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Longitudinal Latent Cognitive Profiles and Psychosocial Well-being in Early Adolescence

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A B S T R A C T

Purpose: Engaging in exploratory risky behaviors and experiencing poor mental health during early adolescence are important markers for poor health during adulthood. Prior research suggests protective effects from cognition, but less is known about the associations between early childhood cognition and early adolescent psychosocial well-being, as identified by self-esteem, mental health, and exploratory risky behaviors. This article investigates the extent that early adolescent psychosocial well-being at the age of 11 years is associated with patterns of cognitive skills measured across the first decade of a child's life.
Methods: We used data collected from the four follow-up sweeps of the UK Millennium Cohort Study and utilized latent profile analysis to identify three discernible cognitive profiles (n = 16,899).
Results: We find cohort members in low-achieving profiles to be more likely to engage in exploratory risky behaviors—drinking, smoking, and antisocial conduct—and to have poor self-esteem and more problem behaviors, compared with their peers in high-achieving profiles. Socioeconomic and family psychosocial markers considerably attenuated these disadvantages.
Conclusions: Understanding which adolescents have adverse psychosocial well-being has implications for the prevention of chronic diseases and for clinical care and policy.

IMPLICATIONS AND CONTRIBUTIONS

Adolescents with poor cognitive skills are more likely to engage in risky behaviors, to have low self-esteem, and more problem behaviors. Socioeconomic factors, parental mental health, and parental supervision were important in explaining differences. Future research should identify protective factors and possible interventions to improve adolescent psychosocial well-being.

Adolescence is a crucial period of psychological, social, and biological change. Early adolescence is an important period given the potential emergence of antisocial behavior, poor mental health, and experimentation with alcohol and smoking [1–3]. The uptake of risky behaviors during this developmental period is concerning as they are linked to subsequent life course outcomes such as educational failure, hypertension, and premature mortality [2,4]. Poor mental health during adolescence has been linked to academic achievement, subsequent anxiety and depression, and eating pathology [5]. The social costs from the loss of productivity and an array of health care expenses due to these pernicious consequences [6] has led to an extensive body of research aimed at better understanding the social etiology of adolescent mental health and exploratory risky behaviors (hereafter referred to as psychosocial well-being) [7]. Ultimately, having information about groups of adolescents who are most vulnerable to poor mental health and exploratory risky behaviors can help in planning both prevention and intervention programs to promote the success of all children.

Existing scholarship has considered the influence of cognitive development in shaping adolescent psychosocial well-being [1,8,9]. However, much of the evidence has focused on cognitive skills in middle to late adolescence [10], finding strong cognitive performance, measured by higher grades, advanced

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courses and school engagement, to be associated with lower levels of alcohol use [11,12] and is protective against cigarette use [13]. Less is known about the linkages between cognitive skills during early childhood and adolescent psychosocial well-being [14]. Understanding inequalities in children's cognitive skills is consequential given the economic benefits of intervening during early childhood to reduce long-term inequalities [15].

Recent evidence examining longitudinal patterns of cognition in early childhood emphasizes the importance of considering the heterogeneity in patterns of cognitive skills and the need to move beyond cross-sectional means [16]. Very few studies examine longitudinal patterns of cognitive skills and associated outcomes. Those studies that have examined patterns of cognitive skills have either relied on cross-sectional cognitive data [14], focused on subgroups of children [17], or grouped cognition along with other domains of school readiness (e.g., health or gross motor skills) [18,19]. No prior studies have explored outcomes in early adolescence.

This study attempts to address these gaps in the literature by investigating the link between patterns of cognitive skills in early childhood and psychosocial well-being among early adolescents. We focus on early adolescence (11 years of age), a period during which increased prevalence of mood disorders has been observed [20] and which may be a sensitive phase due to the onset of puberty and accompanying academic transitions and increasing influence of peer groups [21]. Second, cognition may have a greater influence on psychosocial well-being during developmental transitions [8]. We use a nationally representative sample of children born at the millennium to first identify patterns of children's cognitive skills. Next, we examine the extent to which longitudinal cognitive profiles are associated with markers of adolescent psychosocial well-being (cigarette use, alcohol drinking, antisocial behavior, happiness, self-esteem, and problem behaviors) among 11-year-olds.

