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Mapping trajectories of child and adolescent psychopathology: ascertainment of mental health needs in a general population

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Abstract

Aims. The development of psychopathology during childhood and adolescence is complex and likely to follow diverse patterns. Mapping trajectories of psychopathological difficulties may improve our understanding of the nature of emerging, resolving and persistent psychopathology. The purpose of this study is to examine trajectories of psychopathology throughout childhood and adolescence by examining multiple data sources, including questionnaire-based reports of emotional and behavioural difficulties, psychiatric diagnoses and prescribed psychotropic medications.

Methods. Group-based multi-trajectory modelling was used to identify the psychopathological trajectories. This study included 49,361 full-term live-born singleton children born between 1996 and 2003, recruited into the Danish National Birth Cohort. Strengths and Difficulties Questionnaire data were collected when the children/adolescents were 7, 11 and 18 years old. Annual information about psychiatric diagnoses and redeemed prescriptions for psychotropic medication was retrieved from nationwide registries between the ages of 1 and 18. We included six predefined dimensions to identify the trajectories: internalizing behavioural problems, externalizing behavioural problems, neurodevelopmental diagnoses, affective diagnoses, mixed psychiatric diagnoses and psychotropic medications.

Results. Six distinct trajectory groups were identified for both boys and girls. Approximately 6% of the boys and 8% of the girls receive the bulk of the psychiatric diagnoses and psychotropic medications. We found no support for 'pure' internalizing or externalizing patterns in any identified trajectory, as problems in one dimension often indicated the presence of problems in another dimension.

Conclusions. Our results demonstrate substantial psychiatric comorbidity and add new insights to the understanding of child and adolescent well-being and the complex patterns of developmental psychopathology.

Introduction

The development of psychopathology during childhood and adolescence is complex and may follow diverse patterns (Cicchetti and Rogosch, 2002; Dalsgaard *et al.*, 2020). Psychopathological continuity and discontinuity in developmental pathways are not fully understood, but it is well-established that early mental health problems are not specific and often overlap with different psychiatric diagnoses, also symptoms can change over time, leading to diagnostic crossover to other psychiatric diagnoses (Plana-Ripoll *et al.*, 2019; Watkeys *et al.*, 2024).

Children and adolescents often present with a variety of symptoms and could potentially fit into a number of diagnostic groups, presenting challenges in diagnostic formulation (Gillberg, 2010). Psychiatric disorders in childhood are often grouped into affective and neurodevelopmental disorders. Affective disorders include depression and anxiety, while neurodevelopmental disorders include attention-deficit/hyperactivity disorder (ADHD), autism and schizophrenia (American Psychiatric Association, 2013; Thapar *et al.*, 2017).

Some people may have more than one diagnosis from the same diagnostic group, while others may have diagnoses from different diagnostic groups at different points in time (Shevlin *et al.*, 2017). The overlap between affective and neurodevelopmental disorders aligns with evidence that different mental disorders share some common gene variants (Caspi *et al.*, 2014, 2020; Gandal *et al.*, 2018).

Much epidemiological research focusing on children's psychopathology has applied a cross-sectional approach to examining emotional and behavioural problems or psychiatric diagnoses (Caspi *et al.*, 2020; Dalsgaard *et al.*, 2020). A growing body of evidence suggests several possible factors contributing to psychopathology, especially during childhood and adolescence (Cicchetti and Rogosch, 2002; Plana-Ripoll *et al.*, 2019). Studies mapping the variety of developmental trajectories of childhood psychopathology can improve our understanding of emotional and behavioural difficulties and psychiatric diagnoses. Several well-conducted studies have examined trajectories of ADHD (Stepp *et al.*, 2012), anxiety (de Lijster *et al.*, 2019), depression symptoms (de Lijster *et al.*, 2019; Weavers *et al.*, 2021; Sørensen *et al.*, 2025), anti-social behaviour (Harold *et al.*, 2014) and internalizing and externalizing psychopathology (Reef *et al.*, 2011; Lancefield *et al.*, 2016). Some have even taken a broader perspective by including all psychiatric diagnoses in their analysis (Senior *et al.*, 2024; Watkeys *et al.*, 2025b). An important dimension to include is young people's use of medication, as a previous study has shown that more than 80% of all individuals receive some mental health treatment, including prescriptions, during their lifetime (Kessing *et al.*, 2023). Another study demonstrated that over 30% of youth were prescribed a psychotropic medication and 10% received multiple psychotropic medications (Watkeys *et al.*, 2025a). Psychotropic medication use may reflect an underlying psychiatric diagnosis, such as ADHD, that is not necessarily captured in public health registers, particularly when diagnoses are made in healthcare settings where reporting is not complete or systematic (Lauritsen *et al.*, 2010; Mors *et al.*, 2011; Madsen *et al.*, 2015). Without incorporating prescription data, these individuals may remain unaccounted for in research, potentially leading to biased or incomplete conclusions. To our knowledge, no single study so far has integrated psychiatric diagnoses, self-reported behavioural data and prescription information simultaneously within the same study population from early childhood to adolescence.

