Scandinavian Journal of Psychology, 2022 DOI: 10.1111/sjop.12814

Empirical Article

Clustering of social disadvantage with attention-deficit/hyperactivity disorder in young adults: A register-based study in Sweden

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Virtanen, M., Lallukka, T., Alexanderson, K., Helgesson, M., Heikkilä, K., Ervasti, J., Pentti, J., Vahtera, J., Kivimäki, M., & Mittendorfer-Rutz, E. (2022). Clustering of social disadvantage with attention-deficit/hyperactivity disorder in young adults: A register-based study in Sweden. *Scandinavian Journal of Psychology*.

The clustering of social disadvantage with attention-deficit/hyperactivity disorder (ADHD) in young adulthood is not well understood. We examined the clustering of ADHD with low educational attainment and unemployment in young adulthood; whether such clustering is stronger when unemployment is prolonged; and whether further clustering of disability pensioning, low education and unemployment occurs among those with ADHD. Data were obtained from Swedish health, demographic and social security registers from which 8,990 individuals with recorded ADHD diagnoses at the age of 10–35 and their 44,387 matched referents without mental disorders. Social disadvantage was measured using data on educational attainment, unemployment and disability pension from the diagnosis year or age 19 if diagnosed at younger age. Clustering was examined by comparing observed and expected occurrence (*O*/*E* ratio) of all possible combinations of ADHD, low education and unemployment, and, among those with ADHD, additional combinations with new-onset disability pension. The likelihood of having neither ADHD, low education nor unemployment was increased (*O*/*E* ratio = 1.20, 95% confidence interval 1.19–1.20 at baseline; 1.18, 1.17–1.18 at follow-up), as well as having all three characteristics (*O*/*E* ratio = 3.99, 3.89–4.10 at baseline; 5.68, 5.47–5.89 at follow-up). This clustering was stronger among women than men and when unemployment was prolonged. The results suggest that low education and unemployment appear to cluster remarkably with ADHD among young adults, more so among women and when unemployment is prolonged.

Key words: ADHD, young adults, unemployment, socioeconomic, clustering.

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INTRODUCTION

Attention-deficit/hyperactivity disorder (ADHD) is an early-onset neurodevelopmental disorder characterized by pervasive symptoms of hyperactivity, inattentiveness and impulsivity. ADHD causes problems in everyday life, for example, having a short attention span and being easily distracted, having difficulties in organizing and finishing tasks, restlessness, excessive talking or physical movement and risk-taking behavior. The prevalence of ADHD is about 3% among adults (Giacobini, Medin, Ahnemark, Russo & Carlqvist, 2018; Kooij, Bijlenga, Salerno *et al*., 2019) although underdiagnosis is a common problem in many countries (Kooij *et al*., 2019). If the condition persists into adulthood, ADHD symptoms and associated problems can substantially impair functional capacity, such as academic performance and educational attainment (Erskine, Norman, Ferrari *et al*., 2016; Gordon & Fabiano, 2019; Kooij *et al*., 2019; Rietveld & Patel, 2019; Scholtens, Rydell & Yang-Wallentin, 2013; Whiteford, Ferrari, Degenhardt, Feigin & Vos, 2015), and work capacity (Adamou, Arif, Asherson *et al*., 2013; Biederman & Faraone, 2005; Chen, Mittendorfer-Rutz, Bjorkenstam *et al*., 2022; Gordon & Fabiano, 2019; Jangmo, Mittendorfer-Rutz, Bjorkenstam *et al*., 2021; Rietveld & Patel, 2019; Virtanen, Lallukka, Kivimaki, Alexanderson, Ervasti & Mittendorfer-Rutz, 2020).

To date, empirical evidence about the association between ADHD and occupational outcomes, such as unemployment and work disability are relatively sparse, although the evidence has accumulated after a consensus statement on how ADHD affects employment was published (Adamou *et al*., 2013). A systematic review and meta-analysis on long-term outcomes of ADHD reported a twofold association between ADHD and unemployment (Erskine *et al*., 2016). Another systematic review suggested an association between ADHD and unemployment, noting that all reviewed studies were based on either self-reported or parent-reported outcomes and that ADHD was often defined by survey symptoms instead of the diagnostic criteria (Gordon & Fabiano, 2019). Later studies with register data with ADHD confirmed by diagnosis and the outcome derived from unemployment and work disability registers have confirmed these findings (Chen *et al*., 2022; Fleming, Fitton, Steiner *et al*., 2017; Jangmo *et al*., 2021; Virtanen *et al*., 2020).