Methods

Data

The Millennium Cohort Study is a nationally representative sample of 19,244 families of children born in the United Kingdom between 2000 and 2002, who were living in the United Kingdom at 9 months old and who were eligible to receive Child Benefit [22]. The sample is clustered at the electoral ward level and disadvantaged residential areas and those with a high proportion of ethnic minority residents were oversampled. Primary respondents were mainly mothers, and data collection occurred when cohort members were 9 months, and 3, 5, 7, and 11 years old. During home interviews, trained interviewers carried out cognitive assessments; at the fifth (age 11 years) sweep, interviews were conducted during home visits with both cohort members and their parents/caregivers, and questions were asked about adolescent psychosocial well-being, socioeconomic circumstances, and family psychosocial factors. Cohort members filled out a self-completion booklet. Ethical approval was granted by the Northern and Yorkshire multicentre research ethics committees.

Child cognitive skills are moderated by multiple births, and therefore, we analyzed data on singleton-born cohort members. To characterize longitudinal latent cognitive profiles, we first analyzed a sample of cohort members who had at least one cognitive assessment across the four sweeps. The analytic sample for the latent profile analysis was 16,899. The sample of cohort members with at least one marker of psychosocial well-being at age 11 years was 13,072. This sample was further reduced to a maximum of 11,263 participants with complete data on covariates. Sample sizes varied by outcome measure and ranged from 10,822 to 11,263.

Measures

Markers of psychosocial well-being. This study investigated six measures of adolescent psychosocial well-being. Cohort members reported on whether they had ever tried a cigarette (1 = yes, 0 = no) and ever had an alcoholic drink (1 = yes, 0 = no). Antisocial behavior was self-assessed through four questions asking about being noisy or rude in public, theft, public defacement, and public damage. A binary variable was derived indicating any antisocial behavior versus none. Happiness was measured with six items reflecting cohort member's happiness about different aspects of their life: school work; school; appearance; family; friends; and life as a whole ($\alpha = .83$). Responses on each question ranged from a score of 0 (not at all happy) to a score of 3 (completely happy) and were summed, and a binary variable was constructed to indicate the top 10% of the distribution or high level of happiness (1 = top 10% of scores, 0 = bottom 90% of scores) [23]. Cohort members rated their self-esteem using a shortened and adapted version of Rosenberg's Self-Esteem Scale which comprised five items on a four-point Likert scale (1 = strongly agree to 4 = strongly disagree; $\alpha = .74$) [24]: self-satisfaction, having good qualities, able to do things similar to others, person of value, and feel good about oneself. Similar to self-reported happiness, self-esteem was categorized as a binary variable indicating high self-esteem or the top 10% of the distribution. Parents answered questions about their child's socio-emotional behavior using the Strengths and Difficulties Questionnaire a valid and reliable measure of children's emotional, social, and behavioral difficulties [25]. Scores are summed across four behavioral domains (peer problems, conduct disorders, hyperactivity, and emotional problems) to construct a total difficulties score, which was analyzed as a binary variable with scores defined as "abnormal" or "borderline," collectively referred to as behavioral difficulties (coded as 1), and "normal" (coded as 0) [25]. An externalizing behavior score was the sum of conduct problems and hyperactivity–inattention scales and an internalizing behavior score was the sum of emotional symptoms and peer problems scores. Both externalizing and internalizing scores were used as continuous variables in sensitivity analyses.

