Pathways from parental mental disorders to offspring's work disability due to depressive or anxiety disorders in early adulthood – the 1987 Finnish birth cohort

Running head: Pathways to work disability for mental causes

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Acknowledgements

The research was funded by the Finnish Academy (grant numbers 287488, 294096 and 319200 for TL and JIH). MM received support from the Alli Paasikivi Foundation (2016), the Emil Aaltonen Foundation (2016) and the National Institute for Health and Welfare.

Abstract (250/250)

Background: Parental mental disorders have been shown to predict offspring's mental health problems. We examined, whether pathways from parental mental disorders to offspring's psychiatric work disability in early adulthood are mediated through offspring's mental disorders and social disadvantage in adolescence.

Methods: Study population consisted of the 1987 Finnish Birth Cohort. Data on parents' psychiatric care or work disability due to mental diagnosis between 1987 and 2000 and the cohort participants' health and social factors between 2001 and 2005 were derived from administrative national registers. From 2006 through 2015 52,182 cohort participants were followed for admittance of psychiatric work disability due to depressive or anxiety disorders. First, we applied a pathway analysis to examine the occurrence of each path. We then used mediation analysis to assess the proportion of association between parental mental disorders and work disability mediated by offspring's health and social disadvantage.

Results: The pathway model indicated that the association from parental mental disorders to offspring's work disability due to depressive or anxiety disorder is through mental disorders and social disadvantage in adolescence. Odds Ratio for the total effect of parental mental disorders on offspring's psychiatric work disability was 1.85 (95% CI 1.46–2.34) in the model including offspring's mental disorders that mediated this association by 35%. Corresponding results were 1.86 (95% CI 1.47–2.35) and 28% for social disadvantage in adolescence.

Conclusions: These findings suggest that inter-generational determination of work disability due to mental disorders could be addressed by actions supporting mental health and social circumstances in adolescence.

Key words anxiety, depression, epidemiology, child/adolescent, family

1. INTRODUCTION

Work disability is a major societal and public health challenge, causing a major burden not only to Western societies (OECD, 2010), but also on the individual. In addition to health burden, it increases the risk of lower income level through decreased work participation that can appear in the form of unemployment and even permanent exclusion from the labor market (Birnbaum et al., 2010; Helgesson, Johansson, Nordqvist, Lundberg, & Vingard, 2015; Helgesson, Tinghog, Niederkrotenthaler, Saboonchi, & Mittendorfer-Rutz, 2017; Hultin, Lindholm, & Moller, 2012). In general, mental disorders are the second most common cause of work disability after musculoskeletal disorders (Statistics Finland, 2018; Theis, Roblin, Helmick, & Luo, 2018). Among young adults, however, mental disorders are the leading cause (Gore et al., 2011; Kaltenbrunner Bernitz, Grees, Jakobsson Randers, Gerner, & Bergendorff, 2013; Whiteford et al., 2013). Thus, to enhance work participation also from the beginning of the career, prevention of work disability due to mental disorders in early adulthood is of particular importance.

Some predictors of mental health-related work disability have been identified (Halonen et al., 2017; Ishtiaq-Ahmed, Perski, & Mittendorfer-Rutz, 2014), parental mental disorders being one of them. The association between parents' mental disorders and offspring's early work disability due to mental disorders may be direct as indicated by the evidence on heritability of mental disorders (Franic, Middeldorp, Dolan, Ligthart, & Boomsma, 2010; Kendler, Ohlsson, Lichtenstein, Sundquist, & Sundquist, 2018). However, the association is also likely affected by the offspring's circumstances in childhood and adolescence. Although there is evidence for early risk factors for work disability in general (Gravseth et al., 2007; Halonen et al., 2017; von Bondorff et al., 2015), surprisingly few studies have examined work disability in early adulthood and their possible risk factors from adolescence. Relationships with work disability in early adulthood have been reported for

low educational achievement (Gravseth et al., 2007; Johansson, Leijon, Falkstedt, Farah, & Hemmingsson, 2012), chronic disease (Gravseth et al., 2007), anxious and depressive symptoms (Narusyte, Ropponen, Alexanderson, & Svedberg, 2017), mental disorders (Helgesson et al., 2017), and severe social disadvantage in the family (Harkko, Kouvonen, & Virtanen, 2016). However, it has not been examined, if these factors are on the pathway from parental mental disorders to offspring's mental health-related work disability, and if so, how much the factors from adolescence mediate this association.

The aim of this study was thus to determine whether two different pathways for inter-generational transmission of disadvantage related to mental health exist simultaneously. More specifically, we examined whether parental mental disorders are directly associated with offspring's psychiatric work disability in early adulthood, or whether there are pathways through the offspring's own mental disorders and social disadvantage in adolescence. We also quantified the proportions that the factors from adolescence mediate the association between parental mental disorders and offspring's work disability, and compared the magnitudes of these proportions.