This study was motivated by the need to move beyond isolated data sources to better understand developmental trajectories by integrating symptoms, multiple and repeated diagnoses and medication use. We aimed to explore whether certain groups of children and adolescents with mental health challenges might be underrepresented or overlooked in formal healthcare systems, as well as to characterize groups with more complex and/or severe trajectories. Investigating these patterns could provide insights into gaps in clinical recognition and support the development of more nuanced approaches for early identification and intervention. This also acknowledges that some young people and their families may engage with alternative pathways to care. Understanding these psychopathological trajectories and associated symptoms requires large population-based studies capturing formal diagnoses, relevant symptoms and psychotropic medication use in childhood and adolescence. We aimed to examine how children's psychopathology develops by combining questionnaire-based emotional and behavioural reports, psychiatric diagnoses and psychotropic medication prescription data to identify meaningful trajectory groups in a large Danish population where hospital care is government-funded and medications partially reimbursed.

Methods

Study participants

Participants were drawn from the Danish National Birth Cohort (Olsen *et al.*, 2001; Strandberg-Larsen *et al.*, 2025) and linked with information from nationwide registers (Schmidt *et al.*, 2015; Pottegård *et al.*, 2016). The Danish National Birth Cohort is a nationwide cohort study of pregnant women and their offspring born in Denmark between 1996 and 2003. More than 96,000 mother–infant dyads were recruited to the Danish National Birth Cohort during their first antenatal care visit in general practice. For detailed information, visit www.dnbc.dk.

We included dyads where the pregnancy resulted in a live, full-term (>37 completed gestational weeks) singleton birth, and we excluded children diagnosed with major congenital anomalies, according to the EUROCAT guide, before the age of 1 year, diagnosed with conditions affecting the central nervous system before age 7, or with learning disabilities (Fig. 1 and Supplementary Table S1, available online). We included children with available data on emotional and behavioural difficulties from at least two out of three possible time points at 7, 11 and 18 years of age, regardless of the respondent. With this strategy, we maximized the sample size and ensured that we had sufficient data on emotional and behavioural problems to estimate the trajectory groups. Of the total sample, 22,179 (45%) children provided all 3 assessments and 27,182 provided 2 (55%).

Study measures

Data on emotional and behavioural difficulties, psychiatric diagnoses and prescribed psychotropic medications were used to identify psychopathological trajectories. Detailed definitions, scoring of measures and included dimensions are described below (Supplementary Table S2). Children who emigrated were labelled as missing in years when they were abroad for more than 6 months.

Emotional and behavioural difficulties

The Strengths and Difficulties Questionnaire (SDQ) assessed children's emotional and behavioural difficulties at ages 7, 11 and 18 (Goodman, 2001). SDQ is a screening tool designed to assess five areas of socio-emotional and behavioural development in children and adolescents: emotional symptoms, conduct problems, hyperactivity and inattention, peer relationship problems and prosocial behaviour. At 7 years, SDQs were completed by a parent; at age 11, by teachers, parents and/or self-report in prioritized order (Stone *et al.*, 2010), and at 18 years by self-report. We reduced data to two dimensions: the 10-item externalizing subscale combining the conduct and hyperactivity/inattention items, and the 10-item internalizing subscale based on the emotional symptoms and peer relationship items, each ranging from 0 to 20 (Supplementary Table S2) (Goodman *et al.*, 2010). We used the broader SDQ subscales since previous studies have emphasized the advantages of this division in low-risk samples (Goodman *et al.*, 2010).