Cognitive skills. Cognitive skills were assessed using a subset of the British Ability Scales II (BAS II), which is a battery of cognitive abilities and educational achievement tests [26]. The individual subscales are widely validated, age appropriate, can be analyzed separately and have been shown to predict later child cognitive performance [22]. Data were available on the BAS II Naming Vocabulary Subscale (age 3 and 5 years) which measures vocabulary and expressive reasoning, the Word Reading subscale (age 7 years) involving verbal reasoning, and the Verbal Similarities subscale (age 11 years) assessing cohort member's verbal reasoning and verbal knowledge [22]. Other BAS subscales (e.g., testing spatial abilities) were administered but unavailable at all four sweeps of data collection. Scores on BAS II subscales are

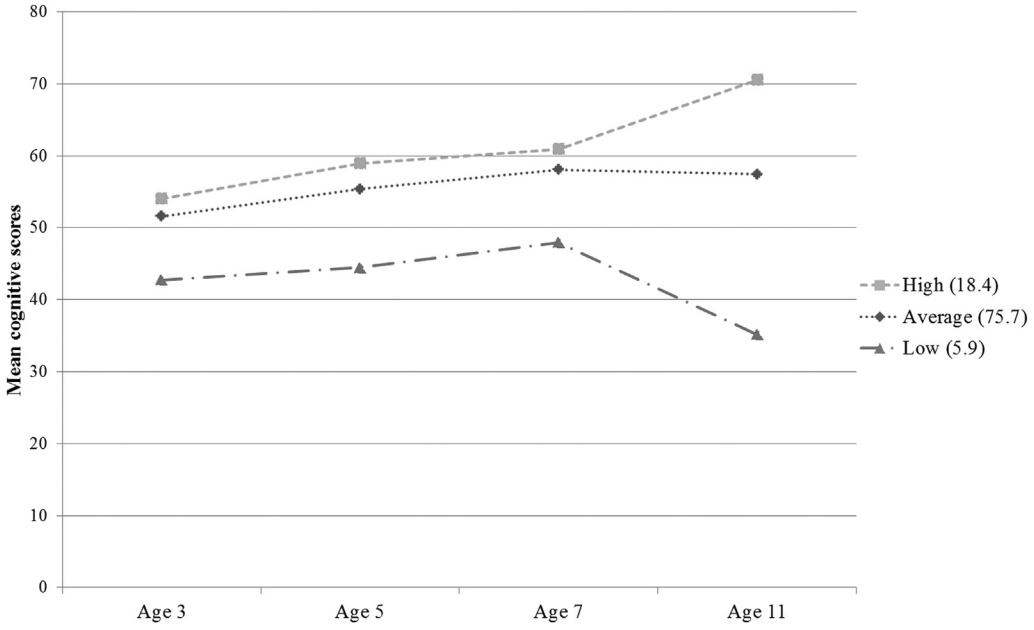

Figure 1. Longitudinal latent cognitive profiles. Sample is 16,899. Latent profile analysis models include cohort member age and gender and correlations between the nearest assessments in age. Millennium Cohort Study, Sweeps 2–5.

standardized to mean 50 and standard deviation 10 and are adjusted for both item difficulty and age.

Covariates. We examined the contribution of cohort member and family characteristics that could account for potential differences in early adolescent psychosocial well-being across maternal demographic, socioeconomic, and family psychosocial domains. Covariates were assessed concurrently to adolescent outcomes with the exception of birth order and mother's age at birth. Continuous variables were centered at the mean and reference categories for categorical variables were assigned to the most advantaged group. Adolescent characteristics were age in years and gender (female is reference). Maternal demographic characteristics were birth order (1 = first birth, 0 = higher parity) and mother's age at time of birth, which was used as a categorical variable for descriptive statistics (<19, 20–24, 25–29, 30–34, >34 years) and continuous for covariate adjustment. Socioeconomic factors were equivalized household income in quintiles (highest income quintile as reference), highest parental education (seven categories on the national vocational qualifications (NVQ) equivalence scale: NVQ5 higher degree [reference], NVQ4 first degree/diploma, NVQ3 A/AS levels, NVQ2 General Certificate of Secondary Education (GCSE) grades A—C, NVQ1 GCSE grades D—G, overseas qualification, and none), single parenthood (reference two-parent family), and a binary indicator of mother's employment (reference employed). We included two measures of family psychosocial environment. Maternal mental health was assessed using the six-item Kessler questionnaire (range: 0–24), a screening scale for assessing psychological distress [27]. For descriptive statistics, we indicate risk for depressive symptoms (1 = at risk, score range: 13–24; 0 = no risk, range: 0–12), and for covariate adjustment, we used a continuous measure. Parental supervision was measured using questions about the weekday and weekend frequency of the cohort member spending unsupervised time with friends. Following previous literature [3], a three-category variable was constructed: rarely/never (most occasionally at weekends/on weekdays), sometimes, and often (unsupervised most weekends and at least 1 day per week).