2. METHODS

2.1 Study population

The study population was from the 1987 Finnish Birth Cohort (FBC), a longitudinal nationwide follow-up study including all children born in 1987 (Paananen & Gissler, 2012). All children surviving the perinatal period were included in the 1987 FBC (n= 59,476). The data include detailed information about the cohort members' health status and social circumstances from the perinatal period to early adulthood (end of 2015, when 28 years), but also information about their parent's health and social factors. The FBC data have been obtained from Finnish national registers (Gissler & Haukka, 2004) and combined to census

data through personal identity code that is unique to each Finnish citizen and resident. The study has ethical approval from the Ethical Review Board of National Institute for Health and Welfare (§28/2009) and register holders' permissions to use register data in research.

Selection of the cohort members for the analytical sample of this study is shown in **Figure 1**. First, we excluded all who died during the follow-up ($n = 756$). We also excluded those who had ever been hospitalized with a primary or secondary diagnoses related to intellectual disability ($n = 464$, International Classification of Diseases (ICD) -9th Revision codes: 317–319 and ICD-10 codes: F70–F79), those with registered disability allowance for persons under 16 years (granted for those who in excess need regular care, attention and rehabilitation due to illness or disability) ($n = 3,187$), and those who had lived abroad (i.e., no register data available) at least for one (cumulative) year during the study period ($n = 1,828$), or had missing data on compulsory elementary school grade point average (GPA, $n = 1,059$) (a factor used to define social disadvantage). Altogether 7,294 cohort members (12.3%) were excluded, and the analytical sample included 52,182 individuals (87.7%).

2.2 Parental mental disorders

Data on parental mental disorders were collected for the first 13 years of the cohort members' life (1987–2000). The Finnish Hospital Discharge Register, maintained by National Institute for Health and Welfare (THL), covers all inpatient care episodes from all Finnish hospitals since 1969, and all specialized-care outpatient visits in public hospitals since 1998 (Gissler & Haukka, 2004). As indicators of mental disorders, we used psychiatric outpatient (primary and secondary diagnosis) and inpatient (primary diagnosis) visits in hospital, and entitlement for work disability pension due to mental and behavioral diagnosis (ICD-9: 291, 292, 295–309, 311–319, and ICD-10: F10–F99). We included this comprehensive set of diagnoses related to mental disorders as there is evidence that parental mental disorders have broad

manifestations in their offspring (Dean et al., 2010), although there is also evidence for transgenerational concordance, particularly for anxiety (van Santvoort et al., 2015). The variable for parental mental disorders was dichotomized based on having either of the indicators as: “1 = yes, 0 = no”.

2.3 Mental disorders and social disadvantage in adolescence

Data on cohort member’s mental health problems and social disadvantage in adolescence were collected from 2001 through 2005 when the cohort members were 14 to 18 years old. Hospital outpatient visits and hospitalizations due to mental disorders (ICD-10: F10–F99), both dichotomized as “1 = yes or 0 = no”, were included to indicate (offspring’s) mental health problems. Additionally, we used data about psychotropic medication use from the Social Insurance Institution of Finland, that was defined as having a prescription for psychoanaleptics (ATC code N06), also dichotomized as “1 = yes or 0 = no”. We calculated a sum of these three indicators of mental health, and values 1 or more indicated the cohort member had had a “mental disorder” in adolescence.

Social factors included information about three factors. *Poor school performance* was defined using final GPA of the certificate given after the compulsory elementary school (9 years). The GPA is important in Finland since admittance into secondary school is based on the GPA from the compulsory elementary school. Low GPA can also indicate social issues related to school and home environments, such as bullying at school and unemployment in the family, that have not been directly measured. In the Finnish schools, the GPA is calculated on a linear scale from 4 (weak, fail) to 10 (excellent) (FinlandEducation.info, 2018). We dichotomized GPA using 7 as the cut-off: GPA 4–6.9 (1= has this disadvantage) and GPA 7.0–10 (0= no disadvantage). Failing to achieve secondary education, on the other hand, limits opportunities to pursue post-secondary education. Thus,

to define the second disadvantage, information on *not having completed secondary education* by 2015 at the age of 28 was used (1 = no secondary education, i.e. has this disadvantage, 0 = no disadvantage). For a sensitivity analysis we used follow-up for secondary education until 2008, i.e., the age of 21. The third social factor indicating low income level was based on information on *family receiving social assistance*, means-tested minimum income benefit, for a minimum of six months at a time, or 12 months cumulatively over the five years (2001–2005) (1 = yes, has this disadvantage and 0 = no disadvantage). We formed a sum of these three factors and values 1 or more indicated a “social disadvantage” in adolescence.

