Research Square

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School Performance Explains Socioeconomic Differences in Mental Health

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Abstract

Background

It is unclear how parental SES and the child's own educational performance relate to the risk of developing a mental disorder in adulthood, and which of these has the largest impact.

Methods

We use a large total-population sample of adolescent school performance, linked to primary care records that capture a wide range of mental health disorders, and analyze school performance along the full spectrum, rather than in discrete categories. We analyze the data using parental income quartile, parental educational attainment, and the adolescent's high school grade point average (GPA) in a multiple regression model that includes all three predictors, to estimate their relative contributions while adjusting for the other factors.

Results

We document a strong educational gradient in mental health that is observable across the full spectrum of school performance. Mental health risk follows a consistent educational gradient, with the likelihood of diagnosis increasing steadily as school performance declines. We further find that the association between parental SES and child mental health conditions is strongly diminished when adjusting for the child's own school performance.

Conclusions

The association between parental SES and adult mental health is largely driven by the child's own educational achievement. These findings suggest that targeting support toward low-achieving students, regardless of their social background, is a potential strategy for reducing mental health inequalities.

Introduction

A large proportion of sociological research has aimed at understanding the relation between socioeconomic position and important life outcomes such as education and health (Montez & Bisesti, 2024). In these studies, it is often highlighted that a family's economic, cultural, and social resources constitute a fundamental cause of health inequalities. For example, in a summarizing theoretical paper, Phelan et al. (2010) argue that socioeconomic position operates as a persistent determinant of health because it provides access to flexible resources, such as money, knowledge, power, and social connections, that can be deployed to avoid risks and adopt protective strategies across different contexts and time periods, thereby continually reproducing inequalities in health outcomes. This social

causation perspective highlights how social advantage reproduces itself through material, cultural, and relational mechanisms. Yet, explanations that exclusively focus on what parents have and do risk overlooking that children differ in traits that influence their educational and mental health trajectories, and that these traits are partly heritable. Families not only transmit environments but also genetic propensities that affect both socioeconomic attainment and mental health. As decades of behavioral genetic research show, intergenerational associations in health and education can partly reflect selection processes, dynastic effects, and correlated genetic liabilities, rather than purely causal effects of parental socioeconomic position (Belsky et al., 2018; Nivard et al., 2024; Van Hootegem et al., 2025).

To disentangle these mechanisms, studies are needed that can clarify the distinct contributions of family socioeconomic position (social causation) and the child's own genetically influenced traits and aptitude (selection) in shaping the risk of developing mental disorders. Clarifying the relative contributions of social causation and selection can provide a more accurate account of how inequalities in mental health arise and persist across generations.

The Relationship Between Educational Achievement and Mental Health Problems

Several Nordic population-wide register studies have shown that low educational performance in adolescence increases the risk of developing a mental disorder in adulthood (Gyllenberg et al., 2022; Kendler et al., 2018; Weckström et al., 2023). In studies that examine educational performance as a categorical variable, it has been shown that children with language and reading problems have worse mental health outcomes in adulthood, compared with their peers without such problems (Hagen et al., 2023). On average, across 14 long-term longitudinal studies, children with reading and language problems scored more than half a standard deviation higher on scales of mental health problems than controls (Hagen et al., 2023). Also, longitudinal population studies show a high stability between mental health problems in the school years and subsequent difficulties in adulthood (Oldehinkel & Ormel, 2023).

Intervention and Prevention of Mental Health Problems

Because most adolescents participate in formal education, school performance offers a unique opportunity for early identification of individuals at elevated risk. Current mental health strategies typically rely either on universal prevention programs or on targeted interventions initiated after symptoms emerge. However, both universal prevention programs and targeted interventions face challenges in demonstrating efficacy. Universal programs often fail to produce meaningful effects, particularly in the long run (Brodeur et al., 2024; Cuijpers, 2022; Humphrey et al., 2025; Pages et al., 2020). Similarly, targeted interventions reach only a limited subset of adolescents, typically with limited effectiveness on narrow outcomes, and often fail to demonstrate long-term effects (Cuijpers et al.,

2023). This underscores the need for new ways of thinking about mental health support that moves beyond the traditional dichotomy of global prevention versus targeted treatment.

A third approach involves identifying at-risk individuals before the onset of disorder, enabling early, high-intensity support that could help prevent later problems. If school achievement proves to be a robust predictor of future mental disorders, it may offer a practical and scalable means of selective prevention. The need for improved identification strategies for selective prevention has also been emphasized in a recent systematic review by McGovern et al. (2024).