Psychiatric diagnoses

The Danish health registries allowed the capture of psychiatric diagnoses from all inpatient admissions and outpatient contacts,

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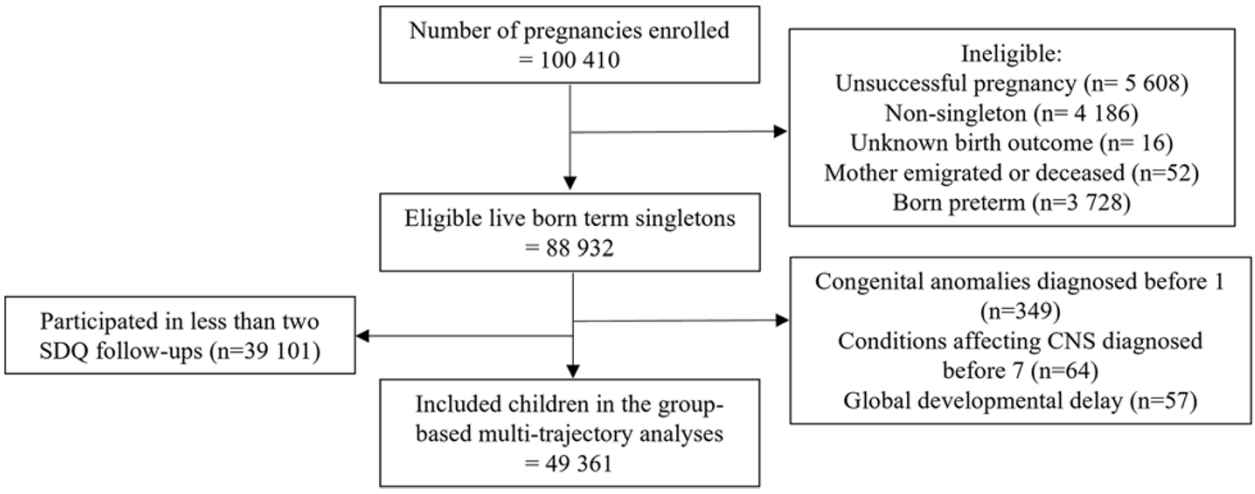

Figure 1. Flowchart illustrating selection of participants from the Danish National Birth Cohort.

including public/private psychiatric hospitals, somatic departments and emergency visits from age 1 to 18 years (Schmidt *et al.*, 2015). We included the main and all subsidiary diagnoses. We established the following three dimensions of psychiatric diagnoses: Neurodevelopmental diagnoses including autism, ADHD and schizophrenia spectrum disorders (ICD-10: F20–F29, F80–F83, F84, F88–F89, F90, F95 and F98.8) (Thapar *et al.*, 2017), affective diagnoses such as anxiety and depression (ICD-10: F30–39, F40–48 and F93) and mixed psychiatric diagnoses (ICD-10: F50, F51, F91, F94, F98.0–98.7, F98.9, F99 and F60–F69) (Supplementary Tables S2, S3 and S5). Children received one count for each unique diagnosis within any of these diagnostic groups per year of life. Psychiatric diagnoses registered before a child's first birthday were omitted due to potential unreliability.

Redeemed psychotropic medication

Diagnoses given by private practice specialists and general practices are not included in the National Patient Register (Mors *et al.*, 2011). To capture as many cases of psychopathology as possible (Mors *et al.*, 2011; Madsen *et al.*, 2015), we included redeemed prescriptions for psychotropic medications from The Danish National Prescription Registry (Pottegård *et al.*, 2016), both to capture children with more severe conditions receiving substantial medication and to identify milder cases, as psychotropic treatment for children and adolescents is initiated by psychiatrists but may subsequently be maintained by general practitioners (GPs), potentially resulting in ongoing treatment without repeated diagnostic registration. We generated yearly binary indicators from 1 to 18 years and grouped children with at least one redeemed prescription (psychostimulants, antidepressants, anxiolytics, antipsychotics and melatonin) (Supplementary Tables S2, S4 and S5).

A study protocol was uploaded to Open Science Framework before initiating any analyses: https://osf.io/3pwk5.

Statistical analyses

We used group-based multi-trajectory modelling (GBMTM) (Nagin *et al.*, 2018) to determine trajectories of psychopathological difficulties based on the multiple measurement outcomes: emotional and behavioural difficulties assessed by SDQ, psychiatric diagnoses and psychotropic medications. GBMTM is a latent class technique suitable for taking full advantage of multidimensional longitudinal data on various complementary markers of an underlying latent construct, e.g., the development of psychopathology measured for the same individual, to derive a data-driven description of the composite underlying construct. Participants were scheduled for the same time points (annual or questionnaire-based), but some observations were missing due to, e.g., non-response, which is accommodated within the GBMTM. Using GBMTM, we obtained the number of trajectory groups that best described our data, the trajectory for each group according to our predefined dimensions (internalizing and externalizing difficulties, psychiatric diagnoses and prescribed psychotropic medications, see Supplementary Table S2), and an estimate that describes the probability of each individual belonging to a specific trajectory group.

