Science Advances
AAAS

Manuscript Template

Full Title: ADHD, Financial Distress, and Suicide in Adulthood: A Population Study

Short Title: ADHD, Financial Distress, and Suicide

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Abstract:

Attention-deficit/hyperactivity disorder (ADHD) exerts lifelong impairment, including difficulty sustaining employment, poor credit, and suicide risk. To date, however, most studies have assessed selected samples, often via self-report. Using mental health data from the entire Swedish population (*N*=11.55 million) and a random sample of credit and defaults (*N*=189,267), we provide the first study of objective financial outcomes among adults with ADHD, including associations with suicide. Controlling for psychiatric comorbidities, substance use, education, and income, those with ADHD start adulthood with normal credit demand and default rates. However, in middle-age their default rates grow exponentially, yielding poor default risk scores and diminished credit access despite high demand. Sympathomimetic prescriptions are unassociated with improved financial behaviors. Finally, financial distress is associated with fourfold higher risk of suicide among those with ADHD. For men but not women with ADHD who suicide, outstanding debt increases in the three years prior. No such pattern was found for others who suicide.

INTRODUCTION

Those who are diagnosed with attention-deficit/hyperactivity disorder (ADHD) (1) show strong biases toward immediate rewards over larger, delayed rewards (2) and are prospectively vulnerable to a variety of adverse behavioral and mental health outcomes across their lifespans (3). In childhood, these outcomes include academic underachievement, grade retention, and social rejection (4). In adulthood, they include higher college drop-out rates, poorer job performance, difficulty sustaining employment, and lower wages than peers of similar intelligence (5,6). Children, adolescents, and adults who are diagnosed with ADHD also engage in more high-risk, impulsive behaviors, including substance abuse, self-injury, and suicide attempts (7,8). These outcomes are often observed even among those who received evidence-based treatment for ADHD in childhood (9,10).

Daily routines in Western societies require people to pay bills on time, make rent and mortgage payments, and keep track of investments and savings. Yet despite awareness that adults with ADHD face difficulties managing these and other financials, the extent of such difficulties and their associations with individual wellbeing have not been evaluated with objective data. According to self-reports, adults with ADHD are more financially dependent on family members, face more difficulties paying bills, open fewer savings accounts, use credit cards more compulsively, and are more likely to use very high interest rate borrowing, such as pawnshops and payday loans, than others in the population (5,8,11,12). To date, however, most data derive from adults who were followed-up after being treated for ADHD in childhood, or recruited via self-selected convenience sampling (e.g., Amazon Mechanical Turk). These recruitment strategies suffer from inherent limitations, including greater severity of ADHD for those enrolled in child treatment studies, systematic biases in self-reported credit and other financial outcomes, and small to modest sample sizes. Thus, the economic magnitude of population-wide effects of ADHD on objective financial outcomes is unknown. Improved understanding of relations among ADHD,

financial behaviors, and suicide may have important implications for prevention and intervention.

In this article, we provide new findings regarding financial behaviors and suicide among adults with ADHD at the population level. We include analyses of changes in financial behaviors in the months and years preceding suicide. These analyses follow from 'ideation-to-action' accounts of suicide, such as *three-step theory* (13). According to these models, many more people are capable of engaging in suicidal behaviors than attempt or die by suicide. Those who are capable *and* attempt are often motivated by psychological pain and hopelessness (14). Thus, three-step theory predicts reduced sense of purpose and increased psychological distress *prior* to suicide. For some, worsening financials may contribute to psychological distress whereas for others, psychological distress may contribute to worsening financials. Either way, any prospective association between worsening financials and later suicide among adults with ADHD could aid in identifying those at highest risk, and serve as a springboard for additional research.

Using mental health data collected from the full Swedish population (N=11.55 million) (15,16) and a random sample of data on credit and defaults (N=189,267) (17) for the period spanning 2002-2015, we evaluate financial outcomes across adulthood—including associations with suicide—among those ages 18 years and older with and without diagnoses of ADHD. These data yield the largest such sample reported to date. Given the very large sample and associated likelihood of identifying trivial effects as significant at any given time, we focus readers' attention on 95% confidence intervals (CIs) across time, which are presented in graphs to follow. These 95% CIs include statistical adjustments for physical and mental health covariates. Details regarding regression equations and statistical controls including propensity score matching appear in the Methods section and in Supplementary Materials, Sections A to C.

RESULTS

Lifetime prevalence of ADHD

In Sweden, all community care providers report *International Classification of Diseases* (1)

diagnostic codes for all physical and mental health conditions to the National Board of Health and Welfare (Socialstyrelsen; http://www.socialstyrelsen.se/english) (15). Between 2002 and 2015, full population registry data obtained from Statistics Sweden (16) revealed an ADHD lifetime prevalence of .015 based on ICD codes reported by physicians. This figure, which includes all individuals ever diagnosed with ADHD (61.3% male, 38.7% female), is well below the estimated lifetime prevalence of ADHD in the U.S. (18), consistent with lower rates of diagnosis in Europe than in North America (19). More conservative diagnostic practices in Sweden than in the U.S. make over-diagnosis in community settings an unlikely confounding explanation for any effects (20), and should be considered before generalizing to U.S. samples. Note that precise control over diagnostic practices is not possible in a population-based study.

Our analyses reveal that rates of *new* diagnoses rose considerably from 2002 to 2015, with increases observed at all ages (Fig. 1A and Supplementary Materials, Section C) (15). As a result, the rate of first-time diagnoses among 20- to 30-year-olds between 2010 and 2015 was higher than the rate of first-time diagnoses among 10- to 20-year-olds before 2006 (Fig. 1B and Supplementary Materials, Section C). Nevertheless, *within* each biennium, most new cases of ADHD were diagnosed before age 20.

ADHD, credit, and financial behaviors

Associations between ADHD and various financial metrics and behaviors appear in Fig. 2. All graphs depict data on credit and defaults for a random sample of Swedes (17) (N=189,267) for adults diagnosed with ADHD (n=1,970) and those without ADHD (n=187,297) across four years spanning 2010-2013. Analyses control for education, income, sex, psychiatric comorbidities (anxiety disorders, depression, substance use disorders, autism spectrum disorder), and available physical health indicators (asthma, respiratory infections). We also ran analyses using propensity score matching on age, income, and education and found no significant changes in our findings.

Credit and default data reveal that those diagnosed with ADHD show only a slightly elevated

demand for credit compared to the general population before age 30. At later ages, however, their demand for credit continues to grow at a time when the rest of the population lowers its demand (Fig. 2A and Supplementary Materials, Section C). This gap in demand stems from credit requests by individuals with ADHD being rejected. Hence, their high credit demand does not translate into greater credit access (Fig. 2B and Supplementary Materials, Section C). In fact, despite requesting more credit, those diagnosed with ADHD are granted less new consumer credit than the general population until about age 50.

Limited credit access for individuals with ADHD can be explained by poor debt repayment behavior. The Swedish National Enforcement Agency (Kronofogden) (21) enforces both public unpaid claims and claims by private collection agencies that are unsuccessfully collected. Kronofogden records shows that adults with ADHD are more likely to incur new arrears than those without ADHD (Fig. 2C and Supplementary Materials, Section C). By age 40, their default risk peaks at over six times that of the general population.

Examining arrears records reveals that adults with ADHD have higher rates of missed payments than others in every category of unpaid claims (Fig. 2D and Supplementary Materials, Section C). The largest differences are observed for misuse of bank accounts (e.g., overdrafts), unpaid alimony, unpaid educational support, impounded property, and unpaid road taxes. In each of these categories, adults with ADHD are over four times more likely to incur arrears. However, many unpaid claims involve relatively small items (e.g., unpaid parking tickets).