2.4 Outcome

Follow-up for work disability was from the beginning of 2006 until the end of 2015. In the Finnish system, work disability pension is always assessed by a physician and many factors such as the person’s possibilities of earning a living are considered in the decision, in addition to the diagnosis. In general, disability pension may be granted to a person aged 16–64 years, however, possibilities for rehabilitative efforts must be first investigated for persons under 20 years, and a temporary rehabilitation allowance for young persons can be granted to those aged 16–19 years. From the earnings-related pension scheme, a disability pension can be granted to a person aged 18–62 years with a work history that has accrued pension. In this scheme, it is further required that the incapacity to work is estimated to last for at least one year. This disability pension can be granted either as a temporary, called as fixed-term rehabilitation subsidy, or as a permanent disability pension. For most young people the fixed-term rehabilitation subsidy will be granted first. Permanent disability pensions can be granted in the early ages in serious cases. Dates of the beginning of permanent or temporary work disability pension due to depressive (ICD-10: F32–34) or anxiety (ICD-10: F40–48) disorders were from the Finnish Centre for Pensions (earnings related pensions) and from the Social

Insurance Institute of Finland (people without work history) by primary diagnosis. The work disability was used as a binary variable (1 = yes, 0 = no).

2.5 Statistical analysis

2.5.1 Pathway analysis

Based on our research hypothesis, parental mental disorders are associated with the offspring's work disability due to depressive or anxiety disorders. This association may be 1) direct (labelled "c" in **Figure 2**), or it may have pathways through 2) offspring's mental disorders in adolescence ("a" and "b"), or 3) offspring's social disadvantage in adolescence ("d" and "e"), while mental disorders and social disadvantage are correlated. We used pathway modelling, which belongs to the structural equation modelling (SEM) family, to determine whether the two mediation paths occur simultaneously. The results of the pathway analyses are reported as (probit) β -estimates with 95% confidence intervals (CI) for each path a–e. A statistically significant effect estimate indicates existence of each path and higher values of β -estimates mean that the event is more likely to happen. Statistical software R's (R Core Team, 2017) (R 3.4.1) lavaan package (Rosseel, 2012) was used for the pathway analysis.

2.5.2 Mediation analysis

Figure 3 shows how i) mental disorders and ii) social disadvantage in adolescence may mediate the relationship between parental mental health and offspring's work disability in early adulthood. To assess the magnitude of the mediation (Baron & Kenny, 1986) by these factors, two separate analyses with counterfactual approach to mediation, allowing exposure-mediator interactions, were conducted. A mediation macro developed for SAS (Valeri & Vanderweele, 2013) was used and it provides separate effect estimates for natural direct

effect (NDE) between parental mental disorders and offspring's work disability due to depressive or anxiety disorders, natural indirect effects (NIE) through the mediating factors in adolescence, and total effects (TE) that sums the NDE and NIE. These effects are reported as odds ratios (OR) with 95% CI. The macro additionally provides the proportion of the association mediated by the tested intermediate factor. As a sensitivity analysis we tested whether restricting follow-up time for secondary education (up to age 21 years) affected the findings for social disadvantage, and assessed the percentage mediated separately for the three social factors. All mediation analyses were performed using SAS 9.3 (SAS Institute, Cary NC).

2.5.3 Additional analyses

There are sex-differences in the prevalence of mental health problems in adolescence (Leikanger & Larsson, 2012) and in the prevalence of work disability (Gravseth et al., 2007; Narusyte et al., 2011). Geographical differences in health have been observed in Finland, with the highest prevalence of mental health problems observed in the Northern Finland (Pirkola et al., 2005). Thus, to explore if there is any moderation by sex and geographical region, we further ran the mediation analyses separately for women and men, and by Northern/Eastern and Southern/Western Finland. The categorization of the geographical regions was based on major regions of Eurostat's Nomenclature of Territorial Units for Statistics level 2 classification (NUTS-2) (Statistics Finland, 2015).

3. RESULTS

Of the study population of 52 182, 51% were males (**Table 1**). During the follow-up, work disability pension due to depressive or anxiety disorders was granted for 446 cohort members (0.9%). Prevalence of the cohort members' parental mental disorders during childhood was

12%. In adolescence, the prevalence of own mental disorders was 8%, and that of social disadvantage 27%. The analytic sample did not differ from the whole cohort (**Table 1**). **Table 2** shows that compared to cohort members who had no work disability, those with work disability due to depressive or anxiety disorders had more often parent with a mental disorder (20% vs. 12%). They also had more mental disorders (41% vs. 8%) and social disadvantage (47% vs. 27%) in adolescence. Of those cohort members with mental disorder in adolescence, 13.5% had a parent with mental disorder in 1987–2000. The corresponding percentage was 18.5, if the cohort member had social disadvantage in adolescence.