Analytic Strategy

We used a three-step latent profile analysis to identify longitudinal latent cognitive profiles [28]. Further detail on the methodology can be found in Appendix A (Supplementary Material). The finalized three-profile model, controlling for age and gender, is illustrated in Figure 1. Fit indices are presented in Appendix Table 1. Based on increasingly poor classification quality, interpretability, Bayesian information criterion, and Lo-Mendell-Rubin, we selected the three-class solution. These cognitive profiles are depicted in Figure 1. The largest group was named the "average" (75.7% of the sample). The scores of this group at each age of assessment were the closest to the overall sample mean, with mean scores ranging between 51 and 57 across the four assessment periods. In contrast to this group, a "low" group (5.9% of the sample) had the poorest cognitive performance across childhood, with mean scores ranging from 35 to 47. In contrast to these two groups, the "high" group (18.4% of the sample) consisted of cohort members with the highest cognitive scores, with means ranging from 54 to 70 across the four assessment points. Noticeably, at age 11 years, cognitive mean scores diverge considerably across the "low" and "high" groups resulting in mean values for the "high" group being double that of the "low" group.

We used the BCH method in Mplus to assess mean differences in psychosocial well-being across longitudinal latent cognitive profiles [29]. The BCH method is traditionally used for continuous variables but can be applied to distal binary outcomes (T. Asparouhov, personal communication, March 2, 2016). However, in doing so, out-of-bounds (i.e., negative) coefficients can

occur although in practice, none of the negative estimates were significantly different from zero. Further detail on this methodology is in Appendix A (Supplementary Material). All pairwise comparisons between profiles were examined for statistically significant differences using Wald tests. Means on the binary outcomes can be interpreted as prevalence estimates, and results will be presented using the latter term. If a mean is estimated to be below zero, we consider the prevalence to be zero and constrain the coefficient at zero for significance testing.

We first present descriptive information by reporting prevalence of all markers of psychosocial well-being by covariates. We then estimate the prevalence in psychosocial well-being across longitudinal latent cognitive profiles. We investigated the importance of maternal demographics, socioeconomic, and family psychosocial domains by separately adjusting for these factors in the following way:

- Unadjusted estimates of prevalence of psychosocial well-being;
- Model 0: cohort member age and gender;
- Model 1: cohort member age, gender, and maternal demographics;
- Model 2: cohort member age, gender, and socioeconomic factors;
- Model 3: cohort member age, gender, and family psychosocial characteristics;
- Model 4: simultaneously adjusts for all covariates.

All analyses were weighted to account for nonresponse of eligible participants into the study and the unequal probability of being sampled.

Results

Variation in psychosocial well-being by cohort member and family factors

Table 1 presents the weighted prevalence of markers of psychosocial well-being by covariates. Boys had higher rates of exploratory risky behaviors (smoking and drinking), antisocial