Collectively, arrears have serious effects on individuals' credit reports as increasingly more entities check credit records. In fact, each additional year with an arrear on one's credit record causally reduces employment by 3 percentage points and wage earnings by $1,000 for the most vulnerable members of Swedish society (22). Default risk among those diagnosed with ADHD is a long-term problem, as indicated by their over-representation among those more than a decade in continuous default (Fig. 2E and Supplementary Materials, Section C).

Given their poor credit history, adults with ADHD are over-represented in higher default risk bins, which reflect poorer credit quality (Fig. 2F and Supplementary Materials, Section C). In fact, the percentage of individuals diagnosed with ADHD increases exponentially with default risk. Compared with the general population, ADHD diagnoses are associated with a much lower likelihood of populating the lowest default risk bin (odds ratio=0.14) and a much higher likelihood of populating the highest default risk bin (odds ratio=3.49).

Associations between medication and arrears

Socialstyrelsen data also allowed us to explore associations between sympathomimetic prescriptions for ADHD (e.g., methylphenidate, atomoxetine, amphetamine, dextroamphetamine) (23) and financial outcomes. Fig. 3 (and Supplementary Materials, Section C) summarizes these prescription data across the population (15), and presents associations between prescriptions and financial behaviors for the random sample of Swedes for whom we observe credit and default data (17). Across all biennia, prescriptions were most common for those between ages 10 and 20 years (Fig. 3A and Supplementary Materials, Section C). Nevertheless, rates of prescriptions rose roughly fourfold between 2006 and 2015 for all age groups. Yet despite increased access to medication, there is no association between prescriptions and new arrears (Fig. 3B and Supplementary Materials, Section C). Rather, similar rates of new arrears are observed in the two years before and after prescription. These data raise obvious questions about relations between medication adherence and financial outcomes given that almost half of adults with ADHD report less than full medication adherence, and given that nonadherence correlates with ADHD severity (24). Thus, it is possible that prescription medications were helpful for those who were fully medication compliant. Unfortunately, we do not have adherence data to analyze, so causal conclusions should not be inferred.

Associations between finances and suicide

Finally, we explore associations between financial outcomes and suicide. Our interest was to

understand whether there is an interaction between financial condition and likelihood of suicide. To address this question, we obtained population statistics on suicide as a cause of death from the National Board of Health and Welfare (Socialstyrelsen) (15). The sample period is 2002-2015 (Supplementary Materials, Section C). For analyses using suicide as outcome, we controlled for education, income, sex, age, physical health, anxiety disorders, substance use disorders, and autism spectrum disorder. We conducted two sets of analyses. In the first, we did not control for depression given (a) expected increases in depression prior to suicide (25), (b) common neural vulnerability to unipolar depression and ADHD in brain regions implicated in anhedonia and reward processing (26,27), and (c) similar deficits in performance on delay discounting tasks among those with ADHD and those with depression (28). Collectively, these findings suggest common (transdiagnostic) etiological mechanisms across disorders (26). Under such circumstances, covarying depression removes variance attributable to shared vulnerability, a practice that has been criticized in the psychopathology literature because it creates statistical entities that distort etiology (29,30). Nevertheless, we conducted a second set of analyses including depression as a covariate given likely interest among readers. Of note, propensity score matching did not change results for either set of analyses.

Results are reported in Fig. 4 (Panels A-C). For the sample as a whole (Fig. 4A), those diagnosed with ADHD are more likely to die by suicide than those without ADHD at almost all ages below 60 years, consistent with previous research (31,32). As shown in Figs. 4B and 4C, nearly identical results were obtained for men and women. Importantly, we also document an interaction effect between ADHD and financial distress on suicide. Based on credit and default data covering 2010 to 2013 (17), disparities in death by suicide are much larger for those diagnosed with ADHD who are at high default risk (Fig. 4D and Supplementary Materials, Section C). In fact, those with ADHD who fall in the highest default risk bins (Bins 3-4) suicide at three times the rate of those with ADHD in low default risk bins (Bins 1-2). Although effect

sizes were reduced when depression was entered in the regression equations (Supplementary Materials, Section C), both men and women diagnosed with ADHD were still more likely to die by suicide at almost all ages below 60 years. Furthermore, high rates of suicide among those with ADHD and especially poor credit (Bins 3-4) were unchanged.

Next, we explore potential changes in financial pressure prior to suicide for those ever diagnosed with ADHD (n=190) versus those never diagnosed with ADHD (n=2,120) using a January 2018 snapshot of everyone registered at the Enforcement Agency (Kronofogden) (21). Figs. 5A and 5B (and Supplementary Materials, Section C) depict outstanding debt in the 36 months leading up to suicide for men vs. women, respectively, in this group, controlling for education, income, physical health, anxiety disorders, substance use disorders, and autism spectrum disorder. Arrear frequency increases significantly in the three years prior to suicide for men diagnosed with ADHD, but not for men without ADHD (Fig. 5A). In contrast, neither women diagnosed with ADHD nor women without ADHD show growth in arrears in the three years prior to suicide (Fig. 5B). Adding depression into the regression equation had no effect on growth in arrears in the three years prior to suicide for men or women diagnosed with ADHD. Although we do not infer a causal relationship between financial distress and suicide for men from these data, findings underscore extreme impairment associated with ADHD across the lifespan, increased chaos in the years immediately preceding suicide, and likely need for targeted intervention.

DISCUSSION

These results provide the first population-based, objective assessment of financial disadvantage faced by individuals diagnosed with ADHD, including associations with suicide. Previous studies documenting financial difficulties of people diagnosed with ADHD derive almost exclusively from self-reports collected from small- to modest-sized treatment-seeking or convenience samples. Such studies indicate overuse and misuse of credit cards, excessive and

very high-interest rate borrowing, and financial dependence on family members and welfare among adults diagnosed with ADHD (11,12).

In a very large population sample, we measure the extent of financial distress and hardship among adults diagnosed with ADHD. Adjusting for income, education, psychiatric and health comorbidities, and substance use, problems with debt repayment and continuous default penetrate well into mid-life, effects that are likely to become magnified as currently diagnosed young adults age. Because few adults were diagnosed in previous generations (Fig. 1B), assessing effects of persistent ADHD into late life is not yet possible in the Swedish population.

New sympathomimetic prescriptions for ADHD were unassociated with financial outcomes. Arrears per month remained constant in the two years preceding and following new prescriptions. These findings are consistent with recent longitudinal studies indicating modest effects of medication on *functional* outcomes among those with ADHD (9,33), despite significant concurrent and long-term reductions in core ADHD symptoms such as hyperactivity and inattention (34,35). Of note, although reduced criminal behavior has been reported among adults diagnosed with ADHD who receive pharmacological treatment (36), other studies find limited effectiveness of stimulants on work productivity and other functional and occupational outcomes (9,37,38). As we note above, however, many adults who receive prescriptions for ADHD do not refill them, and proper dosing is important to achieve clinical benefit (39). It is therefore possible that medications are more helpful for those who comply with treatment. Unfortunately, we do not have data on adherence, exposure periods, medication possession ratios, or doses.