In **Table 3**, we present the effect estimates for each possible pathway suggested in **Figure 2**. In the model simultaneously including all suggested paths, parental mental disorders associated with the offspring's mental disorders ($\beta = 0.366$), and social disadvantage ($\beta = 0.456$) in adolescence. Participant's mental disorders in adolescence were associated with work disability due to depressive or anxiety disorders in early adulthood ($\beta = 0.421$), and the association was existent but weaker also for social disadvantage in adolescence ($\beta = 0.080$).

Results of the mediation analyses are shown in **Table 4**. In both mediation analyses (i and ii) the association between parental mental disorders and offspring's work disability due to depressive or anxiety disorders was partially mediated. Odds ratio for the total effect of parental mental disorders and mental disorders in adolescence on work disability was 1.85 (95% CI 1.46–2.34), of which 35% was explained by mental disorders in adolescence. The corresponding OR for the total effect when including social disadvantage in adolescence was 1.86 (95% CI 1.47–2.35) of which 28% was explained by social disadvantage in adolescence. When restricting the follow-up time for obtaining secondary education, the total effect remained the same (1.86, 95% CI 1.47–2.35). Of the individual

social factors, not having completed secondary degree had largest proportion mediated (25%), followed by recipient of social assistance (13%), and low GPA (3%).

The additional analyses stratified by sex indicated that the NDE of parental mental disorders on work disability in early adulthood was statistically significant in men, but not in women. The NIEs through mental disorders and social disadvantage in adolescence, then, were stronger among women than men (**Table 4**). The proportion mediated by mental disorders in adolescence was 55% in women and 22% in men. The corresponding proportions for social disadvantage were 65% and 11%.

When further looking at the associations by geographical regions, the results indicated that the NDEs, NIEs and TEs were stronger in the Southern/Western regions of Finland when compared to Northern/Eastern regions (**supplemental Table 1**). However, all effect estimates were in the same direction so the differences may partly relate to different sample sizes (N=14 759 Northern/Eastern regions vs. 36 827 Southern/Western regions).

4. DISCUSSION

We observed that parental mental disorders were associated with an increased odds of the offspring's work disability due to depressive or anxiety disorders in early adulthood. This association emerged through the two examined pathways; through offspring's mental and social problems in adolescence. The offspring's mental disorders in adolescence mediated the association between parental mental disorders and disability pension by 35%, while the corresponding proportion mediated by social problems was 28%.

To our knowledge, this is the first study that could look at the possible pathways and mediation for specific work disability diagnoses in young adults, namely depressive and anxiety disorders. Our findings suggest that mental health problems in adolescence are an important factor on the pathway from parental mental disorders to work

disability due to depressive or anxiety disorders in early adulthood. This is in line with the known heritability of mental disorders (Franic et al., 2010; Narusyte et al., 2011) that is likely to increase from adolescence to young adulthood (Bergen, Gardner, & Kendler, 2007). Our findings also agree with the recently published associations between mental health problems in adolescence and work disability in early adulthood (Helgesson et al., 2017; Narusyte et al., 2017). Social disadvantage in adolescence also provided a pathway from parental mental disorders to work disability in early adulthood although the path from social disadvantage to disability pension was somewhat weaker than that for mental disorders. In prior studies, social disadvantage such as becoming a school drop-out or out-of-home care placements (due to e.g. behavioral problems, alcohol and drug abuse or criminal convictions) have also been associated with an increased risk of work disability in early adulthood (De Ridder et al., 2013; Harkko et al., 2016).

In these data, mental disorders in adolescence explained 35% of the association between parental mental disorders and work disability, whereas the corresponding percentage was 28 for social disadvantage. Although our findings indicate stronger mediating effect for mental disorders than social disadvantage, they also suggest that early detection of and interventions on both mental health and social disadvantage in adolescence, particularly to obtain secondary education, might help in preventing work disability due to depressive and anxiety disorders in early adulthood.