We identified trajectories separately for boys and girls because of differences in behaviour and psychiatric disorders between boys and girls (Dalsgaard *et al.*, 2020). Retention weights based on propensity scores were included when estimating the trajectories to minimize bias due to selective attrition (Supplementary Note S1). The propensity score was predicted from maternal psychiatric diagnosis, paternal psychiatric diagnosis, child psychiatric diagnoses, parity, maternal age, alcohol consumption during pregnancy, maternal smoking during pregnancy, maternal educational level, urban/rural residence and quantiles of household income. For covariates with missing data used in the propensity score calculation, missing values were assigned a separate category, since missingness, especially in questionnaire data, can be informative. Covariates were drawn from the Danish National Birth Cohort interviews, national registries or both.

We ran the GBMTM with up to six trajectory groups to determine the best-fitting model (Supplementary Tables S6 and S7). All dimensions were modelled using polynomials from linear to quartic (orders 1 to 4), except the SDQ, which had only three time points and was therefore limited to quadratic (order 2). Model selection was pursued in three steps: The best-fitting model was identified by comparing the Bayesian Information Criterion (BIC) of each model. We examined each model's substantive interest, i.e., whether or not each new group added distinct and meaningful information. Additionally, we verified the adequacy of the preferred model by examining the Average Posterior Probability of Assignment to the trajectories (APPA, >70%) and use of the Odds

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of Correct Classification (OCC, ≥5) (Nagin *et al.*, 2018). The model was developed on a random sample of 80% of the data and the performance was checked on the remaining 20%.

Analyses were conducted in SAS 9.4 using proc traj.

Results

In this study, psychopathological trajectories were examined by analysing data across childhood and adolescence for 23,361 boys and 26,000 girls in the GBMTM analysis.

Childhood psychopathological trajectories

The GBMTM analysis resulted in the selection of six distinct trajectory groups for both boys and girls. The BIC improved when adding groups (Supplementary Tables S6 and S7). We did not observe the emergence of very small groups (less than 2% of the included participants), and each added group appeared to make a distinct conceptual contribution.

The models met established cut-offs for model adequacy, with the APPA ranging between 0.75 to 0.94 for boys and 0.74 to 0.91 for girls, indicating that the model had good assignment accuracy and provided an adequate fit to the data. OCC ranged between 3.09 and 506.56 for the boys' model and between 4.13 and 449.48 for the girls' model with means of 131.5 and 116, respectively (Table 1).

We identified six distinct trajectories characterized by diagnostic patterns and the timing of psychopathology or its absence. For clarity and communication, we assigned descriptive labels to these trajectories, serving as practical references. The trajectory names and detailed descriptions are presented in Table 2. Only one of the trajectories differed substantially between boys and girls, requiring distinct labelling (Boys: 'Early Behavioural Difficulties', girls: 'Non-clinical Behavioural Difficulties'). The estimated trajectories for psychopathological difficulties during childhood and adolescence are presented in Table 2, Figures 2 and 3.

Around three out of four children (78.3% boys and 69.1% girls) belonged to the 'No Significant Problems' or the 'Minimal Difficulties' trajectories. The children belonging to the 'No Significant Problems' or the 'Minimal Difficulties' trajectories had very few emotional and behavioural difficulties and almost no diagnoses. Children belonging to the 'Adolescent-specific Psychopathology' or the 'Neurodiverse' trajectories received neurodevelopmental, affective and mixed diagnoses, so diagnoses from one dimension did not eliminate diagnoses from another dimension. Across ages, most trajectories showed similar trends in emotional and behavioural difficulties, i.e., we observed the same trend over time. Additionally, some of the trajectories had similar emotional and behavioural difficulties courses, e.g., the 'Neurodiverse' and 'Early Behavioural Difficulties' trajectories for the boys and the 'Neurodiverse' and 'Non-clinical Behavioural Difficulties' for girls, but with considerably different diagnostic and prescription patterns.

We observed substantial differences in the distribution of maternal age, education level, parental psychiatric diagnoses, symptoms of infant colic, marital status, alcohol consumption during pregnancy and size for gestational age between children with 'No Significant Problems' and children of all other trajectories (Supplementary Table S8). The children with 'No Significant Problems' were more likely to be born into a household with higher maternal age and education, as well as fewer psychiatric diagnoses. These children also displayed fewer signs of colic as infants and were not as often born small for gestational age. We observed small differences in the characteristics of two trajectories that showed similar emotional and behavioural patterns but did not receive psychiatric diagnoses and redeemed medication to the same extent: the 'Neurodiverse' trajectory to the 'Early Behavioural Difficulties' (for boys) or 'Non-clinical Behavioural Difficulties' (for girls) trajectory. These trajectories differed in that the children in the 'Neurodiverse' trajectory, in general, came from families who had higher rates of parental psychiatric disorders compared to the 'Early Behavioural Difficulties'/'Non-clinical Behavioural Difficulties'. In addition to potential socioeconomic inequalities, this may also reflect greater awareness and help-seeking among parents with psychiatric diagnoses, potentially contributing to earlier assessment and higher rates of diagnoses in this group.