Although direct causes of financial distress among adults with ADHD remain to be elucidated, a number of plausible mechanisms are suggested by the literature. As reviewed in our introductory paragraphs, adolescents and adults with ADHD suffer from persistent, pervasive functional impairment, as indexed by academic and vocational underachievement, high college drop-out rates, poor job performance, difficulty sustaining employment, and lower wages than

their peers (4,5,6). Young adults with ADHD are also more reliant financially on both their parents and social services, and earn almost $600,000 less (U.S.) across their lifetimes than those without ADHD (11). Moreover, self-reported hyperactive and impulsive (but not inattentive) symptoms of ADHD in adulthood are associated with debt burden, high interest rate borrowing, late payments, and present bias in monetary delay discounting tasks, as expressed by preference for smaller, immediate rewards over larger, delayed rewards (12). Taken together, these findings indicate that compared to others in the population, adults with ADHD (a) have fewer resources at their disposal, which likely contributes to demand for credit; and (b) are less able to make short-term decisions that translate into long-term financial benefits.

Regardless of mechanisms, our findings indicate that financial distress is associated with suicide among adults with ADHD. Previous reports reveal higher-than-normal rates of suicide among adolescents and adults diagnosed with ADHD in both treatment-seeking and population-based studies (31,32,40). However, findings of prospective associations between financial distress and suicide risk are new. Participants diagnosed with ADHD whose credit fell in highest default risk bins were 3-4 times more likely to die by suicide than both (a) those with ADHD who were at low risk of default, and (b) those without ADHD who had poor credit.

For those diagnosed with ADHD who suicided, men but not women experienced increasing financial distress in the three years beforehand. This is a new finding that will require future research to explain. For men, the finding is consistent with interpersonal and ideation-to-action frameworks whereby those who are capable to suicide are more likely to attempt when confronted with psychological pain and hopelessness (13,14)—both of which are associated with financial distress (see immediately below). We wish to emphasize, however, that given the descriptive nature of our study, we are unable to identify specific mechanisms or disentangle directions of causality. Thus, we do not know if financial distress contributes directly to suicidal ideation and suicide for men, if both are influenced by unmeasured third variables, or, more likely, some

267 combination of factors. Future work should address these important questions. Nevertheless, our
268 findings indicate objective associations between ADHD and a wide range of financial outcomes,
269 with implications for wellbeing of affected individuals as they move into middle and old age.
270 Based on data we present, many who are diagnosed with ADHD suffer from significant financial
271 distress throughout adulthood, with likely implications for physical and psychological wellbeing.
272 Speculating about specific psychological mechanisms of suicide among those with ADHD
273 and poor financials is even more difficult given no literature base to draw from. One possibility is
274 that poor financials mark more general distress brought about by functional impairment and poor
275 social adjustment, both of which are well documented among adults with ADHD. Relatedly,
276 unemployment, underemployment, and low wages could compromise sense of purpose among
277 those with ADHD. For men, such feelings may be more acute and difficult to deal with given
278 traditional gender roles, increasingly poor financials may eventually induce a sense of
279 hopelessness that worsens over time as debt accrues and dependence on others becomes
280 entrenched. In turn, low self-worth and feelings of failure may eventually contribute to suicidal
281 behaviors. Testing such notions and devising targeted interventions is a potentially important
282 avenue for future research. Such research will require careful planning to evaluate psychological
283 outcomes, including those that may differ for men vs. women. Such studies will be challenging
284 given how difficult precise measurement of psychological outcomes is with large, longitudinal
285 samples. Future research might also include financial data in attempts to predict suicide with
286 machine learning algorithms. If successful, such work could identify prospective
287 vulnerability/risk, an important forerunner to developing effective prevention programs.
288 Overall, our findings add to a growing literature indicating widespread and persistent
289 functional impairment among adults diagnosed with ADHD, and highlight the need for more
290 effective treatments across the lifespan. As noted above, previous research suggests benefits of
291 pharmacologic treatment on quality of life and other outcomes (36,38). However, many such

studies focus on tests of statistical significance and do not consider clinical or economic significance. Effect sizes on functional outcomes are often modest and smaller than effect sizes for core symptoms (see above) (34). Furthermore, medications rarely remediate symptoms fully (36,38). Our findings show that new prescriptions are unassociated with changes in a first-order financial behavior—debt repayment. Thus, simply obtaining a prescription is unlikely to address the severe financial distress associated with ADHD in adulthood. Future studies should address important questions regarding medication adherence, financial behaviors, and their associations with suicide in order to determine (1) whether sympathomimetic prescriptions are helpful for those who take them as prescribed, and (2) whether such medications are more vs. less helpful for some individuals with ADHD than others.

MATERIALS AND METHODS

Data on ADHD and suicide for the period 2002-2015 were available for all adults in Sweden who were over age 18 years (*N*=11,549,190). Registry data from the entire population were provided by Statistics Sweden (https://www.scb.se/en/) (16). These data include all individuals ever diagnosed with ADHD (*n*=177,336) and never diagnosed with ADHD (*n*=11,371,854). No exclusion criteria were used. In Sweden, physicians are required to report ICD (1) diagnostic codes for all physical and mental health conditions, World Health Organization (WHO) Anatomical Therapeutic Chemical codes (1) for all prescription medications, and ICD codes for cause of death to the Swedish National Board of Health and Welfare (Socialstyrelsen; http://www.socialstyrelsen.se/english) (15). We obtained ICD codes for ADHD, WHO codes for centrally acting sympathomimetics (including dose, purchase date, and prescription date), and ICD codes for suicide as a cause of death. In addition, we obtained credit and default data for a random sample (17) for *N*=189,267 participants, including (*n*=1,970) ever diagnosed with ADHD and *n*=187,297 never diagnosed with ADHD. These data include consumer credit from 2010 to 2013 and credit inquiries and arrears from 2007 to 2013 and the Swedish National Enforcement

317 Agency (Kronofogden; https://www.kronofogden.se/InEnglish.html) (21). Descriptive statistics
318 for all variables, including statistical control variables (education, income, sex, psychiatric
319 comorbidities, physical health), appear in Supplementary Materials, Section B, Table S1, for the
320 full sample and Supplementary Materials, Section B, Table S2 for the credit and default sample.
321 Technical details for Figs. 1–5, including regression equations, control variables, and propensity
322 score analyses, are presented in Supplementary Materials, Section C.

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Figures

Fig. 1. Rates of ADHD diagnoses in the Swedish population (*N*=11,549,190), including *n*=177,336 ever diagnosed with ADHD and *n*=11,371,854 never diagnosed with ADHD (15). (A) Rates of new diagnoses per capita for biennia spanning 2002-2015. (B) Rates of new diagnoses per capita by age (years) across biennia spanning 2002-2015.