Somewhat surprising was our finding that among females, the direct association between parental mental disorders and work disability was statistically insignificant, and mental disorders and social disadvantage in adolescence explained a large proportion of the total effect. The gender differences in the pathways to work disability may be related to different genetic contributions to liability to disability (Narusyte et al., 2011). Our findings also suggest that men's, compared to women's, work disability related to mental disorders is

less influenced by social disability, including poor educational achievements, in adolescence. Prior research has proposed that increase in sense of control due to educational achievements decreases depression more in women than in men (Ross & Mirowsky, 2006), which suggests that poor educational achievements could increase mental health problems more in women than men. However, it is possible that there are other (unmeasured) factors – especially for men – that mediate the association between parental mental disorders and offspring’s work disability. These unmeasured factors may include externalizing disorders such as antisocial behavior and substance abuse that are more common among men than women (Hawton & van Heeringen, 2009; Hicks et al., 2007), and that might be detected already in childhood. Compared to externalizing disorder, our measure of mental disorders more accurately covered internalizing disorders that include, e.g., psychotropic medication use that is commonly reported to be at a higher level among women than men (Finnish Medicines Agency Fimea & Social Insurance Institution, 2016; Laaksonen et al., 2010).

The main strength of this study is the large study population, i.e., a complete census of all children born in 1987. The children and their parents were followed-up from national administrative registers for 28 years from the child’s birth to early adulthood. Reliance on high quality and complete national health registers (Gissler & Haukka, 2004; Sund, 2012) in the assessment of the exposure and outcome guarantees no loss to follow-up (except for emigration) or bias due to self-reporting. Unlike most prior studies focusing on work disability, we were also able to focus on young adults and specified work disability diagnoses; depressive and anxiety disorders. The register linkages related to these data have been extensive, but some information could not be accessed. Thus, the limitations of this study include the lack of information on health behaviors, such as substance abuse, and the use of health care services, including variation in access to psychotherapy (Rikala, 2018), that may have led to unmeasured confounding. Finally, although we used the large birth cohort,

generalizability to other birth cohorts and countries with different social and health care systems needs to be verified.

4. CONCLUSION

Our findings suggest that inter-generational transmission of work disability due to mental disorders is not deterministic; instead it could be addressed by actions supporting mental health and social circumstances before adulthood. These actions should be directed to those families where parents who have mental disorders have small children, as well as to adolescents with mental disorders or social disadvantage, particularly difficulties to obtain secondary education. To identify these vulnerable target groups, early detection of mental health problems and access to good quality health care are key aspects that may help in preventing psychiatric work disability in early adulthood.

Conflicts of interest

The authors declare no conflict of interests.

References

- Baron, R. M., & Kenny, D. A. (1986). The moderator-mediator variable distinction in social psychological research: conceptual, strategic, and statistical considerations. *J Pers Soc Psychol*, 51(6), 1173-1182.
- Bergen, S. E., Gardner, C. O., & Kendler, K. S. (2007). Age-related changes in heritability of behavioral phenotypes over adolescence and young adulthood: a meta-analysis. *Twin Res Hum Genet*, 10(3), 423-433.
- Birnbaum, H. G., Kessler, R. C., Kelley, D., Ben-Hamadi, R., Joish, V. N., & Greenberg, P. E. (2010). Employer burden of mild, moderate, and severe major depressive disorder: mental health services utilization and costs, and work performance. *Depress Anxiety*, 27(1), 78-89.
- De Ridder, K. A., Pape, K., Cuypers, K., Johnsen, R., Holmen, T. L., Westin, S., et al. (2013). High school dropout and long-term sickness and disability in young adulthood: a prospective propensity score stratified cohort study (the Young-HUNT study). *BMC Public Health*, 13, 941.
- Dean, K., Stevens, H., Mortensen, P. B., Murray, R. M., Walsh, E., & Pedersen, C. B. (2010). Full spectrum of psychiatric outcomes among offspring with parental history of mental disorder. *Arch Gen Psychiatry*, 67(8), 822-829.
- FinlandEducation.info. (2018). *Grading, Language of Instruction and Academic Year in Finland*. Retrieved August 8, 2018, from <http://www.finlandeducation.info/Education-System/Grading-System-Language-of-Instruction-and-Academic-Year-in-Finland.html>
- Finnish Medicines Agency Fimea, & Social Insurance Institution. (2016). *Finnish Statistics on Medicine*, 2018, from <http://www.fimea.fi/documents/160140/1188389/Suomen+l%C3%A4%C3%A4ketilasto+2016/8082fc4e-a6ce-f78c-c870-9521458b0097>
- Franic, S., Middeldorp, C. M., Dolan, C. V., Ligthart, L., & Boomsma, D. I. (2010). Childhood and adolescent anxiety and depression: beyond heritability. *J Am Acad Child Adolesc Psychiatry*, 49(8), 820-829.
- Gissler, M., & Haukka, J. (2004). Finnish health and social welfare registers in epidemiological research. *Norsk Epidemiologi*, 14(1), 113-120
- Gore, F. M., Bloem, P. J., Patton, G. C., Ferguson, J., Joseph, V., Coffey, C., et al. (2011). Global burden of disease in young people aged 10-24 years: a systematic analysis. *Lancet*, 377(9783), 2093-2102.
- Gravseth, H. M., Bjerkedal, T., Irgens, L. M., Aalen, O. O., Selmer, R., & Kristensen, P. (2007). Life course determinants for early disability pension: a follow-up of Norwegian men and women born 1967-1976. *Eur J Epidemiol*, 22(8), 533-543.
- Halonen, J. I., Kivimäki, M., Vahtera, J., Pentti, J., Virtanen, M., Ervasti, J., et al. (2017). Childhood adversity, adult socioeconomic status and risk of work disability: a prospective cohort study. *Occup Environ Med*, 74(9), 659-666.
- Harkko, J., Kouvonen, A., & Virtanen, M. (2016). Educational attainment, labour market position and mental ill health as pathways from adversities in adolescence to disability pension in early adulthood: A Finnish cohort study using register data. *Scand J Public Health*.
- Hawton, K., & van Heeringen, K. (2009). Suicide. *Lancet*, 373(9672), 1372-1381.
- Helgesson, M., Johansson, B., Nordqvist, T., Lundberg, I., & Vingard, E. (2015). Sickness absence at a young age and later sickness absence, disability pension, death, unemployment and income in native Swedes and immigrants. *Eur J Public Health*.
- Helgesson, M., Tinghog, P., Niederkrotenthaler, T., Saboonchi, F., & Mittendorfer-Rutz, E. (2017). Labour-market marginalisation after mental disorders among young natives and immigrants living in Sweden. *BMC Public Health*, 17(1), 593.
- Hicks, B. M., Blonigen, D. M., Kramer, M. D., Krueger, R. F., Patrick, C. J., Iacono, W. G., et al. (2007). Gender differences and developmental change in externalizing disorders from late adolescence to early adulthood: A longitudinal twin study. *J Abnorm Psychol*, 116(3), 433-447.