Table 1
Prevalence of psychosocial outcomes by covariates

	Smoking	Drinking	Antisocial behavior	High happiness score	High self-esteem score	Behavioral difficulties
n	10,930	10,822	11,054	11,042	10,921	11,263
Cohort member gender						
Male	3.8	15.8	28.1	9.2	13.9	22.6
Female	2.1	11.0	17.0	9.9	12.2	15.6
Maternal demographics						
Birth order						
Cohort member is first born	2.0	12.7	21.3	10.1	14.7	19.3
Cohort member is second or higher birth order	3.8	14.1	23.7	9.2	11.9	19.1
Mother's age at time of birth, years						
14–19	3.7	16.6	31.1	10.3	11.7	28.3
20–24	5.1	13.5	27.2	9.5	12.5	28.9
25–29	3.0	14.8	21.8	9.7	13.2	18.7
30–34	2.0	11.1	18.7	9.5	13.6	13.5
35+	2.0	13.5	21.1	9.0	13.6	13.4
Socioeconomic characteristics						
Equivalized household income						
Lowest quintile	6.5	15.3	33.2	11.3	12.7	32.2
Second quintile	4.8	14.7	26.7	9.7	11.6	26.5
Third quintile	2.0	13.8	21.1	9.9	13.1	16.4
Fourth quintile	1.0	12.3	16.8	8.6	12.4	12.7
Highest quintile	1.1	11.4	16.6	8.4	15.7	9.2
Highest parental educational attainment						
None	8.2	13.3	36.0	14.4	14.1	35.6
Overseas	3.4	10.8	21.6	13.3	17.9	31.0
NVQ1	6.4	15.4	27.8	9.9	11.4	30.3
NVQ2	4.8	16.1	26.0	9.0	9.9	23.3
NVQ3	2.1	14.1	23.8	9.3	12.7	21.0
NVQ4	1.7	12.2	19.1	8.8	13.2	14.3
NVQ5	1.3	11.8	18.5	10.2	17.7	11.3
Family structure						
One parent	5.5	14.9	29.3	8.5	11.6	26.6
Two parent	2.2	13.0	20.6	9.9	13.6	16.8
Maternal employment						
Not working	5.1	13.4	28.4	10.4	12.8	28.6
Working	2.0	13.5	20.0	9.2	13.3	14.7
Family psychosocial characteristics						
Unsupervised time at weekend/weekday						
Often	4.8	16.0	28.2	9.6	12.4	19.6
Sometimes	2.2	13.2	19.7	8.9	13.1	18.5
Never/rarely	1.5	10.4	18.5	10.1	14.0	19.4
Maternal depression						
No risk for depressive symptoms	2.8	13.4	21.9	9.7	13.2	17.0
Maternal risk for depressive symptoms	5.7	13.9	35.3	7.4	11.3	53.0

Prevalence is weighted by overall sample weights from MCS 5.

Table 2
Prevalence of exploratory risky behaviors by longitudinal cognitive profiles

	Unadjusted	Model 0 (M0): age and gender	Model 1: M0 + demographics	Model 2: M0 + socioeconomic	Model 3: M0 + family psychosocial	Model 4: fully adjusted
Panel A: smoking						
High	1.7 (.4)	.8 (.4)	1.5 (.6)	1.1 (.8)	.3 (.8)	1.9 (1.2)
Average	2.7 (.2)[a]	1.9 (.3)	2.7 (.4)	−.6 (.5)	1.0 (.4)	.2 (.8)
Low	6.0 (1.0)[a]	4.8 (1.2)[a,b]	5.2 (1.4)[a]	−4.0 (1.3)	2.0 (2.0)	−5.0 (2.2)
N	10,930	10,930	10,930	10,930	10,930	10,930
Panel B: alcohol						
High	9.3 (.8)	6.7 (1.0)	7.0 (1.4)	5.7 (1.9)	5.3 (1.8)	3.1 (2.9)
Average	12.4 (.5)[a]	10.0 (.6)[a]	10.3 (.8)	10.6 (1.4)	10.2 (1.0)[a]	13.2 (1.9)[a]
Low	12.7 (1.5)[a]	8.9 (1.8)	9.3 (2.0)	5.9 (7.7)	4.0 (3.0)	−5.1 (8.0)[b]
N	10,822	10,822	10,822	10,822	10,822	10,822
Panel C: antisocial behavior						
High	18.5 (1.1)	13.9 (1.6)	17.1 (2.1)	9.3 (2.2)	10.1 (2.6)	9.1 (3.7)
Average	22.1 (.6)[a]	16.4 (.7)	18.3 (.9)	13.1 (1.8)	11.0 (1.2)	12.0 (2.5)
Low	30.1 (1.8)[a,b]	23.4 (2.4)[a,b]	23.8 (2.5)[a,b]	3.0 (8.5)	11.6 (4.3)	−5.6 (9.2)[a,b]
N	11,054	11,054	11,054	11,054	11,054	11,054