The Current Study

Although several studies demonstrate the association between adolescent school performance and the development of mental disorders, their scope is limited by methodological constraints. First, the studies cited above only include diagnostic data on mental disorders from specialized care institutions. Given that most mental disorders are treated in primary care (Schmidt-Mende et al., 2025), this implies that many cases are not identified. Second, the cited studies divide a continuum of performance into discrete categories. This limits the ability to detect more nuanced patterns across the spectrum of school performance, potentially obscuring important insights into how various levels of performance relate to mental health risks, including possible non-linear associations. Third, although adolescent educational success and parental socioeconomic status (SES measured by income and educational attainment) are both linked to adult mental health, few studies disentangle their individual contributions. Because SES and educational performance are strongly correlated, it remains unclear whether SES retains predictive power once educational outcomes are accounted for.

In this study, we aim to assess the relationship between SES, the child's educational performance and the risk of developing a mental disorder. To address the limitations of previous studies, we use a large total-population sample of adolescent school performance, linked to primary care records that capture a wider range of mental health disorders, and analyze school performance along the full spectrum, rather than in discrete categories. This register-based approach is uniquely well-suited to analyze the distinct impact on family SES, school performance and mental health.

Method

The sample was based on the population register of Norway and consisted of all children born between 1986 and 2000, participating in compulsory education, registered with GPA between ages 15 and 17, and with both parents identified in the registries (N = 921,761). As this study of administrative records, we were exempt from collecting informed consent from the study participants. Regional Committees for Medical and Health Research approved the study (reference number 2018/434 and 9220).

Educational Achievement

Norwegian students are evaluated after ten years of compulsory education, usually the year they turn 16 (98%). It is not possible to fail the compulsory education in Norway and all students progress through mandatory education at the same pace. Even the lowest grades go into the GPA score, also those that would not be considered passing at a higher level of education. This means that nearly all students have a valid GPA. These grades have marks from 1 to 6, where 6 is best. The GPA is calculated as the average of all final-year teacher evaluated grades and externally graded exams, multiplied by ten. The GPA is used for ranking students applying for admission to upper secondary education. Students therefore have an incentive to perform well. We further standardized the GPA score (mean = 0, SD = 1) within each birth year cohort to adjust for grade inflation. Lastly, we binned the standardized GPA scores into 100 equally sized percentile groups (n = 9,242). For other analyses, we binned GPA into quartile groups (N = 230,440). We also wanted to assess GPA close to its original form, but in integer form for survival analysis. To accomplish this, we rounded continuous GPA to the nearest whole integer ranging from 1 to 60. However, we excluded bins with less that 500 individuals which truncated our score to 15 to 59, as shown in supplementary figure 1. This included 3,373 individuals (0.3 %).

Diagnoses Of Mental Disorders

All individuals legally residing in Norway have access to a general practitioner. It is standard practice for those experiencing mental health issues to consult their general practitioner, whether for treatment, sick leave, or to obtain a referral to specialized care, such as a psychiatric hospital. The service is free of charge for children and adolescents under 16 and heavily subsidized for adults. General practitioners send billing information to The Norwegian Health Economics Administration (HELFO) along with a diagnosis or reason for the visit to receive reimbursements. Due to these economic incentives, it is unlikely that visits to general practitioners go unreported.

Diagnostic information is coded according to the International Classification of Primary Care, 2nd edition (ICPC-2: Verbeke et al., 2006). We defined a mental disorder as any ICPC-2 diagnosis registered by with a P code, ranging from P70, to P99. We utilized primary care data spanning from 2006 to 2024 to examine the development of mental health problems in early adulthood. To focus on this age group, we selected birth cohorts from 1985 to 2000, which correspond to individuals aged 17 to 39 over the observation period. This approach allows us to capture the transition from late adolescence into early adulthood, maximizing data availability while concentrating on the post-high school period.

Our population sample were followed from 1. January in the year they turned seventeen until the end of follow-up on 31 December 2024. This entails that those who were born in 1985 were followed from 1. January 2006 (the year they turn 21) until 31 December 2024 (the year they turn 39), and those born in 2000 from the year they turned 17 to December the year they turned 24, with each birth cohort following the same pattern (See supplementary figure 2).