Discussion

We identified six trajectories reflecting distinct developmental patterns of emotional and behavioural difficulties, psychiatric diagnoses and psychotropic medication use across childhood and adolescence characterized by different developmental patterns across

Table 1. Validation of chosen model: Group membership probabilities and OCC for 6 group-based latent trajectories of psychopathology in 49,361 participants from the Danish National Birth Cohort

	Boys		Girls	
Psychopathological trajectories	Average probability/posterior of group membership (%)	OCC	Average probability/posterior of group membership (%)	OCC
No Significant Problems	75	9.82	77	6.47
Minimal Difficulties	79	3.09	69	4.13
Neurotypical with Rising Behavioural Problems	75	27.30	74	14.30
Early Behavioural Difficulties/Non-clinical Behavioural Difficulties	80	72.92	79	55.95
Adolescent-specific Psychopathology	86	169.37	91	164.22
Neurodiverse	94	506.56	91	449.48

Average probability/posterior of group membership (i.e., the probability that a specific participant belongs to the trajectory group) greater than 70% and OCC greater than 5 represents a good model fit.

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Table 2. Labels, characteristics and percentages of the six trajectory groups

Trajectory label	Boys	Girls
1. No Significant Problems	Includes boys persistently displaying both low internalizing and externalizing problem scores and receiving no diagnoses or prescriptions **Proportion: 23.4%**	Includes girls scoring lowest on internalizing and externalizing problem scores, receiving no diagnoses and no medicines **Proportion: 34.1%**
2. Minimal Difficulties	This trajectory has low scores on internalizing and externalizing problem scores at all follow-ups. A very small number received psychiatric diagnoses in pre-adolescence **Proportion: 54.9%**	This trajectory scores low on internalizing and externalizing problem scores at all time points. These girls receive almost no diagnoses or prescriptions apart from a tiny number of affective diagnoses and mixed diagnoses in their late teenage years **Proportion: 35%**
3. Neurotypical with Rising Behavioural Problems	This trajectory exhibits slowly rising internalizing and externalizing problem scores with age. Receives a negligible number of prescriptions late in the teenage years, but no psychiatric diagnoses **Proportion: 9.9%**	This trajectory displays low internalizing and externalizing problem scores at the 7 and 11 years follow-up, followed by a rapid increase in scores at 18 years. This trajectory does not receive any psychiatric diagnoses beyond very few mixed diagnoses in the very late teens. Some had medicine prescriptions in their second year of life, but the total annual rate was extremely low **Proportion:16.6%**
4. Early Behavioural Difficulties	This trajectory of boys has high behavioural problem scores, especially the internalizing problem score, and scores decrease slightly through adolescence. They receive some neurodevelopmental and mixed diagnoses but the boys in this trajectory are diagnosed with few affective disorders and do not receive prescriptions **Proportion: 5.2%**	-
4. Non-clinical Behavioural Difficulties	-	This trajectory of girls scores high on internalizing and externalizing problem scales in childhood and adolescence, but did not receive any registered diagnoses. It cannot be concluded whether a clinical threshold is met, or whether psychiatric treatment has simply not been accessed **Proportion: 6.3%**
5. Adolescent-specific Psychopathology	This trajectory displays slowly rising internalizing problem scores and fairly steady externalizing problem scores. This trajectory receives diagnoses around adolescent onset in all three diagnostic dimensions, and medicine prescriptions late in childhood/adolescence. This trajectory has the highest proportion of affective disorders **Proportion: 5.8%**	This trajectory displays low internalizing and externalizing problem scores in childhood (at 7 and 11 years), but subsequently their problem scores increase considerably up to 18 years and end high. This trajectory did not receive any diagnoses until pre-adolescence, when they received the greatest number of affective disorders and mixed diagnoses. The girls in this trajectory receive the second greatest number of neurodevelopmental disorders and prescriptions in late adolescence **Proportion: 3.5%**
6. Neurodiverse	This trajectory experiences difficulties across all included dimensions except affective disorders. The children have high internalizing and externalizing problem scores, receive the highest portion of neurodevelopmental diagnoses and have the highest number of medicine prescriptions across childhood and adolescence. This trajectory also receives some mixed diagnoses in middle childhood, but few affective disorder diagnoses **Proportion: 2.2%**	This trajectory scores persistently high on internalizing and externalizing problem scales. Members of this trajectory receive the greatest and increasing number of neurodevelopmental diagnoses throughout adolescence. Prescriptions start in early childhood and increase throughout adolescence. They also receive affective disorders and mixed diagnoses predominantly in adolescence **Proportion: 3%**