Smoking, alcohol consumption, and antisocial behavior are binary variables. Standard errors in parentheses. Negative prevalence estimates are considered to be zero.
[a] Mean significantly different from high-performing profile at $p < .05$.
[b] Mean significantly different from average-performing profile at $p < .05$. All models are adjusted for MCS 5 sample weights.

behavior, and more behavioral problems than girls but had higher self-esteem scores. Cohort members who were second or subsequent order births, compared with those who were first births, had a higher prevalence of smoking, drinking, and antisocial behavior, whereas those who were first born had higher happiness and self-esteem scores. Higher rates of drinking, antisocial behavior, and problem behaviors were evident among those with younger mothers. Socioeconomic disadvantage and more frequent unsupervised time were linked to higher prevalence of poor psychosocial well-being. Poor psychosocial outcomes were evident among cohort members of mothers at risk for depressive symptoms.

Cognitive skill development and psychosocial well-being in early adolescence

Table 2 (risky behaviors) and Table 3 (mental health) explored the linkages between psychosocial well-being and longitudinal cognitive profiles before and after accounting for covariates.

Unadjusted smoking prevalence estimates by longitudinal cognitive profiles (panel A: first column, Table 2) shows the highest prevalence of smoking among cohort members in the low profile (6%) which is significantly higher than cohort members in either the average (3%) or high profile (2%). The rates of smoking between average and high profiles differed significantly from each other but adjusting for age and gender explained these differences (model 0). Adjusting for maternal demographics explained significant differences in smoking between low and average profiles (model 1), whereas socioeconomic (model 2) and family psychosocial (model 3) characteristics accounted for differences between low and high profiles. Fully adjusted models showed no significant differences in smoking across longitudinal cognitive profiles.

Similar to smoking prevalence, cohort members in low and average profiles had significantly higher prevalence of drinking (13% and 12%, respectively), as compared with their peers in the high-performing profile (9%; panel B: Table 2). Adjusting for a range of covariates attenuated the difference in prevalence of

Table 3
Prevalence of mental health by longitudinal cognitive profiles

	Unadjusted	Model 0 (M0): age and gender	Model 1: M0 + demographics	Model 2: M0 + socioeconomic	Model 3: M0 + family psychosocial	Model 4: fully adjusted
Panel A: happiness						
High	12.2 (1.1)	12.2 (1.6)	12.4 (1.7)	9.3 (1.9)	11.6 (2.0)	10.9 (3.0)
Average	9.9 (.5)	10.8 (.6)	10.5 (.8)	11.6 (1.5)	11.3 (1.0)	10.1 (1.9)
Low	14.2 (1.5)[b]	15.5 (2.6)	16.2 (2.9)[b]	10.3 (6.6)	15.1 (4.5)	15.1 (8.1)
N	11,042	11,042	11,042	11,042	11,042	11,042
Panel B: self-esteem						
High	18.5 (1.2)	18.6 (1.5)	17.2 (1.9)	20.5 (2.9)	19.8 (2.4)	20.5 (4.1)
Average	12.2 (.5)[a]	11.6 (.7)[a]	10.7 (.9)[a]	14.9 (1.9)	11.5 (1.1)[a]	13.2 (2.2)
Low	8.5 (1.1)[a,b]	8.0 (1.6)[a]	8.7 (1.6)[a]	8.4 (7.5)	9.8 (3.1)[a]	16.3 (9.1)
N	10,921	10,921	10,921	10,921	10,921	10,921
Panel C: behavioral difficulties						
High	10.0 (.8)	6.4 (1.0)	5.6 (1.4)	2.1 (1.6)	1.1 (1.7)	−3.3 (2.7)
Average	17.9 (.6)[a]	15.0 (.7)[a]	16.1 (.8)[a]	4.6 (1.4)	4.4 (1.0)	.5 (1.7)
Low	44.2 (2.3)[a,b]	38.9 (3.0)[a,b]	35.2 (3.1)[a,b]	24.3 (10.6)[a]	19.1 (5.0)[a,b]	2.3 (10.1)
N	11,263	11,263	11,263	11,263	11,263	11,263

