1. BACKGROUND

Exposure to parental psychopathology during childhood is associated with multiple negative health and social outcomes among offspring throughout the life course, including an increased risk of psychopathology (e.g., Anda et al., 2002; Sørensen et al., 2011; Björkenstam et al., 2016; Martikainen et al., 2018). The relationship between parents and their children is interdependent and characterized by mutual influence and interlocking trajectories that continue throughout the life course (Elder et al., 2003). Children's psychopathology may thus also constitute a stressful situation for the parents, which can detrimentally affect their mental health (e.g., Butler & Bauld, 2005; Greenfield & Marks, 2006; Orford et al., 2013; Richert et al., 2018). It is therefore important to model parental and offspring trajectories concurrently further our understanding of the intergenerational transmission of mental ill-health and its potential implications for the reproduction of health inequalities.

The reciprocal association between parental and offspring psychopathology may be sociodemographically patterned. For example, the transmission of psychopathology between generations may differ by sex, with some studies highlighting a stronger transmission between mothers and children (e.g., Bishop et al., 2023; Pitkänen et al., 2023) and others suggesting that the transmission is stronger between parents and children of the same sex (e.g., Andreas et al., 2018; Kendler et al., 2018). The relationship between dual trajectories might also differ by socioeconomic position. Parents with a lower socioeconomic position have a generally higher prevalence of psychopathology (Halfon et al., 2017), and a low childhood socioeconomic position is a well-established risk marker for offspring's later psychiatric disorders and substance use (e.g., Bellis et al., 2016; Boyd et al., 2022; Kendler et al., 2014; Sellström et al., 2011).

To establish temporal ordering of psychopathology incidence across both generations, the present study uses group-based dual trajectory models to estimate contemporaneous mental health trajectories for parents and their offspring over the offspring's first 30 years of life (Nagin, 2005; Jones & Nagin, 2007). We estimate the trajectories of hospitalization for psychiatric disorders or substance use for Finnish children born between 1980–1989 and their biological mothers and fathers. Using population-based, longitudinal Finnish administrative data, we can identify the exact dates of each hospitalization, which will be aggregated annually in the form of cross-sectional observations to examine transitions across successive years. This novel approach will yield a progression of psychopathology over the life course for both generations and identify distinctive trajectory groups based on both the parents' and children's mental health. We will further use multinomial regression modeling to estimate the probabilities associated with joint group membership as a function of sex and socioeconomic position, thereby emphasizing between-group differences.

2. MATERIALS AND METHODS

2.1 Data and ethical approval

The study is based on a total population sample of individuals residing in Finland during the 1970, 1975, 1980, and 1985 censuses or at the end of years 1987–2020. The primary data consist of annual sociodemographic information (available from 1987–2020), derived from administrative registers maintained by Statistics Finland (Statistics Finland, 2021). We linked these data with records obtained from other register holders by way of unique, pseudonymized personal identification numbers. The current study primarily uses records of specialized (hospital-presenting) inpatient care (available 1970–2020), which were taken from the Care Register for Healthcare, maintained by the Finnish Institute for Health and Welfare (Finnish Institute for Health and Welfare, 2021). The Statistics Finland Board of Statistical Ethics and the Social and Health Data Permit Authority (Findata) approved the use of these data (permission nos. TK-53-1490-18 and THL/2180/14.02.00/2020, respectively).

2.2 Study population

The study population consists of children born between 1980–1989 (*n*=769,046) and their biological parents. We exclude the children who emigrated during the follow-up period, the children for whom we cannot identify both biological parents, and the children for whom annual sociodemographic information is missing for either biological parent (e.g., due to emigration). These criteria yield a preliminary sample of 618,460 children and their biological mothers and fathers.

2.3 Mental and behavioral disorders

We identify inpatient care admissions related to psychopathology for children and their parents using hospital discharge records (1979–2020). Using main or contributory diagnostic codes from the International Classification of Diseases, tenth revision (ICD-10), we identify hospitalizations attributable to psychopathology: F10–F99, excluding F17 and F70 (World Health Organization, 2019). We use the equivalent diagnoses in the eighth (1972–1986) and ninth (1987–1995) revisions for events occurring before 1996. The measure is dichotomized to indicate whether hospitalization occurred or not during each calendar year.

2.4 Socioeconomic position

We examine the association between socioeconomic position in the family of origin and the subsequent trajectories. We account for parental socioeconomic position by including highest parental educational attainment in the year of birth as a proxy measure. We considered three categories: basic (International Standard Classification of Education (ISCED) 2011 levels 0-1), secondary (ISCED 2-4) and tertiary (ISCED 5 or higher).