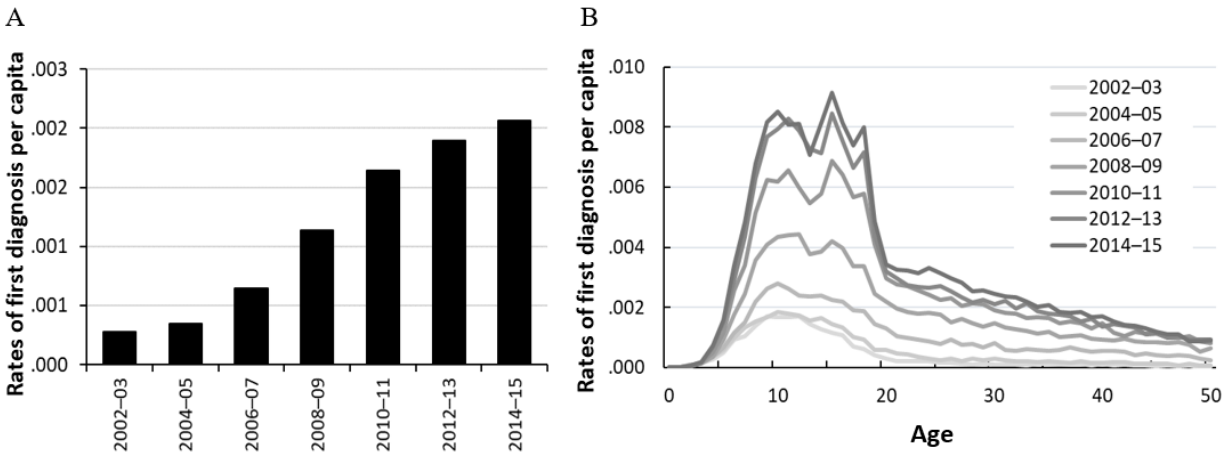


Fig. 2. Associations between ADHD and financial behaviors. Data on credit and defaults for a random sample of Swedes (17), including *n*=1,970 individuals ever diagnosed with ADHD and *n*=187,297 individuals never diagnosed with ADHD from 2010 to 2013. (A) Credit requests (e.g., credit cards, credit lines) per month by age (years) and ADHD status. Credit request values are estimated, adjusting for education, income, sex, psychiatric comorbidities, and physical health (see text). Widening 95% confidence intervals at older ages indicate fewer ADHD cases. (B) New consumer credits per month (estimated, adjusting for education, income, sex, psychiatric comorbidities, and physical health) by age (years) and ADHD status. (C) New arrears incurred per month (estimated, adjusting for education, income, sex, psychiatric comorbidities, and physical health) by age (years) and ADHD status. (D) Percentage elevation in arrear type for those with ADHD compared with the population, sorted from top to bottom by frequency of arrear type in the general population. Panel 2D is based on a January 2018 snapshot of everyone registered at the Enforcement Agency (21) including *n*=5,736 ever diagnosed with ADHD and *n*=63,216 never diagnosed with ADHD. (E) Percentage of people with unpaid claims diagnosed with ADHD by number of years delinquent. The hatched horizontal line represents the base rate of ADHD in the population (.015). (F) Percentage of people in successive default risk bins diagnosed with ADHD. Default risk is plotted along the *x*-axis, with increasing scores indicating higher likelihood of default. Proportions of the overall population and percentage default risk in each bin are as follows: Bin 1 (.47; 0-0.1%), Bin 2 (.11; 0.1-0.2%), Bin 3 (.07; 0.2-0.3%), Bin 4 (.05; 0.3-0.4%), Bin 5 (.03; 0.4-0.5%), Bin 6 (.02; 0.5-0.6%), Bin 7 (.05; 0.6-0.9%), Bin 8 (.05; 0.9-1.4%), Bin 9 (.05; 1.4-2.7%), Bin 10 (.05; 2.7-30.9%), and Bin 11 (.05; 30.9-97.7%). The hatched horizontal line represents the base rate of ADHD in the population (.015).

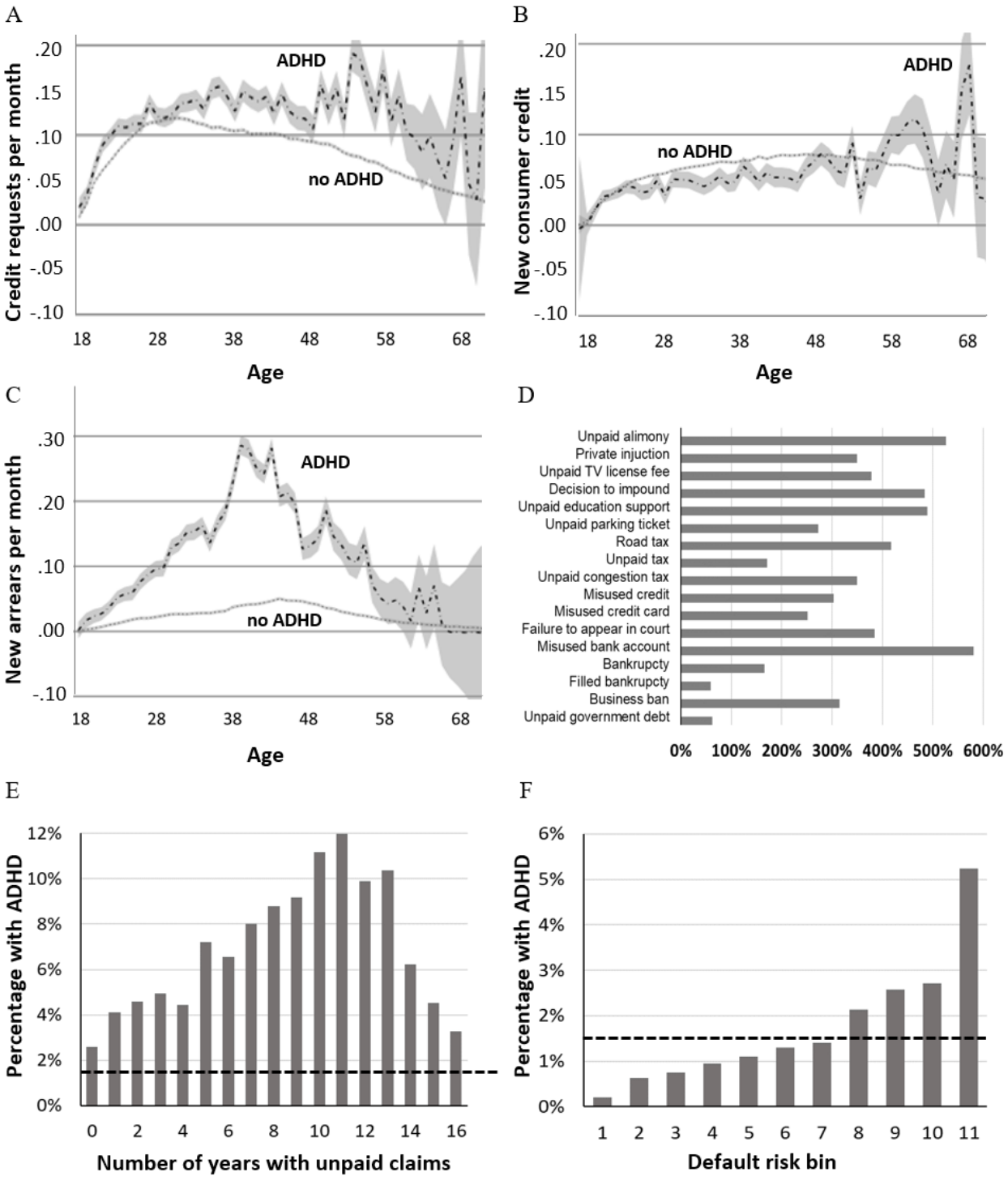

A
Credit requests per month
.20
.15
.10
.05
.00
-.05
-.10
ADHD
no ADHD
18
28
38
48
58
68
Age
B
New consumer credit
.20
.15
.10
.05
.00
-.05
-.10
ADHD
no ADHD
18
28
38
48
58
68
Age
C
New arrears per month
.30
.20
.10
.00
-.10
ADHD
no ADHD
18
28
38
48
58
68
Age
D
Unpaid alimony
Private injuction
Unpaid TV license fee
Decision to impound
Unpaid education support
Unpaid parking ticket
Road tax
Unpaid tax
Unpaid congestion tax
Misused credit
Misused credit card
Failure to appear in court
Misused bank account
Bankrupcty
Filled bankrupcty
Business ban
Unpaid government debt
0%
100%
200%
300%
400%
500%
600%
E
Percentage with ADHD
12%
10%
8%
6%
4%
2%
0%
0
2
4
6
8
10
12
14
16
Number of years with unpaid claims
F
Percentage with ADHD
6%
5%
4%
3%
2%
1%
0%
1
2
3
4
5
6
7
8
9
10
11
Default risk bin