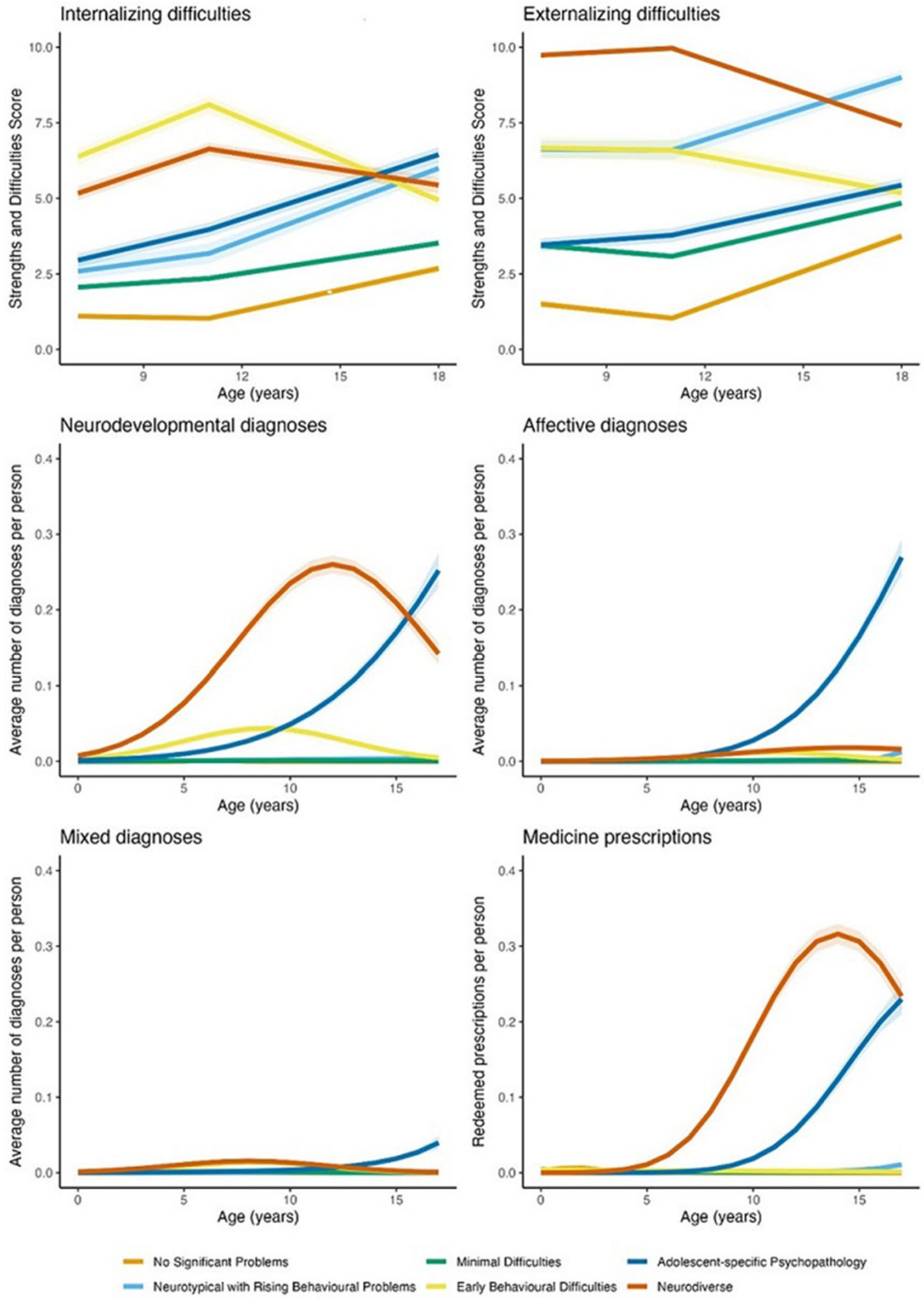

Figure 2. Boys' psychopathological trajectories in the Danish National Birth Cohort based on reported emotional and behavioural problems (SDQ) and register information on psychiatric diagnoses and psychotropic medication prescriptions obtained from a sample of 23 361.

childhood and adolescence. Differences between trajectories were apparent from early childhood and became more pronounced over time. We observed that a small group of children, 6% of boys and 8% of girls ('Adolescent-specific Psychopathology' and 'Neurodiverse'), had the highest burden of registered psychiatric diagnoses and psychotropic medication use over time. Although