Parents Educational Attainment and Income

Parental educational attainment was classified using the International Standard Classification of Education (ISCED). For each individual, we used the highest educational level reported for either parent to create a single parental education measure. These values were then collapsed into four categories for analysis: ISCED levels 0–2 were grouped as Compulsory education, levels 3–5 as Upper secondary education, level 6 as Bachelor's degree, and levels 7–8 as Master's degree or higher. We did not include a separate PhD level as very few individuals in our dataset received a PhD. For income, we started with each parent average pensionable income while the child was between 10 – 20. Pensionable income includes wages, capital income, pensions and government assistance such as disability benefits. Next, we calculated the average value between mother and father. If the child lacked one parental income, we used the one available. We further z-standardized the average parental income grouped by the child's birth year, to remove inflation effects. Lastly, we binned income into four equally sized quartiles.

Statistical Approach

After splitting up the adolescent population into percentile GPA groups, we assessed the cumulative incidence of receiving a mental disorder diagnosis from the ICPC-2 classification manual. Next, to assess co-morbidity, we removed all repeating diagnoses, so that only unique diagnoses were left in the dataset. We utilized R to organize, model and plot our data. We used the ggsurvfit package (Sjoberg et al., 2022) to model time-to-event and the survival package (Therneau, 2001) to model survival using the cox proportional hazard model. We employed a two-step modeling strategy using Cox proportional hazards regression to examine the associations between parental socioeconomic status and adolescent mental disorder diagnoses. Specifically, we considered three predictors: parental income quartile, parental educational attainment, and the adolescent's high school grade point average (GPA). First, we estimated bivariate models for each predictor separately, providing unadjusted hazard ratios for the association between that factor and the likelihood of receiving a mental disorder diagnosis. Next, we fitted a multiple regression model including all three predictors, in order to estimate their relative contributions while adjusting for the other factors.

Results

Consistent with prior findings, parental socioeconomic status (defined as parental income and educational attainment) was highly predictive of child GPA, as shown in Figure 1. The effect gradients for parental education and parental income were similar. The standard deviations of child GPA across the four levels of parental education were 8.88 for Compulsory Education (n = 113,535), 8.07 for Upper Secondary (n = 383,788), 7.63 for Bachelor's Degree (n = 303,495), and 7.04 for Master's Degree (n = 123,370). The standard deviations of child GPA across the parental income quartiles were 8.77 for the first quartile (n = 218,528), 8.20 for the second quartile (n = 232,758), 7.88 for the third quartile (n = 234,674), and 7.34 for the fourth quartile (n = 235,801).

There was a steep educational gradient when assessing proportion developing a mental health problem as a function of GPA percentile group, as shown in Figure 2. The association appears linear from GPA percentile bin 100 to 25 but increased rapidly onward towards the lowest GPA.

We also did this with GPA rounded to the nearest integer, as shown in supplemental Figure 3. The steepening at the top effect that is evident when assessing percentile bins is not seen when assessing GPA rounded to the nearest integer. However, a strong linear trend is evident. It should be noted that transforming a normally distributed variable into percentiles inherently introduces non-linearity into a bivariate normal relationship. Further technical details regarding this distributional shift are provided in the supplemental materials.

To further assess the association with parental education, we plotted the cumulative incidence at age 39 for each of the parental education levels, as shown in Figure 3. Although GPA is highly associated with the probability of receiving a mental disorder diagnosis, variation across parental education levels is minimal and does not materially change the overall association. The event diagnoses reflect general incidence trends for young adults, with depression and anxiety disorders accounting for the largest share. See Supplemental Figure 4 for a breakdown across the age distribution.

In addition, we found that comorbidity tracked the educational gradient, as shown in Figure 4. Individuals with more than three diagnoses were mostly concentrated in the bottom 25 percentile bins. Receiving three or more different diagnoses was quite rare.

As shown in Figure 5, the associations between parental SES and child mental disorder largely vanish once we control for the child's own educational achievement. Notably, the hazard ratio for parental education reverses from positive to negative. The association with parental income is also substantially weakened, though less sharply. Conversely, the association with the child’s GPA is robust, remaining almost constant even after controlling for parental SES. Detailed regression outputs are available in the supplemental materials.

Discussion

We document a strong educational gradient in mental health that is observable across the full spectrum of school performance. Mental health risk follows a consistent educational gradient, with the likelihood of diagnosis increasing steadily as school performance declines. This pattern extends to comorbidity, with individuals experiencing multiple conditions clustering at the lower end of the GPA distribution. We further find that the association between parental SES and child mental health conditions is strongly diminished when adjusting for the child’s own school performance. While school performance fully accounts for the association between parental education and child mental health, a residual effect remains for parental income.

Our finding of a strong gradient in mental health by school performance is in line with prior register-based studies (Gyllenberg et al., 2022; Weckström et al., 2023). By applying a more fine-grained

operationalization of educational achievement, we show that the overall linear gradient does not fully capture the disproportionate risk among the very lowest performing adolescents. Collectively, these findings extend the evidence base by quantifying the magnitude of risk associated with underachievement and demonstrating the critical value of analyzing the full continuum of school performance.