Section Editor: Asmus Vogel

Some studies have also suggested that conditions comorbid with ADHD, including depression, intellectual disability, and developmental disorder increase the risk of unemployment (Fleming, Salim, Mackay *et al*., 2020; Jangmo *et al*., 2021) and sickness absence and disability pension (Chen *et al*., 2022; Jangmo *et al*., 2021; Virtanen *et al*., 2020). Poor educational attainment has also been suggested to mediate the association of ADHD with unemployment and disability pension (Jangmo *et al*., 2021; Rietveld & Patel, 2019).

As most of the literature has focused on one outcome at one time point, and most often on educational attainment instead of occupational outcomes, the extent to which ADHD, low education, unemployment and work disability pension co-occur, that is, cluster within individuals, is not known. In addition, studies on prolonged unemployment are lacking, those using register data are sparse, and differences between women and men are not well understood. Understanding the clustering of adversities is important because clustered adversities tend to have a greater impact than individually assessed characteristics (Kivimaki, Lawlor, Davey Smith *et al*., 2007), and it is not known whether clustering is stronger when unemployment is prolonged. Disability pension is a rarely examined societal and health-related outcome. Improved understanding of the relationships among connected risk factors would help to identify high risk groups and develop interventions to prevent the accumulation of social disadvantage and labor market marginalization. Our theoretical framework is the theory of cumulative disadvantage/advantage (CDA), which refers to a systemic tendency for divergence between individuals in a given characteristic or capital, such as money, health, or status over time (Dannefer, 2003).

The observed-expected (*O*/*E*) ratio is a simple summary estimate of clustering, that is, whether combinations of risk factors occur more (or less) often than would be expected if the risk factors were independent (Schuit, van Loon, Tijhuis & Ocke, 2002). In the present study, we used nationwide linked register data of individuals diagnosed with ADHD at the age between 10 and 35 and a matched reference group without any recorded mental disorders, to examine: (1) whether ADHD, unemployment and low educational attainment clustered; (2) whether clustering was stronger when unemployment was prolonged; (3) whether there were differences between women and men; and (4) whether further clustering of disability pension, low education and unemployment occurred among the group diagnosed with ADHD.

METHODS

Participants and procedure

We obtained the data for this study from the nationwide registers in Sweden. Data on specialized inpatient healthcare (1987–2011) and specialized outpatient healthcare (2001–2013) were obtained from the National Board of Health and Welfare's registers (dates and diagnoses), from which we identified the onset date occurring 2001–2010 for the first recorded ADHD (diagnosis F90 from the International Statistical Classification of Diseases and Related Health Problems 10th Revision [ICD-10]) for individuals aged 10–35 years. Individuals with ADHD were included in the analyses if they had lived in Sweden at least 5 years prior to the register record of ADHD and if they were not on disability pension at study baseline, a total of 8,990 individuals with ADHD. For each individual with ADHD, we randomly selected five matched references from the general population register that had not any indication of mental disorders (F-diagnoses) during the study period (1987–2011, N = 44,387). They were matched to cases on age, sex, area of residence and country of birth, and their follow-up began at the same time as ADHD patient's. A 1-year follow-up began from the date of diagnosis, except when age at diagnosis was less than 19 years, in which case the follow-up began at the age of 19.

Measures

Statistics Sweden's Longitudinal Integration Database for Health Insurance and Labor Market Studies (LISA) (Ludvigsson, Svedberg, Olen, Bruze & Neovius, 2019) provided linked data on sociodemographic factors (sex, age, educational level [<10, 10–12, >12 years], birth country [Sweden, other than Sweden], and area of residence [big cities, medium-sized cities, small towns/municipalities). Annual number of unemployment days was obtained from Swedish Employment Agency. We calculated the following three dichotomous unemployment variables at baseline and at follow-up: (1) any unemployment (>0 days); (2) medium-to-long-term (>90 days); and (3) long-term (>180 days) unemployment. Baseline included the year before and during the year when the follow-up started, and the follow-up included the year after the follow-up started.

The Swedish Social Insurance Agency registers (MiDAS: MikroData för Analys av Socialförsäkringen) comprise information on disability pension, from which a variable (yes/no) was calculated to exclude people on disability pension at baseline and to analyze occurrence of new disability pension at follow-up. Ethical approval for the project was granted by the Regional Ethical Review Board, Stockholm, Sweden (Diary number: 2007/5:6, 2016/1533–32).