Hultin, H., Lindholm, C., & Moller, J. (2012). Is there an association between long-term sick leave and disability pension and unemployment beyond the effect of health status?--a cohort study. *PLoS One*, 7(4), e35614.

Ishtiak-Ahmed, K., Perski, A., & Mittendorfer-Rutz, E. (2014). Risk markers of all-cause and diagnosis-specific disability pension--a prospective cohort study of individuals sickness absent due to stress-related mental disorders. *BMC Public Health*, 14, 805.

Johansson, E., Leijon, O., Falkstedt, D., Farah, A., & Hemmingsson, T. (2012). Educational differences in disability pension among Swedish middle-aged men: role of factors in late adolescence and work characteristics in adulthood. *J Epidemiol Community Health*, 66(10), 901-907.

Kaltenbrunner Bernitz, B., Grees, N., Jakobsson Randers, M., Gerner, U., & Bergendorff, S. (2013). Young adults on disability benefits in 7 countries. *Scand J Public Health*, 41(12 Suppl), 3-26.

Kendler, K. S., Ohlsson, H., Lichtenstein, P., Sundquist, J., & Sundquist, K. (2018). The Genetic Epidemiology of Treated Major Depression in Sweden. *Am J Psychiatry*, appiajp201817111251.

Laaksonen, M., Mastekaasa, A., Martikainen, P., Rahkonen, O., Piha, K., & Lahelma, E. (2010). Gender differences in sickness absence--the contribution of occupation and workplace. *Scand J Work Environ Health*, 36(5), 394-403.

Leikanger, E., & Larsson, B. (2012). One-year stability, change and incidence in anxiety symptoms among early adolescents in the general population. *Eur Child Adolesc Psychiatry*, 21(9), 493-501.

Narusyte, J., Ropponen, A., Alexanderson, K., & Svedberg, P. (2017). Internalizing and externalizing problems in childhood and adolescence as predictors of work incapacity in young adulthood. *Soc Psychiatry Psychiatr Epidemiol*, 52(9), 1159-1168.

Narusyte, J., Ropponen, A., Silventoinen, K., Alexanderson, K., Kaprio, J., Samuelsson, A., et al. (2011). Genetic liability to disability pension in women and men: a prospective population-based twin study. *PLoS One*, 6(8), e23143.

OECD. (2010). *Sickness, Disability and Work: Breaking the Barriers. A Synthesis of Findings across OECD Countries* from <http://dx.doi.org/10.1787/9789264088856-en>

Paananen, R., & Gissler, M. (2012). Cohort profile: the 1987 Finnish Birth Cohort. *Int J Epidemiol*, 41(4), 941-945.

Pirkola, S. P., Isometsa, E., Suvisaari, J., Aro, H., Joukamaa, M., Poikolainen, K., et al. (2005). DSM-IV mood-, anxiety- and alcohol use disorders and their comorbidity in the Finnish general population--results from the Health 2000 Study. *Soc Psychiatry Psychiatr Epidemiol*, 40(1), 1-10.