Happiness and self-esteem are binary variables indicating top deciles of their respective scales. Behavioral difficulties is a binary variable indicating borderline or abnormal scores on the Strengths and Difficulties Questionnaire (SDQ). Negative prevalence estimates are considered to be zero.
[a] Mean significantly different from high-performing profile at $p < .05$.
[b] Mean significantly different from average-performing profile at $p < .05$. All models are adjusted for MCS 5 sample weights. Standard errors in parentheses.

alcohol consumption between high and low profiles to nonsignificance (model 3). Fully adjusted models showed significant differences between high and average profiles (prevalence estimates = 3% and 13%, respectively; model 4). Panel C (Table 2) explores the link between cognitive profiles and antisocial behavior prevalence. Low (30%) and average (22%) cognitive profiles had significantly higher prevalence than the high cognitive profile (19%). Age and gender attenuated differences between high and average profiles to nonsignificance (model 0), whereas differences between high and low profiles were mostly explained by socioeconomic and family psychosocial characteristics (models 2 and 3).

Findings for happiness are shown in Table 3 (panel A). Cohort members in the low profile had significantly higher prevalence of happiness (14%) compared with cohort members in the average-performing profile (10%; unadjusted). There were no differences in the prevalence of happiness between low and high profiles (12%) and average and high profiles. Each domain of family characteristics accounted for the significant differences between low and average profiles.

Cohort members in low (9%) and average (12%) profiles had significantly lower prevalence of high self-esteem compared with their peers in the high profile (19%; unadjusted model, Table 3, panel B). Socioeconomic characteristics accounted for differences between low and average profiles and the high profile (model 2).

Panel C (Table 3) reports the prevalence of behavioral difficulties. In unadjusted results, cohort members in average and low profiles had significantly higher prevalence of behavioral difficulties (18% and 44%) than their peers in the high-achieving profile (10%). Adjustment for socioeconomic factors attenuated the prevalence for cohort members in the average profile such that differences between high and average and average and low profiles were no longer significant (model 2).

For each marker of mental health in Table 2, there were no significant differences in prevalence estimates across profiles in fully adjusted models.

Discussion

This is the first study, to our knowledge, to examine the association between longitudinal cognitive profiles and early adolescent psychosocial well-being. We showed that children with a low-performing profile across the first decade of life were more likely to engage in exploratory risky behaviors—drinking, smoking, and antisocial conduct—and to have poor self-esteem and more problem behaviors, compared with their peers with a high-performing profile. Socioeconomic and family psychosocial markers, as operationalized here, explained this disadvantage. Our findings build upon the previous scholarship that has focused on adolescent academic performance that also found significant links between cognition and exploratory risky behaviors [11,12]. Our research reinforces the importance of the family environment and the combination of familial, economic, and socioemotional resources which may influence optimal adolescent health [30].

Consistent with our findings, prior studies using data-driven methods have identified multiple cognitive developmental profiles, including (1) a group predominantly high achieving, (2) a group characterized by average scores, and (3) a group identified by weak or below average scores [19,31]. This research has underscored the importance of latent classes to highlight heterogeneity in cognitive performance [32]. A recent study using the Millennium Cohort Study emphasized the use of multiple assessments of cognitive performance to avoid regression to the mean, a potential pitfall of only using one measurement occasion [33]. We move beyond this study by looking at the extent to which these profiles are linked to markers of psychosocial well-being.

A unique contribution of our study was its exploration of the association between longitudinal cognitive profiles and psychosocial well-being during early adolescence. Our results are broadly consistent with one previous study [19], which showed profiles characterized by below average school readiness dimensions were associated with worse health. However, there are marked differences between the previous study and the current analyses. First, Hair et al. [19] did not focus on early adolescence and psychosocial well-being. The importance of health and health inequalities in early adolescence is underscored in studies showing that psychosocial well-being in childhood is consequential for a number of outcomes in adulthood, including welfare receipt and schooling attainment [34]. Second, in our study we focused on one dimension of development, that is, cognitive skills across childhood, whereas other researchers have consolidated multiple measures of child development (e.g., language, cognition, physical health, and others) when constructing profiles [18]. Multidimensional constructs can obscure understanding of how one particular aspect of child development, here cognitive skills, can influence adolescent health. Our study was able to show that children who were consistently performing below average across childhood were more at risk of poor mental health and risky behaviors than their consistently above average-performing peers.