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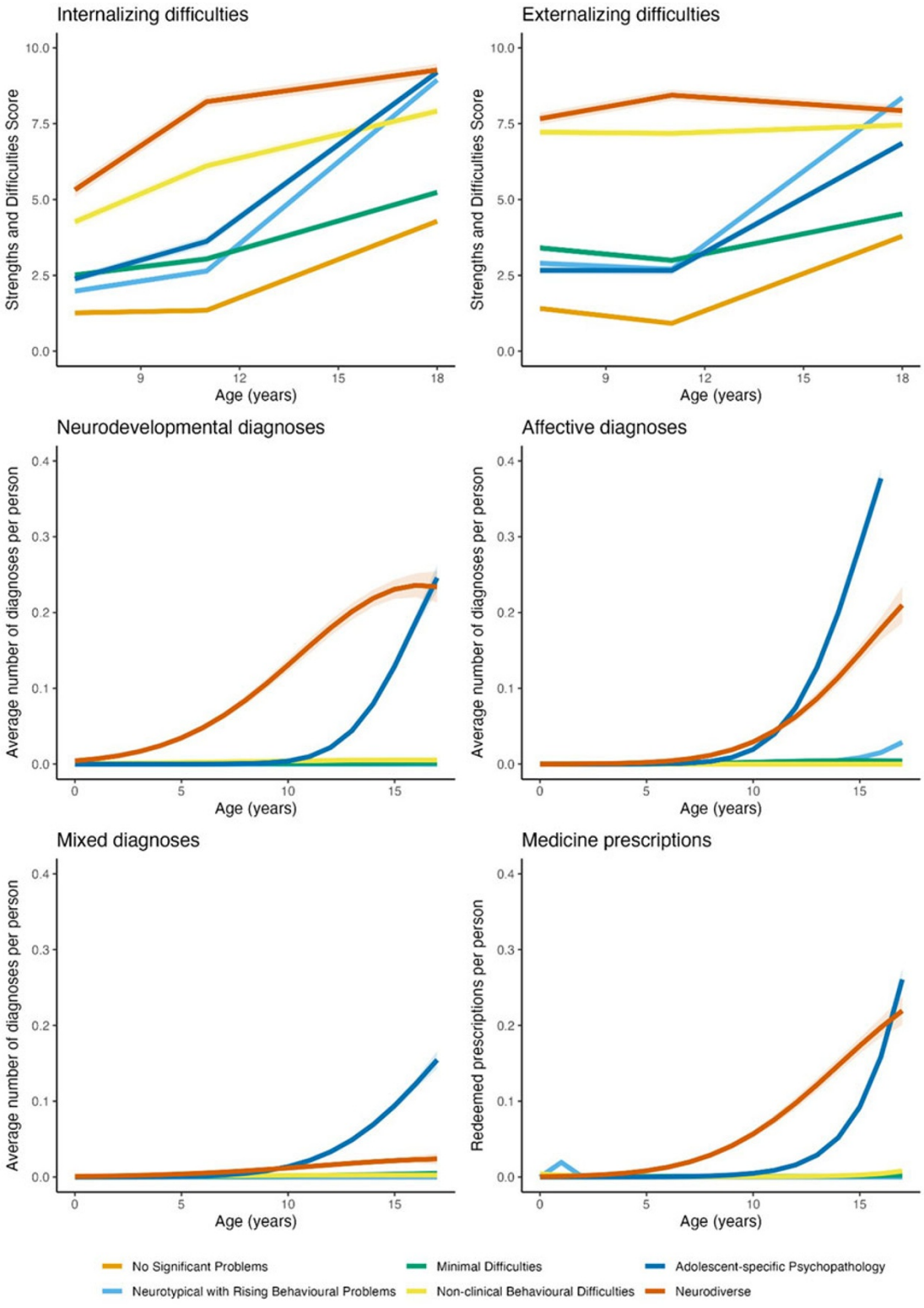

Figure 3. Girls' psychopathological trajectories in the Danish National Birth Cohort based on reported emotional and behavioural problems (SDQ) and register information on psychiatric diagnoses and psychotropic medication prescriptions obtained from a sample of 26 000.

several trajectories showed elevated emotional and behavioural difficulties, these two groups were primarily distinguished by sustained contact with psychiatric treatment rather than high SDQ scores alone. This is a key strength of the study, as trajectories were identified using both symptom questionnaires and registry data, extending beyond approaches based solely on self- or

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parent-reported measures (Reef *et al.*, 2011; Stepp *et al.*, 2012; Harold *et al.*, 2014; Lancefield *et al.*, 2016; de Lijster *et al.*, 2019; Weavers *et al.*, 2021). Two trajectories showed substantial difficulties without any contact with psychiatric healthcare services, as indicated by the absence of diagnoses or prescribed medication, characterized either by emotional and behavioural difficulties from early childhood or by rising emotional and behavioural problems in adolescence. It remains unclear whether these trajectories reflect sub-diagnostic levels of difficulties or unmet needs among children not identified by services.