Beyond the scientific value of this association, our findings suggest that educational performance may serve as a practical and scalable tool for predicting and allocating resources to prevent the development of mental disorders. Unlike many conventional risk indicators, information on school performance is systematically collected, readily available, and requires no additional screening infrastructure. The predictive value is particularly decisive at the lower end of the distribution, where more than half of the adolescents in the bottom percentiles eventually develop a mental disorder. Concentrating preventive efforts on this group may therefore represent an efficient strategy with substantial potential reach. Moreover, the use of educational performance as a marker of risk directly responds to recent calls in the prevention literature for more precise and scalable methods of identifying at-risk youth (McGovern et al., 2024).

In predictive terms, adding parental SES contributes little beyond what is already captured by educational performance. This may reflect a broader societal trend in which family SES and educational outcomes are increasingly intertwined, as recent Norwegian studies suggest (Markussen & Røed, 2023; Sandsør et al., 2023). Our results challenge sociological perspectives that view parental resources as the primary engine of health inequality. In the Norwegian context, where private tutoring is rare and schooling is publicly funded, the direct causal utility of parental income on a child's trajectory is constrained. Consequently, the assumption that socioeconomic disparities in mental health are driven principally by parental provisions, risks conflating correlation with causation. The finding that parental socioeconomic status (SES) retains little predictive power after adjusting for the child's own school performance challenges the simple view of intergenerational disadvantage as a straightforward social transfer. Instead, this suggests that the associations are not a matter of parents simply transferring resources but rather point to a myriad of complex mechanisms. These mechanisms, which include genetic transmission, assortative mating and correlated genetic liabilities (Belsky et al., 2018; Nivard et al., 2024; Van Hootegem et al., 2025), suggest that parents transmit potential, both genetic and environmental, rather than just socioeconomic resources. This complexity underscores that the reality of how advantage is transmitted is undeniably intricate.

Notably, our results indicate a divergence in how the two socioeconomic indicators behave in the multiple regression model. While the association between parental educational attainment and the risk of mental disorder is effectively nullified when adjusting for the child's GPA, the association with parental income is less attenuated and remains significant. This suggests that parental education largely proxies heritable traits mediated through the child's academic performance, whereas financial resources may possess an independent causal dimension. The persistence of income-related risk, even after controlling for aptitude, may imply that economic hardship imposes direct environmental stressors or limits access

to flexible resources in ways that affect mental health independently of educational potential, consistent with the perspective of fundamental cause theory.

However, we cannot rule out that parental income indexes other heritable traits that protect against mental disorders. The association between parental education and child diagnosis changed direction when moving from bivariate to multiple regression models. We interpret this pattern as likely reflecting collider bias, as both mental health and parental education may lead to help-seeking. Once both parental SES and child GPA are accounted for, what remains may capture differences in parental awareness of, and responsiveness to, mental health concerns. Parents with higher education may be more sensitive to early symptoms and more proactive in seeking medical attention, leading to an increased likelihood of a recorded diagnosis.

Limitations

This study has some limitations. First, although registry data provide large-scale and comprehensive coverage, they rely on contact with health services. Individuals who never seek medical help are not recorded, and the registers contain no detailed information about symptom severity, duration, or functional impairment. Our incidence estimates should therefore be regarded as conservative, likely underestimating the true burden of mental disorders in the population. Second, the Norwegian educational system is characterized by relatively low levels of stratification, limited access to private schooling, and strong universal welfare provisions. These institutional features may reduce the direct impact of parental resources on educational achievement and health outcomes. Caution is therefore warranted in generalizing our findings to countries with more segmented educational systems or less comprehensive health and welfare arrangements. Third, the association between educational performance and mental health should not be interpreted as causal evidence. We cannot rule out reverse causation, as early manifestations of mental health problems may impair school performance and thereby contribute to the observed associations. Moreover, it remains unclear to what extent cognitive and non-cognitive factors influence both educational achievement and mental health. Both domains of individual differences are linked to each construct (Malanchini et al., 2024; Nordmo et al., 2025), underscoring the complexity of the underlying mechanisms.

In conclusion, our findings demonstrate that educational achievement is not only an outcome of inequality but also a powerful early indicator of future mental health problems. Leveraging this information for preventive efforts may represent a promising path toward reducing the long-term burden of mental disorders.