That we find socioeconomic characteristics and family psychosocial factors to be relevant in explaining differences in prevalence of psychosocial well-being between cohort members in low and high profiles is in line with empirical work linking these family-level characteristics to adolescent well-being [35,36]. Our findings align with evidence of income gradients in self-esteem and risky behavior among adolescents [35]. Differences between low and high profiles in prevalence of drinking, smoking, and engagement in antisocial behavior were partially explained by family psychosocial factors. It has been suggested that parental supervision, positive monitoring, and good parent-child communication is influential in decreasing poor behavior and delinquency [37] and reducing risk-taking behavior [36]. Further, exploratory risky behaviors in our study were sensitive to maternal psychological distress, supporting evidence that family environment and other psychosocial stressors operate as both additive and cumulative risk factors that may make adolescents vulnerable to substance use [38].

The present study not only indicates the family environment to be important for influencing early adolescent psychosocial well-being but also reinforces the importance of taking a family approach to addressing psychosocial well-being. Income redistribution has the potential to alleviate the effects of poor financial circumstances on a family's ability to provide enriching experiences, reduce parental depression, and provide adequate supervision [36]. Our findings emphasize the importance of efforts to ameliorate maternal depression as a salient element of intervention programs focused on healthy development [39]. Equally, evidence from a randomized cohort study suggests that parental monitoring and supervision may deter adolescent risky behaviors [40]. Young people's psychosocial well-being may also

be adversely affected through their perception of their position in the socioeconomic hierarchy [35]. Thus, these multiple pathways through which socioeconomic circumstances influence adolescent psychosocial well-being could inform health- and school-based interventions to alleviate or prevent poor psychosocial well-being [41]. Furthermore, there is also success in incorporating family involvement programs in school-based prevention programs to improve adolescent psychosocial well-being [42].

The strength of this study is that we examined data on objective measures, collected by trained observers, of cognitive ability among cohort members. Second, we took advantage of the longitudinal nature of the data to capture the heterogeneity of cohort member's cognitive development. However, it could be the case that we have underestimated effects if socioeconomic measures and family environment variables lack precision, as they are proxies for a myriad of ill-defined socio-environmental factors [16]. Cognitive skills focused on in this article are verbal ability and reasoning and reading knowledge. However, cognition includes a broad constellation of behaviors, social skills, and nonverbal cognitive skills (e.g., spatial skills) [43]. Given that cognition is a multidimensional concept [19], it is plausible that children achieving mastery in one type of cognitive skill may be disadvantaged in other cognitive competencies. Future research questions should consider other components of cognition in creating longitudinal profiles and the extent to which these other elements of cognitive skills are important for adolescent psychosocial well-being. We did not have measures of the school environment. Indeed, students' perception of teacher support and school connectedness is associated with improved psychosocial well-being among adolescents [44]. It is an important priority for future research to extend this work to examine contextual school factors to better understand the development of poor psychosocial well-being. Finally, other studies find a reciprocal relationship between drinking and psychosocial well-being [45] such that adolescents may drink as a coping mechanism to deal with distress or feelings of marginalization. Our data did not afford us the opportunity to temporally order our markers of psychosocial well-being, and this is an important area of inquiry with future data collections.

This study is the first to examine psychosocial well-being among early adolescents in conjunction with cognitive profiles in a nationally representative cohort of early adolescents in the United Kingdom. Importantly, we utilize a battery of markers of psychosocial well-being, including exploratory risky behaviors and mental health measures. Our results provide another perspective that further illustrates the substantial challenges for individuals who have poor cognitive performance across childhood and arrive at the doorstep of adolescence with compromised psychosocial well-being, which may persist into adult life. Future research needs to understand the wider social influences that may impact upon children who are at risk of academically lagging behind their counterparts and who may emerge to have an adverse health and behavioral profile at the beginning of adolescence.

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Supplementary Data

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