human Development Study of Early Child Care and Youth Development (1354 American children), and the Panel Study of Income Dynamics-Child Development Supplement (237 American children), found that students' self-concepts of their academic abilities (math and reading specifically in their study) play an important role in motivating their achievements over time and across levels of achievement. They concluded the individual's concepts of their abilities predicts their later achievement.[31]

If it is not innate intelligence that drives educational attainment, then educational interventions should be able to improve outcomes for children. Previous literature[17] provided important insights into how childhood educational interventions can lead to positive adult outcomes, both mentally and otherwise. Their findings suggested that those children who are enrolled in educational interventions are more likely to exhibit positive behaviors and stronger socio-emotional states than those children who are not enrolled.

By examining the Child-Parent-Center (CPC) educational intervention program for young children, the Chicago Longitudinal Study demonstrated the effectiveness of such interventions on adult outcomes.[32] This groundbreaking study followed patients for 24 years after their enrollment in the CPC to examine the influence of childhood factors on adult outcomes. Those children who experienced interventions in pre-school were significantly more likely to complete high school and attend college, find stable employment, and have better health as adults than a control group that did not receive the interventions. Yet another study suggested that intensive educational programs in pre-school significantly increase the total number of years a child spends in school, increases the likelihood that the child will attend a four year university, and decreases the chances that the child will be involved in a teen pregnancy.[33]

In our sample, females were significantly more likely than males to go to college. Despite higher rates in attending college, females were significantly less likely to be employed and to be categorized into the high personal income group at the time of the Pathways follow-up. This suggests that the women in our sample faced additional barriers to career success, beyond those associated with going to college. Our findings are also consistent with prior research that has shown that women are at a much higher risk of developing significant depression and symptoms of generalized anxiety disorder.

It should be noted that the NCPP data was not originally designed to perform such types of investigations. The architects of the project had the distinct goal of investigating the consequences of early exposures, including in utero exposures, on childhood outcomes up until 7 years of age. The data that was collected into adulthood was an extension of the primary project.

Additionally, the GHQ is not an ideal measure of psychopathology. It provides a valid assessment of overall mental state, though does a poor job at identifying diagnosis specific findings. Therefore, classification by specific psychiatric illnesses could not be performed in this study. If data collection had been performed today, more specific

instruments in addition to the GHQ would have been administered to more thoroughly assess adult mental health.

A large number of subjects did not provide a response to the question regarding personal income. Those who did not respond were significantly more likely to have had lower WRAT scores as a child, less years of schooling overall, and worse GHQ and IQ scores. In short, those who did not respond were worse off by all measures.

A specific strength of this data set is the high response rate in follow-up. Johns Hopkins researchers tracked down outcomes from over 70% of the original Pathways subjects (70% of those who completed the WRAT at 7 years old also completed a follow-up interview), a testament to both the overall effectiveness of their methods as well as their commitment to the Pathways Study. The follow-up time is especially long, thus allowing us to make stronger conclusions regarding characteristics of the adult sample. Other studies have had significantly shorter follow-up times. For example, a previous study linking childhood functioning with adult mental health disorders had a follow-up time of only 15–20 years.[34] This study is also strengthened by its use of the WRAT as a hard and fast measure of educational attainment. The WRAT is a primary measure of educational attainment, while many of the other studies that were published using the NCPP dataset used secondary measures such as third party (e.g., teachers, staff) evaluations.

In an effort to develop a more specific understanding of the complex interrelationship between educational attainment and status achievement, this study examines a predominantly African-American low socioeconomic sample that was taken from an inner city section of Baltimore, MD. It therefore seeks to bridge the gap in external validity that has limited findings from previous NCPP analyses by demonstrating similar trends in a previously unstudied demographic. Our results imply that individuals from such a population who have low educational attainment by age 7 are at the highest risk for poor outcomes, both mentally and professionally. In terms of professional outcomes, both intelligence and strong academic performance in childhood are key to potential monetary success and a stepping stone toward college.

Ethical approval

The IRB of the Johns Hopkins University has approved the study.

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Conflict of interest

Acknowledgements

Appendix 1.

a. Pathways to adulthood sample selection	Total	%
Total JHCPS sample	4025	100
Died – during neonatal period	122	3
Died before 4 month exam	30	0.7
Died after 4 month exam	35	0.9
Followed in the CPS	3838	100
Born in 1959	427	11.1
Did NOT complete 7 or 8 year exams	404	10.5
Eligible for pathways to adulthood	3007	100
Pilot study	60	2
Conflict of interest	7	0.2
Replicate group	247	8.2
Final eligible sample	2694	

Source: Hardy and Shapiro (1997).

b. Final eligible follow-up sample	G1 (*n*)	G2 (*n*)
Eligible sample	2306	2694
Not located	292	474
Located	2014	2220
Not fieldable		
Out of country/incapable	17	11
Deceased, no data	69	17
Fieldable sample	1928	2192
In field end of follow-up	58	157
Refused	151	135
Absent G2[a] interview	na	71
Deceased with data	167	71
Full Interview	1552	1758
Response rate (known outcome)	77.9	71.4
Response rate (full interview)	67.3	65.3

[a] G2 children: the children from the mother denoted as G1 in the sample of National Collaborative Perinatal Project (NCPP), Jonhs Hopkins.
Source: Hardy and Shapiro (1997).

c. General characteristics of the G2[a] sample	Total G2 sample
Total (*n*)	1820
Sex (*n*)	1820
Male	856 (47%)
Female	964 (53%)
Race (*n*)	1820
White	332 (18.2%)
African American	1492 (81.8%)
Aggregated WRAT scores (*n*)	1775
Mean score	72.8
Std. deviation	17.8
Range	10–139
GHQ scores (*n*)	1748
Mean score	43.5
Std. deviation	10.81
Range	11–100
Years of completed school	1820
Mean years	12.15
Std. deviation	2.17
Range	x3–14
Employed (*n*)	1791
No (%)	1422 (79.4)
Yes (%)	369 (20.6)
Personal income (*n*)	1465
Mean income	$16,486
Std. deviation	$14,377
Range	$0–$25,000

[a] G2 children: the children from the mother denoted as G1 in the sample of National Collaborative Perinatal Project (NCPP), Jonhs Hopkins.

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