Declarations

Author Contribution

M.N. and F.A.T. conceived the original idea and conducted the initial analyses. M.M.L. provided additional input and contributed to revisions. All authors wrote and edited the manuscript.

Data Availability

The Norwegian registries encompass the entire population and contain sensitive information that is not publicly accessible. However, researchers can apply for access. This process requires two key steps: first, obtaining ethical clearance to use the data for research purposes, and second, requesting Statistics Norway to compile the dataset from separate registries.The URLs provided below link to the current webpages where researchers may submit applications for data access. However, please note that both the URLs and the procedures or requirements for obtaining access are subject to change overtime. It is therefore recommended that applicants consult the respective websites for the most up-to-date information.Diagnoses:https://helsedata.no/no/forvaltere/helsedirektoratet/kontroll-og-utbetaling-av-helserefusjoner-kuhr/Income and Education Data:https://www.ssb.no/en/data-til-forskning

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Figures

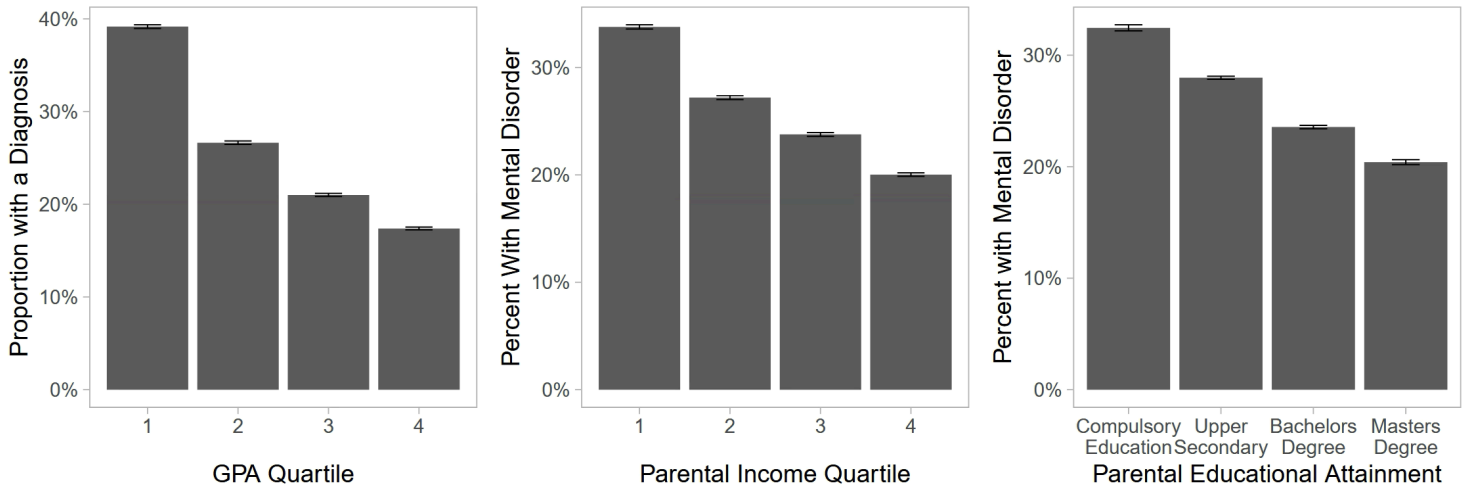


Figure 1

The proportion of adolescents who develop a mental disorder as a function of GPA and Parental Socio-Economic Status