Fig. 3. Prescriptions for ADHD and associations between new prescriptions and arrears. (A) Prescriptions per capita for the entire population, by age (years), across biennia spanning 2006-2015. Data are from the full Swedish population, including *n*=177,336 individuals ever diagnosed with ADHD and *n*=11,371,854 never diagnosed with ADHD (15). (B) Average number of new arrears in the two years preceding and following prescriptions for ADHD. No differences were found when data were analyzed separately for men versus women. Data are from the random sample on credit and defaults (17), including *n*=1,970 individuals ever diagnosed with ADHD and *n*=187,297 never diagnosed with ADHD. Arrears are residualized, adjusting for education, income, sex, age, psychiatric comorbidities, and physical health, and can extend below zero.

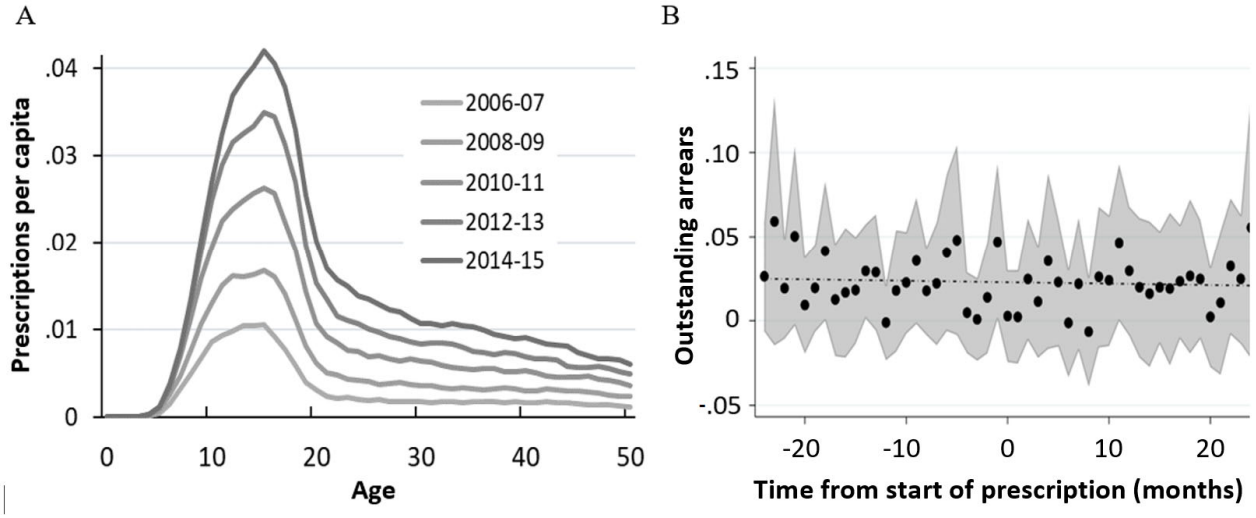


Fig. 4. **Suicide outcomes by ADHD status**. (A) Probability of suicide during the study observation period for all people diagnosed with ADHD and all people without ADHD from ages 18 through 70 (values are estimated, controlling for education, income, sex, psychiatric comorbidities, and physical health, and can therefore extend below zero). (B) Probability of suicide during the study observation period for men diagnosed with ADHD and men without ADHD from ages 18 through 70 (values are estimated, controlling for education, income, sex, psychiatric comorbidities, and physical health, and can therefore extend below zero). (C) Probability of suicide during the study observation period for women diagnosed with ADHD and women without ADHD from ages 18 through 70 (values are estimated, controlling for education, income, sex, psychiatric comorbidities, and physical health, and can therefore extend below zero). No differences were found between men and women. Data are from the full Swedish population from 2002 to 2015, including *n*=177,336 individuals ever diagnosed with ADHD and *n*=11,371,854 individuals never diagnosed with ADHD (15). Widening confidence intervals above age 60 result from fewer ADHD cases. (D) Disparities in suicide rates for those with and without an ADHD diagnosis by default risk bin. Data are from a random sample of Swedes (17), collected between 2010 and 2013, including *n*=1,970 ever diagnosed with ADHD and *n*=187,297 never diagnosed with ADHD. Increasing scores along *x* indicate higher likelihood of default. We collapsed into 4 default risk bins to obtain stable estimates of suicide given comparatively low base rates. Proportions of the overall population and percentage default risk in each bin are as follows: Bin 1 (.47; 0-0.1%), Bin 2 (.18; 0.1-0.3%), Bin 3 (.15; 0.3-0.9%), and Bin 4 (.20; 0.9-97.7%).