R Core Team. (2017). *R: A language and environment for statistical computing*. R Foundation for Statistical Computing. Retrieved Accessed February 23, 2018, from <http://www.R-project.org/>

Rikala, S. (2018). Masennus, työkyvyttömyys ja sosiaalinen eriarvoisuus nuorten aikuisten elämänkuluissa (Depression, work disability and social inequality in young adults' life courses). . *Yhteiskuntapolitiikka* 83(2), 159-170.

Ross, C. E., & Mirowsky, J. (2006). Sex differences in the effect of education on depression: resource multiplication or resource substitution? *Soc Sci Med*, 63(5), 1400-1413.

Rosseel, Y. (2012). lavaan: An R Package for Structural Equation Modeling. *Journal of Statistical Software*, 48(2), 1-36.

Statistics Finland. (2015). *Major Regions 2015*. Retrieved Dec 14, 2015, from http://www.stat.fi/meta/luokitukset/suuralue/001-2015/index_en.html

Statistics Finland. (2018). *Recipients of disability pension* from <http://findikaattori.fi/en/76>

Sund, R. (2012). Quality of the Finnish Hospital Discharge Register: a systematic review. *Scand J Public Health*, 40(6), 505-515.

Theis, K. A., Roblin, D. W., Helmick, C. G., & Luo, R. (2018). Prevalence and causes of work disability among working-age U.S. adults, 2011-2013, NHIS. *Disabil Health J*, 11(1), 108-115.

Valeri, L., & Vanderweele, T. J. (2013). Mediation analysis allowing for exposure-mediator interactions and causal interpretation: theoretical assumptions and implementation with SAS and SPSS macros. *Psychol Methods*, 18(2), 137-150.

van Santvoort, F., Hosman, C. M., Janssens, J. M., van Doesum, K. T., Reupert, A., & van Loon, L. M. (2015). The Impact of Various Parental Mental Disorders on Children's Diagnoses: A Systematic Review. *Clin Child Fam Psychol Rev*, 18(4), 281-299.

Whiteford, H. A., Degenhardt, L., Rehm, J., Baxter, A. J., Ferrari, A. J., Erskine, H. E., et al. (2013). Global burden of disease attributable to mental and substance use disorders: findings from the Global Burden of Disease Study 2010. *Lancet*, 382(9904), 1575-1586.

von Bonsdorff, M. B., Tormakangas, T., Salonen, M., von Bonsdorff, M. E., Osmond, C., Kajantie, E., et al. (2015). Early life origins of all-cause and cause-specific disability pension: findings from the Helsinki Birth Cohort Study. *PLoS One*, 10(4), e0122134.

Table 1. Descriptive statistics of the study population and the 1987 Finnish Birth Cohort.

Variable	Study population (n=52,182)		FBC 1987 [†] (n=59,476)	
	n	%	n	%
Sex				
Men	26,582	50.9	30,435	51.2
Women	25,600	49.1	29,041	48.8
Work disability due to depressive or anxiety disorder	446	0.9	568	1.0
Parental mental disorders	6,281	12.0	7,314	12.3
Work disability due to mental diagnosis	1,309	2.5	1,583	2.7
Psychiatric outpatient visits in hospitals	5,925	11.4	6,879	11.6
Mental disorders in adolescence	4,094	8.0	5,311	8.9
Mental health diagnosis [‡]	3,357	6.4	4,416	7.4
Prescription of psychoanaleptic [§]	737	1.4	895	1.5
Social disadvantage in adolescence	14,052	26.9	17,072	28.7
Low GPA [¶]	11,101	21.3	12,265	20.6
No second level degree	1,833	3.5	3,513	5.9
Recipient of social assistance	1,118	2.1	1,294	2.2
Living area				
Northern/Eastern Finland	14,759	28.3	16,388	27.6
Southern/Western Finland	36,827	70.6	41,682	70.1
Missing	594	1.1	1 032	1.7

[†] The 1987 Finnish Birth Cohort; [‡] ICD-10 codes: F10–F99; [§] ATC code N06; [¶] GPA, grade point average reflecting school performance. On a scale 4–10: 4–6.9=low

Table 2. Descriptive statistics of the study population by the outcome (work disability status) and mediators (mental disorders and social disadvantage).