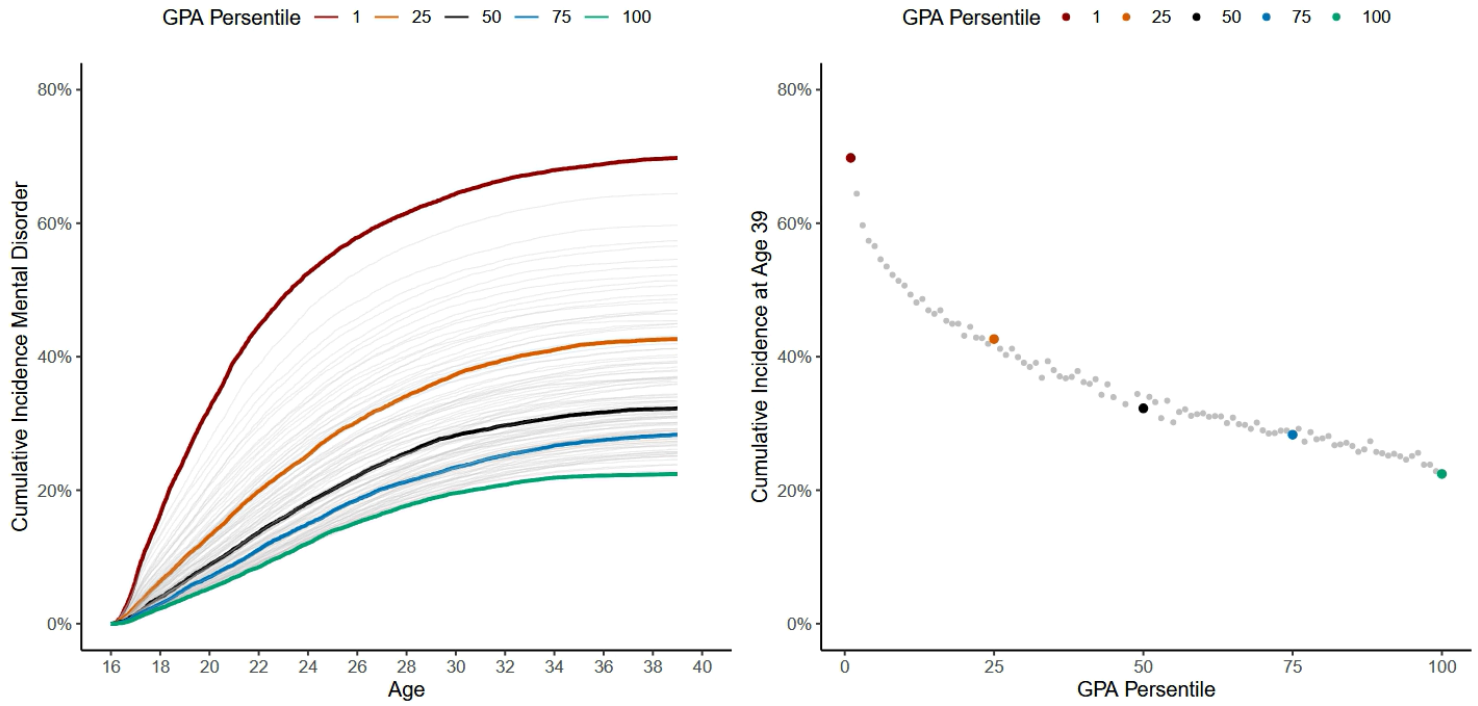


Figure 2

The left plot shows the cumulative incidence of a mental disorder as a function of age and high-school GPA percentile set at age 16. Each line represents a percentile score with the 1st, 25th, 50th, 75th and 100th percentile emphasized for clarity. The right plot shows the gradient of the cumulative incidence at age 39 and the high-school GPA gradient. Each dot represents a GPA percentile, corresponding to the developmental curves.