2.5 Covariates and effect modifiers

Given known sex differences in the presentation of psychiatric morbidity (e.g., Boyd et al., 2015; Kuehner, 2017; McLean et al., 2011; Van de Velde et al., 2010), substance misuse (McHugh et al., 2018), and treatment seeking (Roberts et al., 2018), the main analyses include a dichotomous measure of child's sex, coded according to biological sex assigned at birth. Additionally, we include a measure of parental civil status to indicate whether the biological parents are married or cohabiting or not. Finally, child's birth year is applied using dummy variables to account for potential cohort trends, and parental age at the time of birth is included to account for selection into early childbearing, which is further associated with relative sociodemographic disadvantage in early life (Hobcraft & Kiernan, 2001). Maternal and paternal age are each included as categorical variable (*<20 years*,*20–30 years*, *>30 years*).

2.6 Empirical approach

In the first stage of the analysis, we will use a group-based dual trajectory model to jointly estimate contemporaneous trajectory groups of hospitalization related to psychopathology for children and their parents over a 30-year period (Nagin, 2005; Jones & Nagin, 2007). This analysis will be performed using the TRAJ package in Stata (version 17; StataCorp, 2021). The final models will be identified using an iterative process where we will first derive two- to *x*-trajectory solutions using four potential polynomial functions (intercept, linear, quadratic, and cubic). We will then employ both formal statistical criteria (Bayesian information criteria (BIC), Akaike information criterion (AIC), and entropy) alongside visual assessment to determine an optimal number of trajectory groups that are both accurate and meaningful (Nagin, 2010). We will first estimate univariate models for the children and their parents, respectively (Nagin & Tremblay, 2001). Next, we will estimate the probability of group membership in the joint model to assess the interrelationship between the parent and child outcomes across this 30-year period. These

linkages will be estimated by considering a) the probability of the trajectory group membership among the children, conditional on the parental trajectories, b) the probability of trajectory group membership among the parents, conditional on the children's trajectories, and c) the joint probabilities of trajectory group membership for both children and parents.

In the second stage of the analysis, we will use multinomial regression to estimate the probabilities associated with univariate and joint group membership as a function of childhood socioeconomic position, adjusting for child's sex, parental civil status, child's birth year, and maternal and paternal age at birth. As a second step, we will include sibling-level fixed effects to control for unobserved factors shared among siblings.

2.7 Effect heterogeneity

In the main analyses, we will estimate a collective parental trajectory; however, we also plan to estimate trajectories by parental sex to differentiate hospitalization occurrence for each biological parent. Moreover, we plan to conduct separate analyses by both parental and child's sex to account for homotypic (dis)continuity in patterns of psychopathology by sex. We will additionally consider homotypic and heterotypic (dis)continuity across generations by type of disorder. Here, we will estimate trajectories that separate hospitalizations for psychiatric disorders from those attributable to substance use. For these analyses, diagnoses that reflect psychiatric disorders and substance use will be exclusively included as substance use-attributable hospitalizations. Finally, since a shared environment can influence the transmission of mental and behavioral disorders between parents and children (e.g., Pitkänen et al., 2023), we will conduct a sensitivity analysis to compare differences between joint trajectories among parents and children who resided together for most of the child's upbringing (ages 0–17) and those who did not.

3. EXPECTED RESULTS

Among parents, we expect to find trajectories reflecting consistently low psychopathology, consistently high psychopathology, and variant psychopathology across the 30-year follow-up. Among offspring, we similarly expect to find a group with consistently low psychopathology, as well as groups suggesting early onset and late onset, respectively. We expect that the group with the highest probability of membership among both parents and offspring will be low psychopathology. For the joint trajectories, we expect to observe that the probability of membership in children's trajectories characterized by a higher risk of psychopathology will be conditional upon parental trajectories with higher psychopathology. One potentially novel finding would be observing joint trajectories with discordant timing of onset, e.g., that parental trajectories with a late peak of psychopathology will be conditional upon children's trajectories with an early or late onset. Such dynamic trajectories will help us empirically better understand the directionality of the effects between parent and offspring psychopathology and can spark theoretical considerations. Finally, we expect that families in a lower socioeconomic position may be a particularly vulnerable population, characterized by the accumulation of stressful life events over the life course that collectively affect the mental health of both parents and their offspring (Dannefer, 2003; Ben-Shlomo et al., 2014), and thereby contributing to the reproduction of inequalities. These results will help to further a disentangling of the reciprocal processes between parents and children that contribute to the intergenerational transmission of mental and behavioral disorders.

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