Variable	No work disability		Work disability	
	n	%	n	%
Early adulthood				
Sex				
Men	26,472	51.1	155	65.2
Women	25,309	48.9	291	34.8
Parental mental disorders	6,191	12.0	90	20.2
Mental disorders in adolescence	3,910	7.6	184	41.3
Social disadvantage in adolescence	13,841	26.8	221	47.3
Living area				
Northern/Eastern Finland	14,631	28.3	128	28.7
Southern/Western Finland	36,523	70.6	304	68.2
Missing	582	1.1	14	3.1
Adolescence				
Sex				
Male	25,188	52.4	1,394	34.0
Female	22,900	47.6	2,700	66.0
Parental mental disorders	3,248	7.1	846	13.5
Living area				
Northern/Eastern Finland	13,746	28.6	1,013	24.7
Southern/Western Finland	33,837	70.4	2,990	73.0
Missing	505	1.1	91	2.2
Adolescence				
Sex				
Male	17,247	45.2	9,335	66.4
Female	20,883	54.8	4,717	33.6
Parental mental disorders	3,686	9.7	2,595	18.5
Living area				
Northern/Eastern Finland	10,885	28.5	3,874	27.6
Southern/Western Finland	26,878	70.5	9,949	70.8
Missing	367	1.0	229	1.6

Table 3. Associations for each path from parental mental disorders (PMD) to offspring's mental disorders (MD) and social disadvantage (SD) in adolescence, and work disability (WD) due to depressive or anxiety disorders in early adulthood from the path model.

Effect	Path	$\beta^{\dagger}$	95 % CI		P-value
a	PMD $\rightarrow$ MD	0.366	0.323	0.408	<0.001
b	MD $\rightarrow$ WD	0.421	0.379	0.463	<0.001
c	PMD $\rightarrow$ WD	0.042	-0.050	0.133	0.371
d	PMD $\rightarrow$ SD	0.456	0.423	0.490	<0.001
e	SD $\rightarrow$ WD	0.080	0.035	0.124	<0.001

† probit β -estimate

PMD = parental mental disorders 1987–2000 (0–13 years); MD = mental disorders 2001–2005 (14–18 years); SD = social disadvantage 2001–2005 (14–18 years); WD = work disability due to depressive or anxiety disorders 2006–2015 (19–28 years).

Table 4. Results of mediation analyses among all cohort members and separately for men and women.

Effect	Path	OR [†]	95 % CI [‡]	% [§]
All				
Mediation analysis i)				
a	PMD → MD	2.04	1.89 2.22	
b	MD → WD	9.51	7.68 11.8	
NDE (c)	PMD → WD	1.55	1.22 1.98	
NIE		1.19	1.11 1.28	
TE		1.85	1.46 2.34	35
Mediation analysis ii)				
d	PMD → SD	2.12	2.00 2.24	
e	SD → WD	2.39	1.94 2.95	
NDE (c)	PMD → WD	1.62	1.27 2.07	
NIE		1.15	1.06 1.24	
TE		1.86	1.47 2.35	28
Men				
Mediation analysis i)				
a	PMD → MD	2.31	2.03 2.64	
b	MD → WD	10.1	6.81 15.0	
NDE (c)	PMD → WD	2.29	1.57 3.33	
NIE		1.16	1.04 1.30	
TE		2.66	1.85 3.82	22
Mediation analysis ii)				
d	PMD → SD	2.04	1.89 2.20	
e	SD → WD	1.86	1.29 2.68	
NDE (c)	PMD → WD	2.48	1.70 3.63	
NIE		1.07	0.96 1.20	
TE		2.66	1.86 3.83	11
Women				
Mediation analysis i)				
a	PMD → MD	1.89	1.70 2.09	
b	MD → WD	8.09	6.24 10.5	
NDE (c)	PMD → WD	1.21	0.88 1.66	
NIE		1.21	1.10 1.33	
TE		1.46	1.07 1.99	55
Mediation analysis ii)				
d	PMD → SD	2.47	2.28 2.68	
e	SD → WD	3.82	2.95 4.94	
NDE (c)	PMD → WD	1.16	0.84 1.62	
NIE		1.26	1.11 1.43	
TE		1.47	1.08 2.00	65

[†] OR, odds ratio; [‡] CI, confidence interval; [§] proportion mediated

NDE = natural direct effect; NIE = natural indirect effect; TE = total effect; PMD = parental mental disorders 1987–2000 (0–13 years); MD = mental disorders 2001–2005 (14–18 years); SD = social disadvantage 2001–2005 (14–18 years); WD = work disability due to depressive or anxiety disorders 2006–2015 (19–28 years).

Figure legends

Figure 1. Flow chart of the sample selection.

Figure 2. Pathways from parental mental disorders to offspring's mental disorders and social disadvantage in adolescence, and work disability due to depressive or anxiety disorders in early adulthood.

Figure 3. i) Mental disorders (MD) and **ii)** social disadvantage (SD) in adolescence mediating the relationship between parental mental disorders (PMD) and work disability (WD) due to depressive or anxiety disorders in early adulthood.