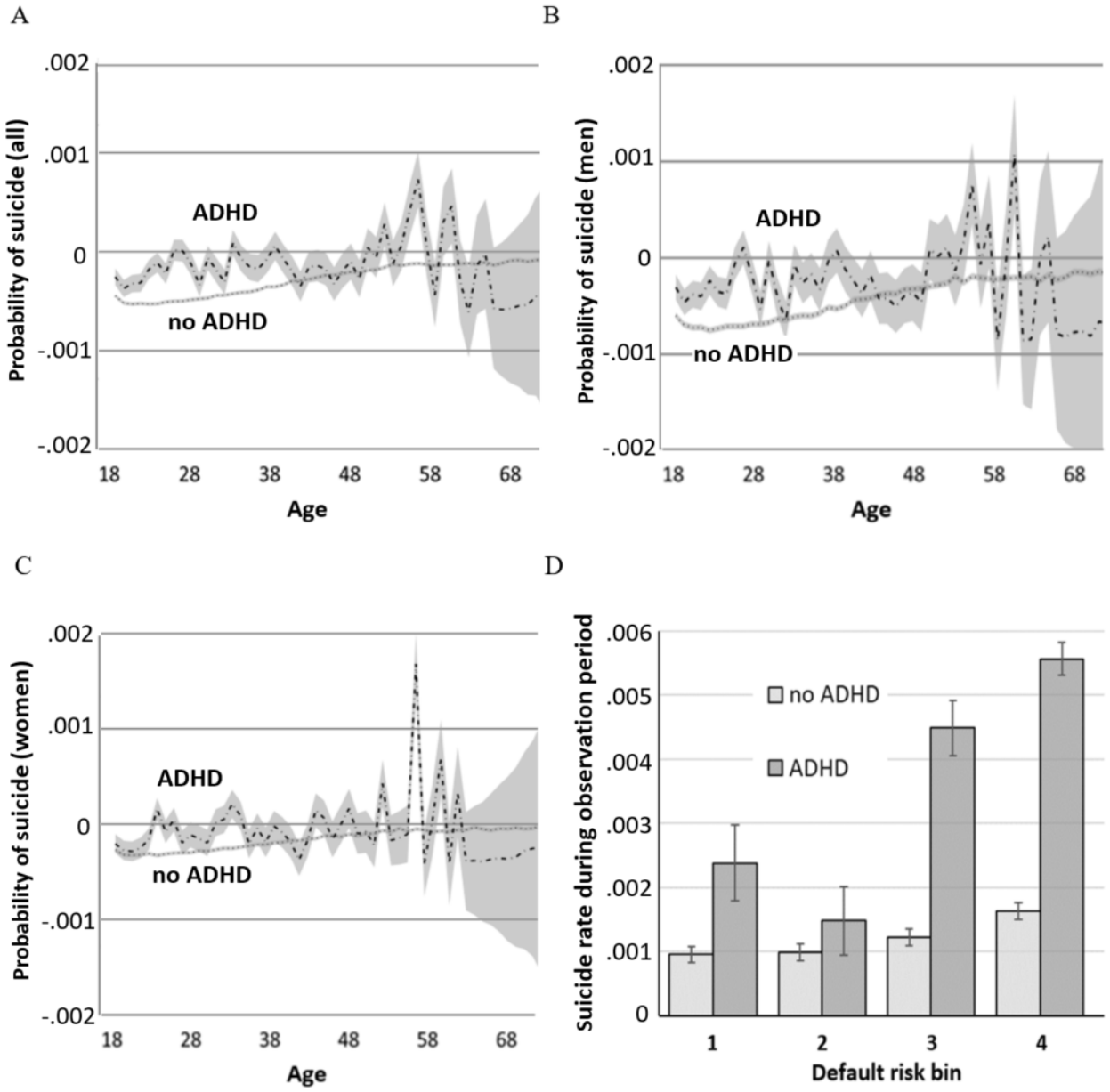
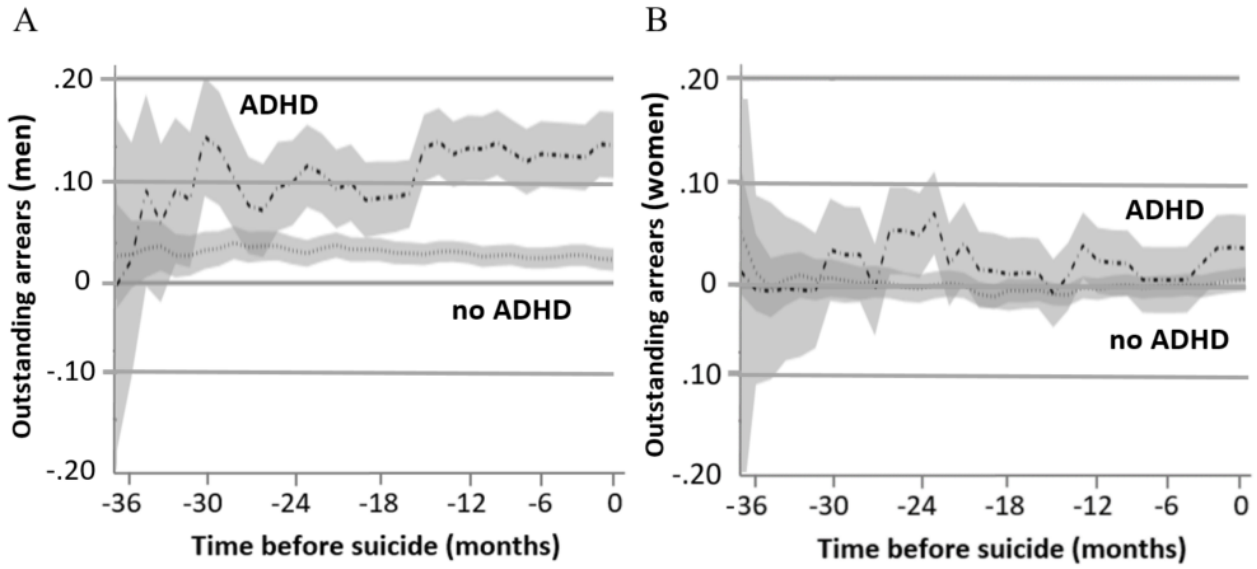

A
B
C
D
Probability of suicide (all)
Probability of suicide (men)
Probability of suicide (women)
Suicide rate during observation period
ADHD
no ADHD
Age
Default risk bin
.002
.001
0
-.001
-.002
.006
.005
.004
.003
.002
.001
18
28
38
48
58
68
1
2
3
4

Fig. 5. **Growth in debt in the 36 months preceding suicide for those diagnosed with ADHD and those without ADHD**. Suicide data for the full Swedish population are merged with credit data obtained from the Swedish National Enforcement Agency (Kronofogden) mål database (41). Time to event (suicide) is indicated in months. (A) Estimated growth in debt (with 95% confidence intervals) for men diagnosed with ADHD who suicided (*n*=131) versus men diagnosed with ADHD who did not suicide (*n*=1496). (B) Estimated growth in debt (with 95% confidence intervals) for women diagnosed with ADHD who suicided (*n*=59) versus women diagnosed with ADHD who did not suicide (*n*=620). Regressions use data from a January 2018 snapshot of everyone registered at the Enforcement Agency who died by suicide, including *n*=190 ever diagnosed with ADHD and *n*=2,120 never diagnosed with ADHD (21).



Acknowledgments

We thank Tatja Hirvikoski for sharing her knowledge of ADHD in Sweden, Jesper Böjeryd and Johan Orrenius for their excellent research assistance, and both Stephen P. Hinshaw and Ann Vander Stoep for their helpful comments. **Funding**: We thank VINNOVA and the National Institutes of Health (Grant UL1TR002733) for their generous support. **Author contributions**: I.B.-D. and M.B. designed and directed the research, with T.P.B. assisting. M.B. analyzed the data, with assistance from Jesper Böjeryd and Johan Orrenius. T.P.B. wrote the manuscript, with input from M. B. and I.B.-D. **Competing interests**: T.P.B., I.B.-D., and M.B. report no competing or conflicting interests. **Data and materials availability**: Complete registry data from the entire Swedish population provided by Statistics Sweden. Diagnostic data (2002-2016 International Classification of Diseases codes for ADHD), prescriptions per patient and month (2005-2016 World Health Organization Anatomical Therapeutic Chemical code N06Ba for centrally acting sympathomimetics including dose, purchase date, and prescription date), and cause of death (registry on cause of death [Dödsorsaksregistret, Socialstyrelsen] including date and ICD categories of X64-X84 for self-intentional) obtained from Socialstyrelsen. Credit and default data, provided by the Swedish Enforcement Authority (Kronofogden) and a credit registry. External databases are available through an application procedure including a review by the Swedish ethical review board for researchers in Sweden at Socialstyrelsen (http://www.socialstyrelsen.se/english), Statistics Sweden (https://www.scb.se/en/ [2018]), and Kronofogden Swedish Enforcement Authority (https://www.kronofogden.se/InEnglish.html [2018]).

SUPPLEMENTARY MATERIALS

Section A

External databases:

S1: Socialstyrelsen (Swedish National Board of Health and Welfare). http://www.socialstyrelsen.se/english (2018).

S2: Statistics Sweden https://www.scb.se/en/ (2018).

S3: Random credit registry sample (2018).

S4: Kronofogden Swedish Enforcement Authority. https://www.kronofogden.se/InEnglish.html (2018).