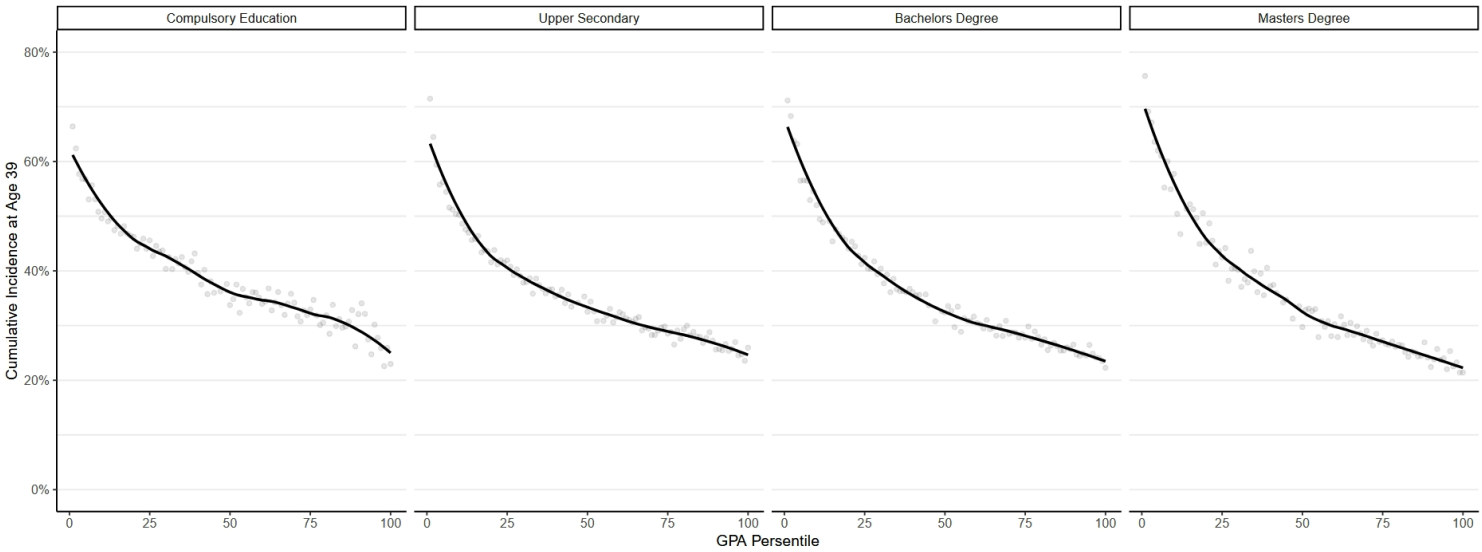


Figure 3

The cumulative incidence of any mental disorder at age 39, as a function of high school GPA and parental education level.

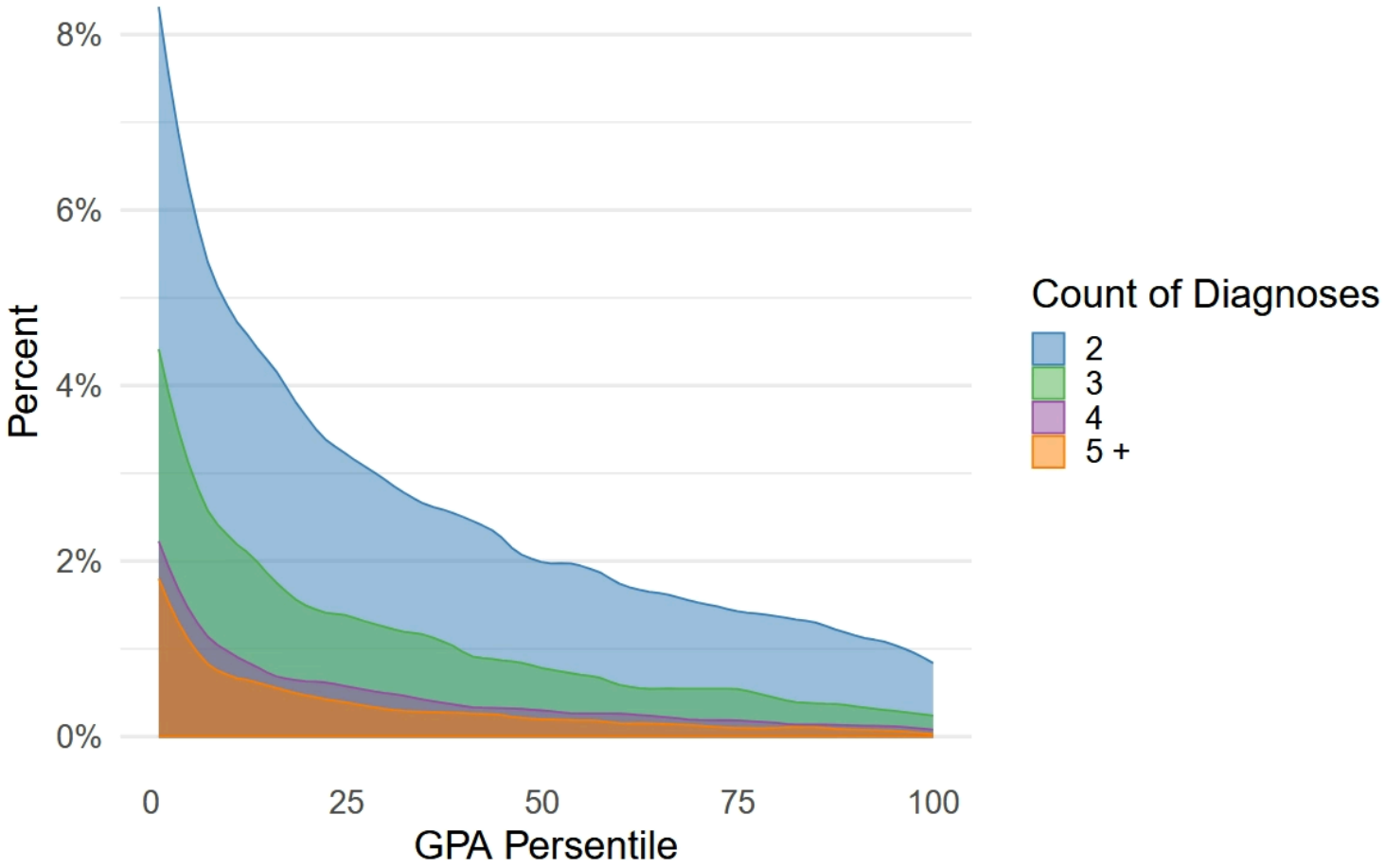


Figure 4

Comorbidity across the high school GPA gradient for individuals with more than one diagnosis. Each layer corresponds to N-unique diagnoses an individual received in the follow-up time.