Data analysis

Descriptive statistics (means, standard deviations [*SD*s]), numbers and proportions) of covariates were calculated for the ADHD cases and the reference group. The expected prevalence for a combination of indicators of social disadvantage was calculated by multiplying the individual probabilities of each risk factor, based on their observed prevalence in the data. A measure of clustering was calculated as the observed prevalence (*O*) divided by the expected prevalence (*E*) and expressed as *O*/*E* ratio (Schuit *et al*., 2002). Ninety-five percent confidence intervals (CI) were obtained using bootstrapping. Co-occurrence (clustering) is indicated when individuals are more likely than expected to have either no risk factors or many risk factors and are less likely to have a single risk factor. When the risk factors are clustered, an *O*/*E* ratio of <1 indicates having a single risk factor, and >1 indicates having either no risk factors or several risk factors (Kivimaki *et al*., 2007).

Clustering analyses were performed to examine clustering of ADHD, low education and unemployment, and, among the people with ADHD, to examine clustering of low education, unemployment and disability pensioning. Clustering was examined at the baseline year and during the 1-year follow-up. The SAS 9.4 statistical software (SAS Institute Inc., Cary, NC, USA) was used in all analyses.

RESULTS

Of the 8,990 individuals with ADHD and their 44,387 matched referents, 66% were men, 94% were born in Sweden and 32% lived in big cities (Table 1). The mean age at baseline was 21.7 years. Individuals with ADHD had lower educational level than the referents (57% vs. 16% with primary school level or less) and higher prevalence of unemployment at baseline (60% vs. 36%) and at 1-year follow-up (39% vs. 17%).

Table 1. *Descriptive statistics of young adults diagnosed with ADHD and their matched reference group*

	All (*N* = 53,377)	ADHD group (*N* = 8,990)	Matched reference group[a] (*N* = 44,387)
Mean (*SD*) age at the beginning of follow-up	21.7 (4.6)	21.7 (4.6)	21.7 (4.6)
Sex			
Men	35,411 (66.3)	5,962 (66.3)	29,449 (66.4)
Women	17,966 (33.7)	3,028 (33.7)	14,938 (33.7)
Birth country			
Sweden	50,044 (93.8)	8,423 (93.7)	41,621 (93.8)
Other	3,333 (6.2)	567 (6.3)	2,766 (6.2)
Area of residence			
Big city	17,088 (32.0)	2,871 (31.9)	14,217 (32.0)
Medium-sized town	19,869 (37.2)	3,350 (37.3)	16,519 (37.2)
Small town or village	16,420 (30.8)	2,769 (30.8)	13,651 (30.8)
Education			
Elementary	12,066 (22.6)	5,161 (57.4)	6,905 (15.6)
High school	35,061 (65.7)	3,381 (37.6)	31,680 (71.4)
University/college	6,250 (11.7)	448 (5.0)	5,802 (13.1)
Unemployment at baseline (yes)	21,301 (39.9)	5,427 (60.4)	15,874 (35.8)
Unemployment at follow-up (yes)	9,365 (20.9)	2,978 (39.4)	6,387 (17.1)

Notes: ADHD = attention-deficit/hyperactivity disorder.
[a]Matched by age, sex, birth country and area of residence.

Clustering of ADHD, unemployment and low education

Figure 1 shows clustering of ADHD, unemployment (≥1 days) and low educational attainment with *O*/*E* ratios and their 95% CIs at baseline (Fig. 1A), and at 1-year follow-up (Fig. 1B). The *O*/*E* ratio was higher for the occurrence of none of the characteristics; 1.20 (95% CI 1.19–1.20) at baseline, 1.18 (95% CI 1.17–1.18) at follow-up, and for the occurrence of all three characteristics; 3.99 (95% CI 3.89–4.10) at baseline, 5.68 (95% CI 5.47–5.89) at follow-up. The *O*/*E* ratio was smaller than 1.00 for the combinations that included one or two risk factors, with the exception of "ADHD + + no unemployment + low education" (at baseline and at follow-up) and "no ADHD + unemployment + low education" (at follow-up).

Clustering and prolonged unemployment

Results for the study question of whether clustering was stronger when unemployment was prolonged are shown in Table 2, which shows that with unemployment of one or more days, the *O*/*E* ratio of having all three characteristics (ADHD, unemployment and low education) was 3.99 (95% CI 3.89–4.10) at baseline and 5.68 (5.47–5.89) at follow-up. The corresponding O/E ratios for >90 days and >180 days of unemployment were 4.19 (4.04–4.35) and 6.08 (5.73–6.44), and 5.87 (5.50–6.24) and 6.84 (6.10–7.58), respectively (see details of the analyses in Supplementary Tables S1 and S2). Thus, clustering strengthened when the duration of unemployment was longer and between the baseline and follow-up assessments.