Variables used for analysis of credit:

Variable	Description
Default risk (%)	A number in the interval 0–100 indicating estimated probability of future default (0 = zero probability of default in next 12 months)
Age	Age at end of the year
Credit arrears	Number of flags of unpaid debt in last three years visible in the credit registry system
Credit requests last 12 months	Number of inquiries to credit registry for individual during the last 12 months
# credit cards	Number of credit cards
# installment loans	Number of installment loans
# credit lines	Number of credit lines
Years of education	Years of education
Labor income (SEK)	Filed labor income on tax return
Diagnosed with ADHD	1 if the individual ever has an F90 code in the diagnosis data; zero otherwise
Anxiety	1 if the individual ever has an F40 or F41 code in the diagnosis data; zero otherwise
Substance	1 if the individual ever has an F10 or F19 code in the diagnosis data; zero otherwise

Depression	1 if the individual ever has an F32 or F33 code in the diagnosis data; zero otherwise
Autism	1 if the individual ever has an F84 code in the diagnosis data; zero otherwise
Respiratory infection	1 if the individual ever has an J069 code in the diagnosis data; zero otherwise
Asthma	1 if the individual ever has an F459 code in the diagnosis data; zero otherwise
Suicide (Self-intentional death)	1 if individual died and the cause of death was in the interval X60–X84; 0 if other cause of death; missing if individual has not died
Sympathomimetic ADHD medication prescriptions	1 if individual is prescribed a central acting sympathomimetic (ICD category N06BA); 0 otherwise
Years in continuous default	1 if individual appears in Kronofogden data in year *y* (debt can have originated earlier); 0 otherwise
New diagnosis of ADHD	1 if individual received a diagnosis that year; 0 otherwise
New arrears	1 if individual received an arrear that month; 0 otherwise

Section B

Table S1

Means and standard deviations of study variables across the full population, by ADHD status.

Study variable	Participants with ADHD		Control participants	
Demographics	full sample (n = 177,336)[a]	*> age 18, 2010-13 only (*n=*104,976)*[b]	full sample (n = 11,371,854)[a]	*> age 18, 2010-13 only (*n=*7,962,751)*[b]
Age	19.64 (13.42)	*30.96 (11.27)*	40.86 (23.58)	*49.06 (19.07)*
Male	61.29%	*56.84%*	49.55%	*49.38%*
Years of education	10.65 (1.87)	*10.84 (1.90)*	11.80 (2.40)	*12.01 (2.40)*
Income	(SEK)70,133 (11,956)	*(SEK)83,117 (23,666)*	(SEK)163,382 (222,902)	*(SEK)183,764 (237,430)*
Suicides within sample period (%)	0.33%	*0.40%*	0.15%	*0.08%*
Psychiatric comorbidities (lifetime %)				
Alcohol/substance use disorder	19.10%	*29.73%*	3.03%	*3.37%*
Anxiety	32.99%	*45.63%*	4.58%	*5.07%*
Autism	18.58%	*16.02%*	0.46%	*0.34%*
Depression	30.97%	*44.41%*	5.30%	*5.91%*
Sympathomimetic prescriptions	73.26%	*50.86%*	3.16%	*1.66%*
Physical health outcomes (lifetime %)				
Asthma	9.70%	*4.69%*	4.15%	*2.33%*
Respiratory infection	8.96%	*6.78%*	3.83%	*3.10%*

[a]Non-italicized columns include all in the Swedish population, including those below age 18 years.
[b]Italicized columns include only those who were age 18 years or older between 2010 and 2013. This matches the Swedish Credit and default sample (see text and Table S2 below).
Notes. See text and Supplementary Materials Section A for full descriptions of study variables. Given the very large sample size and broad age range, we do not report confidence intervals or *p*-values in this table. Readers are referred to figures that appear throughout, which include 95% confidence intervals by age.

Table S2

Means and standard deviations of study variables for Swedish credit and default sample, by ADHD status.

Study variable	Participants with ADHD (n = 1,970)		Control participants (n = 187,297)	
	mean	*SD*	mean	*SD*
Demographics				
Age	33.03	(11.08)	50.22	(18.43)
Male	55.96%	-	49.05%	-
Years of education	11.14	(1.97)	12.07	(2.40)
Income	(SEK)105,261	(143,603)	(SEK)191,775	(244,829)
Credit data				
Default risk score (%)	17.32	(26.30)	3.66	(13.05)
Credit arrears	4.02	(11.35)	0.79	(6.14)
Credit inquiries (last 12 months)	1.54	2.60	1.00	(1.81)
New arrears (last month)	0.06	(0.24)	0.01	(0.11)
Number of credit cards	0.90	(1.50)	1.52	(1.82)
Number of installment loans	0.05	(0.23)	0.08	(0.30)
Number of credit lines	0.36	(0.77)	0.38	(0.82)
Credit card limit	(SEK)11,713	(23,260)	(SEK)21,626	(34,728)
Installment loan limit	(SEK)3,489	(23,519)	(SEK)6,786	(39,378)
Credit line limit	(SEK)23,289	(74,249)	(SEK)27,701	(162,280)
Credit card balances	(SEK)3,522	(10,895)	(SEK)4,665	(15,128)
Installment loan balances	(SEK)3,471	(23,414)	(SEK)6,764	(39,267)
Credit line balances	(SEK)22,362	(72,590)	(SEK)25,921	(159,585)
Suicides within sample period (%)	0.046%	-	0.0079%	-
Psychiatric comorbidities (lifetime %)				
Alcohol/substance use disorder	28.45%	-	3.29%	-
Anxiety	46.45%	-	5.02%	-
Autism	15.0%	-	0.31%	-
Depression	47.41%	-	6.00%	-
Sympathomimetic prescriptions	49.46%	-	0.02%	-
Physical health outcomes (lifetime %)				
Asthma	6.25%	-	3.10%	-
Respiratory infection	4.63%	-	2.27%	-

Notes. See text and Appendix Section A for full descriptions of study variables. Given the very large sample size and broad age range, we do not report confidence intervals or *p*-values in this table. Readers are referred to figures that appear throughout, which include 95% confidence intervals by age.

Section C

Technical details including regression equations for analyses depicted in Figs. 1–5:

Figure 1A. Rates of new diagnoses per capita for biennia spanning 2002-2015

Plotted: bar graph of the number of new diagnoses per capita
Estimation method: none (raw data)
Data source: Socialstyrelsen (15) for medical data and Statistics Sweden (16) for numbers of people in each cohort
Sample: full Swedish population (*N*=11,549,190)
Years: 2002-2015
# of unique individuals: ever diagnosed with ADHD (*n*=177,336), never diagnosed with ADHD (*n*=11,371,854)

Figure 1B. Rates of new diagnoses per capita by age

Plotted: number of first diagnosis of ADHD from ages 0–50 years, by biennia, from 2002 to 2015
Estimation method: none (raw data)
Data source: Socialstyrelsen (15) for medical data and Statistics Sweden (16) for numbers of people in each cohort
Sample: full Swedish population (*N*=11,549,190)
Years: 2002-2015
# of unique individuals: ever diagnosed with ADHD (*n*=177,336), never diagnosed with ADHD (*n*=11,371,854)

Figure 2A. Credit requests (e.g., credit cards, credit lines) per month by age (years) and ADHD status

Estimation method: linear regression
Estimation equation:

$$Credit\ requests = \beta_i * month + \widehat{\beta_\iota} * age\ ADHD + \widehat{\beta_\iota} * agenoADHD + \\ +\beta_i * anxiety + \beta_i * substance + \beta_i * respiratory\ infection + \beta_i * autism \\ +\beta_i * depression + \beta_i * astma + \beta_i * incomebin + \beta_i * educationlevel + \varepsilon$$

Plotted: $\widehat{\beta_i}$ for each age with 95% confidence intervals
Data source: Credit and default data (17) matched with Statistics Sweden (16) data
Sample: random sample (*N*=189,267) of adults *Years*: 2010-2013
# of unique individuals: ever diagnosed with ADHD (*n*=1,970), never diagnosed with ADHD (*n*=187,297)