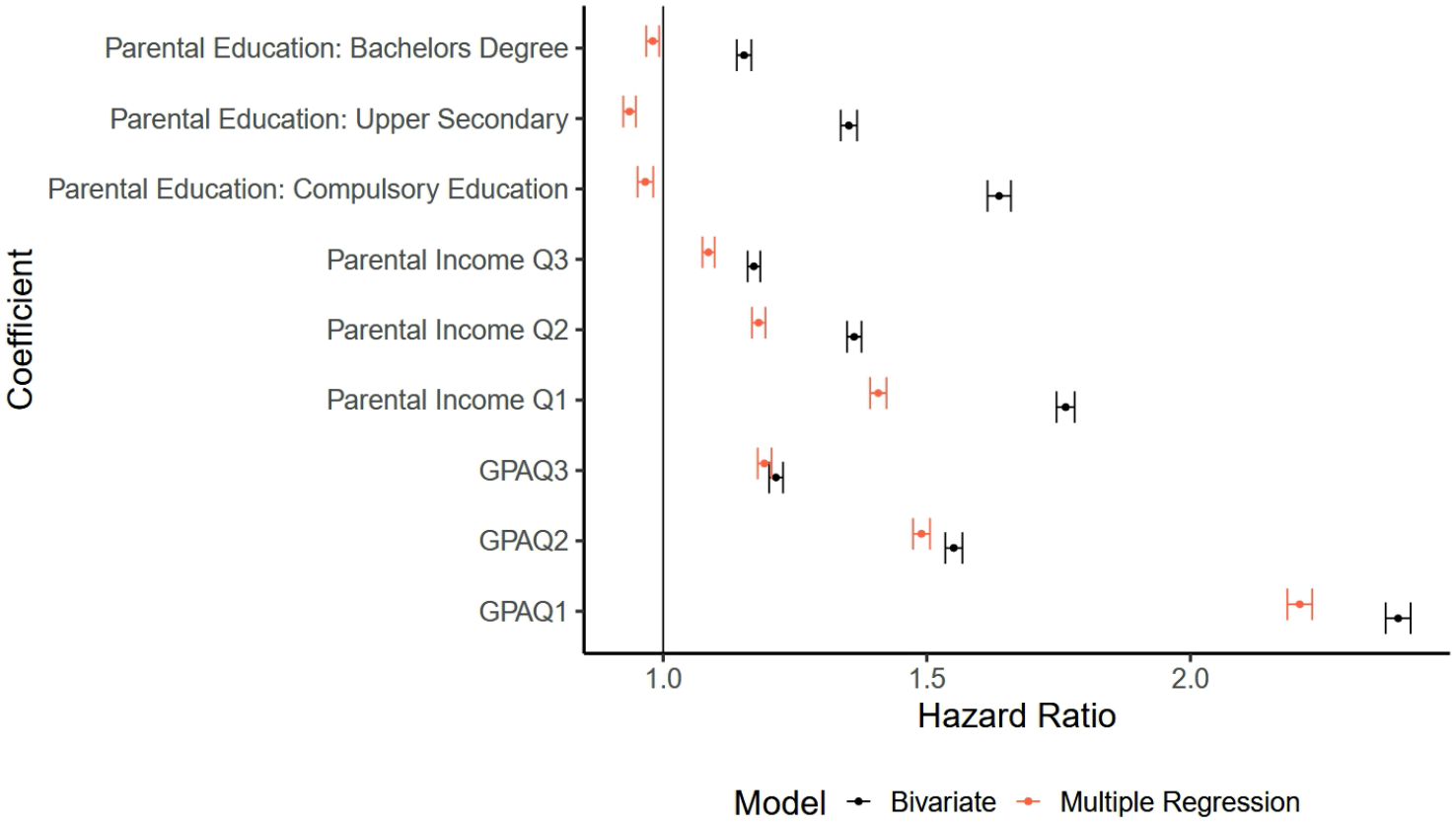


Figure 5

Risk factor analysis for mental disorder diagnosis or complaints from cox proportional hazard model. Parents with a master's degree or higher, income quartile 4 and high-school GPA quartile 4 serve as comparison.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- supplement.docx