Differences between women and men

Separate analyses for women and men, respectively, are presented in Tables S3 and S4, suggesting that clustering of ADHD, unemployment and low education may be stronger among women than men.

Clustering of disability pension, low education and unemployment among individuals with ADHD

Table 3 shows results from a cluster analysis of low education, unemployment and new-onset disability pension at follow-up when the sample was restricted to those with an ADHD diagnosis. O/E ratio of having none of the risk factors was 1.18 (1.16–1.19) which means that also among those with ADHD there is a group of individuals who have high education, no unemployment and no disability pension. However, also O/E of having all three risk factors was 0.84 (0.71–0.97), whereas a

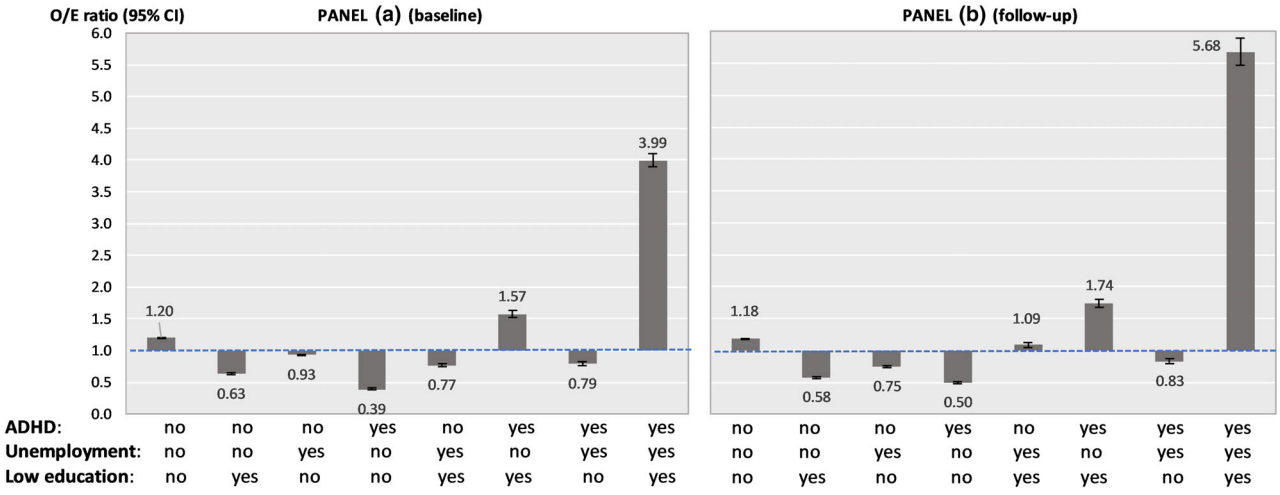

Fig. 1. Clustering of ADHD, unemployment and low education among young adults at baseline (a) and at follow-up (b). ADHD, attention-deficit/hyperactivity disorder.

Table 2. *Clustering of ADHD, unemployment and low education among young adults at baseline and at follow-up (before and after the diagnosed ADHD/age 19), by length of unemployment*

Time	Length of unemployment	*O*/*E* ratio	95% CI
Baseline	Any	3.99	(3.89–4.10)
	Medium to long	4.19	(4.04–4.35)
	Long	5.87	(5.50–6.24)
Follow-up	Any	5.68	(5.47–5.89)
	Medium to long	6.08	(5.73–6.44)
	Long	6.84	(6.10–7.58)

Note: ADHD = attention-deficit/hyperactivity disorder; CI = confidence interval; *O*/*E* = observed/expected.

Table 3. *Clustering of low education (LE), unemployment (UE) and disability pension (DP) among young adults with ADHD after the diagnosed ADHD/age 19*

Low education, unemployment, DP	*O*/*E* ratio	95% CI
None	1.18	(1.16–1.19)
Only DP	0.69	(0.58–0.80)
Only UE	0.81	(0.78–0.84)
Only LE	0.85	(0.83–0.86)
UE and DP	0.38	(0.27–0.49)
LE and DP	1.62	(1.52–1.73)
LE and UE	1.17	(1.15–1.19)
All three	0.84	(0.71–0.97)

Note: ADHD = attention-deficit/hyperactivity disorder; CI = confidence interval; *O*/*E* = observed/expected.

combination of low education and disability pension (without unemployment) produced an *O*/*E* ratio of 1.62 (1.52–1.73), and a combination of low education and unemployment (without disability pension) produced an O/E ratio of 1.17 (1.15–1.19). This means that among those with ADHD, the possibility of having all three risk factors was decreased but the possibility of having two of the three risk factors was increased.