Figure 2B. New consumer credits per month by age (years) and ADHD status

Estimation method: linear regression
Estimation equation:

$$New\ consumer\ credit = \beta_i * month + \widehat{\beta_\iota} * age\ ADHD + \widehat{\beta_\iota} * agenoADHD + \beta_i * anxiety + \beta_i * substance + \beta_i * respiratory\ infection + \beta_i * autism + \beta_i * depression + \beta_i * astma + \beta_i * incomebin + \beta_i * educationlevel + \varepsilon$$

Plotted: $\widehat{\beta_i}$ over age with 95% confidence intervals
Data source: Credit and default sample (17) matched with Statistics Sweden (16) data
Sample: random sample (*N*=189,267) of adults *Years*: 2010-2013
# of unique individuals: ever diagnosed with ADHD (*n*=1,970), never diagnosed with ADHD (*n*=187,297)

Figure 2C. New arrears incurred per month by age (years) and ADHD status

Estimation method: linear regression
Estimation equation:

$$New\ arrears = \beta_i * month + \widehat{\beta_\iota} * age\ ADHD + \widehat{\beta_\iota} * agenoADHD + \beta_i * anxiety + \beta_i * substance + \beta_i * respiratory\ infection + \beta_i * autism + \beta_i * depression + \beta_i * astma + \beta_i * incomebin + \beta_i * educationlevel + \varepsilon$$

Plotted: $\widehat{\beta_i}$ over age with 95% confidence intervals
Data source: Credit and default data (17) matched with Statistics Sweden (16) data
Sample: random sample (*N*=189,267) of adults
Years: 2010-2013
# of unique individuals: ever diagnosed with ADHD (*n*=1,970), never diagnosed with ADHD (*n*=187,297)

Figure 2D. Elevation in arrear type for those diagnosed with ADHD compared with the full population

Plotted: bar graph of percentage of people ever diagnosed with ADHD for respective score bin
Estimation method: none (raw data)
Data source: Credit and default sample (17) matched with Socialstyrelsen (15)
Sample: random sample (*N*=189,267) of adults
Years: 2010-2013
# of unique individuals: ever diagnosed with ADHD (*n*=1,970), never diagnosed with ADHD (*n*=187,297)

Figure 2E. Percentage of people with unpaid claims who are diagnosed with ADHD

Plotted: percentage of people with unpaid claims who are diagnosed with ADHD, by number of years in continued delinquency
Estimation method: none (raw data)
Data source: Kronofogden Swedish Enforcement Authority (22)
Sample: full adult (age 18 and over) Swedish population (*N*=9.85 million)
Years: cross-sectional snapshot of everyone registered in January 2018

Figure 2F. Percentage of people in successive default risk bins with ADHD

Plotted: bar graph of percentage of people ever diagnosed with ADHD across increasing default risk bins (larger bin values reflect worse credit)
Estimation method: none (raw data)
Data source: Swedish Credit and default sample (17) matched with Socialstyrelsen (15)
Sample: random sample (*N*=189,267) of adults
Years: 2010-2013
# of unique individuals: ever diagnosed with ADHD (*n*=1,970), never diagnosed with ADHD (*n*=187,297)

Figure 3A. Rates of new prescriptions per capita by age

Plotted: percentage of population receiving medications for ADHD (24), by biennia, from 2006 to 2015
Estimation method: none (raw data)
Data source: Socialstyrelsen (15) for medical data and Statistics Sweden (16) for number of individuals in each cohort
Sample: full Swedish population (*N*=11,549,190)
Years: 2006-2015
# of unique individuals: ever diagnosed with ADHD (*n*=177,336), never diagnosed with ADHD (*n*=11,371,854)

Figure 3B. Prescription event time and new arrears

Estimation method: linear regression
Estimation equation:

$$New\ arrears = \beta_i * month + \widehat{\beta_\iota} * eventtime\ ADHD + \widehat{\beta_\iota} * eventtiemnoADHD + \beta_i * anxiety + \beta_i *\ substance + \beta_i *\ respiratory\ infection + \ \beta_i *\ autism + \beta_i * depression + + \beta_i * astma + \beta_i * incomebin + \beta_i * educationlevel + \varepsilon$$

Plotted: $\widehat{\beta_i}$ over age with 95% confidence intervals, over event time *t*, where *t* = 0 when the individual first receives a prescription for ADHD (17)
Data source: Swedish Credit and default sample (17) matched with Socialstyrelsen (15)
Sample: random sample (*N*=189,267) of adults *Years*: 2010-2013
# of unique individuals: ever diagnosed with ADHD (*n*=1,970), never diagnosed with ADHD (*n*=187,297)

Figure 4A. Suicide rate by age and ADHD status

Estimation method: linear regression
Estimation equation:

$$Suicide = \beta_i * year + \widehat{\beta_\iota} * age\ ADHD + \widehat{\beta_\iota} * agenoADHD + \beta_i * anxiety + \beta_i * substance + \beta_i * autism + \beta_i * respiratory\ infection + \beta_i * astma + \beta_i * incomebin + \beta_i * educationlevel + \varepsilon$$

Plotted: $\widehat{\beta_i}$, with 95% confidence intervals over age
Data source: Socialstyrelsen (15) and Statistics Sweden (16)
Sample: full Swedish population (*N*=11.44 million)
Years: 2002 to 2015

Figures 4B and 4C replicate analyses for Figure 4A among only men and only women, respectively (see immediately above).

Figure 4D. Suicide rates by default risk score bins and ADHD status

Estimation method: linear regression
Estimation equation:

$$Suicide = \beta_i * month + \widehat{\beta_\iota} * scorebinADHD + \widehat{\beta_\iota} * scorebinnoADHD + \beta_i * anxiety + \beta_i * substance + \beta_i * autism + \beta_i * respiratory\ infection + \beta_i * astma + \beta_i * incomebin + \beta_i * educationlevel + \varepsilon$$

Plotted: $\widehat{\beta_i}$, with 95% confidence intervals, over default risk score bins
Data source: Credit and default sample (17) matched with Socialstyrelsen (15)
Sample: random sample (*N*=192,043189,267) of adults *Years*: 2010-2013
# of unique individuals: ever diagnosed with ADHD (*n*=1,7631,970), never diagnosed with ADHD (*n*=190,280187,297)

Figures 5A and 5B. Growth in debt in the 36 months preceding suicide for those with and without ADHD, run separately for men (5A) and women (5B).

Estimation method: linear regression

$$1(Active\ debt\ kronofogden > 0 = \beta_i * year + \widehat{\beta_\iota} * eventime\ ADHD + \widehat{\beta_\iota} * eventtimenoADHD + \beta_i * anxiety + \beta_i * substance\ \beta_i * autism + \beta_i * respiratory\ infection + \beta_i * astma + \beta_i * incomebin + \beta_i * educationlevel + \varepsilon$$

Plotted: $\widehat{\beta_i}$ over event time with 95% confidence intervals
Boolean starting from the existence of aktiv = 1 in a month until aktiv = 0 for the same individual or the time period ends
Data source: medical records from Socialstyrelsen (15) matched with the Kronofogden (22) active debt dataset
Sample: all individuals with suicide as registry cause of death (codes X59–X85)
Years: 2014-2016
# of unique individuals: ever diagnosed with ADHD (*n*=190), never diagnosed with ADHD (*n*=2,120); All individuals suicided.