DISCUSSION

The results of this large longitudinal register-based study of young adults in Sweden suggest that individuals with ADHD are at increased risk of the co-occurrence of low education and unemployment. The clustering of these indicators of social disadvantage was stronger the longer the unemployment had lasted. The clustering also seemed to be more pronounced among women than men and strengthened over time. An analysis of people with ADHD further indicated that low education separately clustered with unemployment and with new-onset disability pension.

To our knowledge, this is the first study investigating the clustering of ADHD and social adversities in young adulthood. Our findings are in line with previous investigations which have shown associations of ADHD with poor educational attainment and unemployment (Erskine *et al*., 2016; Gordon & Fabiano, 2019; Kooij *et al*., 2019; Scholtens *et al*., 2013; Whiteford *et al*., 2015), and work capacity (Adamou *et al*., 2013; Biederman & Faraone, 2005; Chen *et al*., 2022; Gordon & Fabiano, 2019; Jangmo *et al*., 2021; Rietveld & Patel, 2019; Virtanen *et al*., 2020). Previous research has also suggested that poor educational attainment may actually be the link between ADHD and unsuccessful labor market outcomes (Jangmo *et al*., 2021; Rietveld & Patel, 2019). Other studies have shown that accumulated social adversities in childhood environment, such as financial difficulties, are associated with a higher risk of ADHD (Keilow, Wu & Obel, 2020; Russell, Ford & Russell, 2018), thus, it is possible that the associations are bi-directional; adversities causing ADHD and ADHD, in turn, causing adversities. Our results add to these findings by showing that social disadvantage may continue accumulating throughout young adulthood among individuals with ADHD and that the clustering of ADHD, low education and unemployment may increase over time. In terms of further outcomes, such as premature mortality, it is important to take into account clustering of adversities with ADHD when estimating the risk.

We also found that in this cohort, the clustering of ADHD, low education and unemployment was stronger among women (4.71 at baseline; 6.62 at follow-up) than men (3.71 at baseline; 5.28 at follow-up). This is a novel finding which needs to be explored in further studies. The prevalence of ADHD is higher among men than women and there are also sex-differences in the symptom profiles. Women tend to demonstrate more inattention-type symptomatology whereas symptoms among men are typically characterized by externalizing behavior, such as hyperactivity or impulsivity (Nussbaum, 2012). Because inattention-type symptoms are less evident in classroom settings than, for example, hyperactivity and impulsivity, girls are less likely to be referred to healthcare services and are typically diagnosed later than boys (Nussbaum, 2012). This may reduce their possibilities to receive effective, early treatment interventions. There is also some evidence that women with ADHD have a higher risk of developing substance abuse disorders than men with ADHD (Nussbaum, 2012). ADHD is also associated with early single parenthood (Kooij *et al*., 2019) which is more common among women than men with ADHD (Pollak, Dekkers, Shoham & Huizenga, 2019; Skoglund, Kopp Kallner, Skalkidou *et al*., 2019). This may further reduce these young women's opportunities in education and paid work.

When we restricted the data to individuals with ADHD, we found that at follow-up, a combination of having low education and disability pension without unemployment was clustered (*O*/*E* ratio = 1.62). Similarly, a combination of having low education and unemployment without disability pension was clustered although the association was weaker (*O*/*E* ratio = 1.17). Having all three in combination was less likely than expected (*O*/*E* ratio = 0.84). These findings can be interpreted from the social security system perspective: if a person is granted a disability pension or is long-term sickness absent from work for a long period of time, it is less likely that he/she seeks unemployment benefits. Moreover, individuals with ADHD who receive unemployment benefits are probably fit enough to continue seeking job and do not claim for disability pension. However, there was also clustering of advantage among individuals with ADHD; the observed prevalence of having none of the three (low education, unemployment and disability pension) was greater than the expected prevalence. Thus, higher education may protect

young adults with ADHD from early labor market marginalization. A previous study has shown that the association between externalizing problems and high-school drop-out may be mediated by poor school grades (Sagatun *et al*., 2014). Individuals with ADHD and high education may also represent those with high functional capacity enabling them to attain higher education. It is also possible that high education gives them means to cope and adapt to work-related demands.

The strengths of our study include high-quality detailed register data that cover the entire population in Sweden and a prospective study design which allowed us to examine how clustering of social disadvantage changes over time. The Swedish healthcare registers have been proven to have good coverage and high validity (Ludvigsson *et al*., 2011) although the coverage of outpatient care was not completely accurate during the first years of observation. The limitations include that ADHD was identified from specialized healthcare (inpatient and outpatient records). Consequently, children and young adults whose ADHD was diagnosed and managed solely in primary healthcare are misclassified in our analyses as not having ADHD. However, as most people with ADHD would at least at some point in the disease trajectory have had assessment and/or treatment in specialized healthcare, it is likely that the proportion of individuals misclassified is small. Further studies could also include diagnosis-specific disability pension to examine whether mood disorders are the main diagnoses of disability in ADHD (Addicoat, Thapar, Riglin, Thapar & Collishaw, 2020). In the Swedish hospital registers, the diagnosis of ADHD was based on ICD-10 and was not verified according to the DSM-5 criteria which would have been more accurate. As we did not include comorbidity in our study, it would be important to examine the contribution of comorbid psychiatric conditions and intellectual disability on the clustering of disadvantage.

Because the follow-up was short and the study cohort comprised young adults, some of them may still be continuing their education. It is more likely that individuals with ADHD were those who dropped out of school, thus, the clustering estimates may be underestimates of the actual levels of clustering. For many young individuals in our study, the findings only covered the very beginning of adult life. Therefore, further studies with longer follow-up periods are needed to examine whether the findings of our study persist into middle age. Data on specialized schooling were not available in our study, thus, the potential positive effect of specialized schooling on labor market outcomes was not possible to examine. This would be an important factor to consider in future studies. Finally, further research is needed to examine the generalisability of our findings to other countries with different social security and health care systems.

In conclusion, the findings of this study suggest that young adults with ADHD are at an increased risk of the clustering of low education and unemployment, more so among women and when unemployment is prolonged. Further studies should examine whether the difference between women and men is associated with different symptom profiles or later diagnosis and thus delayed treatment for women and investigate the processes through which social disadvantage clusters. Intervention studies are also needed to examine whether special support to prevent prolonged unemployment would reduce clustering of disadvantage in individuals with ADHD. In addition among individuals with ADHD, clustering of low education with unemployment on the one hand and low education with disability pension on the other, suggest an increased risk of labor market marginalization associated with low education. These findings emphasize the need of further research to develop measures that prevent clustering of social disadvantage among children and adolescents with ADHD. Our findings also support the development of educational systems that support children and young people with ADHD and learning difficulties. Further research should also compare welfare policies to identify interventions effective in preventing trajectories that lead to labor market marginalization associated with ADHD.

CONFLICT OF INTREST

The authors have no conflict of interest to declare.

FUNDING SOURCES

The study was supported by Swedish Research Council for Health, Working Life and Welfare (FORTE). TL was supported by the Social Insurance Institution of Finland (grant 29/26/2020), MK was supported by NordForsk (70521), the Academy of Finland (311492), Finnish Work Environment Fund, and Helsinki Institute of Life Science (H815). The study utilized data from the REWHARD consortium supported by the Swedish Research Council (2017–00624).

DATA AVAILABILITY STATEMENT

The data used in this study is administered by the Division of Insurance Medicine, Karolinska Institutet, and cannot be made publicly available. According to the General Data Protection Regulation, the Swedish law SFS 2018:218, the Swedish Data Protection Act, the Swedish Ethical Review Act, and the Public Access to Information and Secrecy Act, these type of sensitive data can only be made available, after legal review, for researchers who meet the criteria for access to this type of sensitive and confidential data. Readers may contact Professor Ellenor Mittendorfer-Rutz regarding the data.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of the article:

Table S1 Clustering of ADHD, low education and medium-length unemployment (>90 days) at baseline and at follow-up.

Table S2 Clustering of ADHD, low education and long-term unemployment (>180 days) at baseline and at follow-up.

Table S3 Clustering of ADHD, low education and unemployment (≥1 days) at baseline by sex.

Table S4 Clustering of ADHD, low education and unemployment (≥1 days) at follow-up by sex.

Received 4 June 2021, Revised 23 January 2022, accepted 3 February 2022