We observed various combinations of diagnostic patterns and timing across trajectories. Rather than showing clear evidence of heterotypic continuity, our findings indicate increasing comorbidity over time: difficulties in one domain tended to co-occur with difficulties in other domains within trajectories characterized by adverse psychopathology. For instance, neurodevelopmental diagnoses generally stabilized over time, as shown by others (Solmi *et al.*, 2021), whereas affective and mixed diagnoses increased with age, especially in the 'Neurodiverse' trajectory. This pattern aligns with previous studies reporting high levels of psychiatric comorbidity across development (Plana-Ripoll *et al.*, 2019; Caspi *et al.*, 2020; Watkeys *et al.*, 2024, 2025b; Krantz *et al.*, 2025).

We observed that emotional and behavioural difficulties measured on the SDQ may be present without a (registered) associated diagnosis or psychotropic medication. This supports the view that the population burden of mental health problems in children and adolescents substantially exceeds the proportion who receive a formal psychiatric diagnosis through public services, highlighting a 'hidden' group who may manage difficulties outside the public psychiatric system, either intentionally or unintentionally, in line with previous work (McGorry *et al.*, 2024).

We initially aimed to categorize diagnoses into externalizing and internalizing groups, reflecting the SDQ subscales. However, to ensure greater clinical translation, and following clinician advice, we chose to use the grouping of neurodevelopmental and affective disorders instead. While we recognize that externalizing disorders, such as conduct and oppositional behaviours, are widely acknowledged as important in characterizing childhood psychopathology and its progression (Speranza *et al.*, 2023; Watkeys *et al.*, 2025b), we prioritized a classification that better aligns with clinical diagnostic practices. This decision reflects a practical focus, though we acknowledge that other studies have taken alternative approaches.

Up to 13% (15% in Denmark (Dalsgaard *et al.*, 2020)) of all children and adolescents are diagnosed with at least one mental disorder before reaching 18 years of age (Polanczyk *et al.*, 2015) and with evident trends across period and birth cohorts (Momen *et al.*, 2025). In our study, we were able to identify approximately half of this group, around 6% of boys and 8% of girls, who had multiple and persistent mental health problems throughout childhood and adolescence. This distinction highlights that our study focuses on those with more consistent and diverse mental health difficulties rather than all individuals who have ever received a diagnosis.

Previous studies show that the DNBC under-represents individuals with lower socioeconomic status and childhood psychiatric diagnoses, while loss to follow-up further reduces the sample (Jacobsen *et al.*, 2010; Howe *et al.*, 2016; Madsen *et al.*, 2020). As the participants are generally healthier and more advantaged, the findings may have limited generalizability to under-represented groups. We applied weighting (i.e., cloning) to minimize this issue (Petersen *et al.*, 2024)

The trajectories for boys and girls were generally comparable with a few exceptions: We found a male trajectory ('Early Behavioural Difficulties'), which received neurodevelopmental and mixed diagnoses in pre-adolescence accompanied by high levels of emotional and behavioural difficulties. Both their emotional and behavioural difficulties scores and the number of diagnoses decreased in mid-childhood. The closest parallel female trajectory ('Non-clinical Behavioural Problems') has persistently high emotional and behavioural problem scores, but no psychiatric diagnoses. This suggests that a male trajectory exists with possible transient mental health problems, with no parallel female trajectory. In contrast, the 'Neurodiverse' trajectory shows a very different prescription pattern between girls and boys, with boys' prescriptions peaking and falling around age 14, whereas girls' prescriptions continue to rise, accompanied by a rise in affective diagnoses only observed in girls at this age.

Irritability or emotional dysregulation are features of affective disorders in children and adolescents, perhaps linked with unrecognized neurodevelopmental diagnoses (Eyre *et al.*, 2019). This aligns with the increase in affective disorders we observe from pre-adolescence among girls in the 'Neurodiverse' trajectory. Difficulties related to an underlying psychiatric condition may also explain the delayed onset of affective disorders, often co-occurring with neurodevelopmental diagnoses in boys belonging to the 'Adolescent-specific psychopathology' trajectory. The identified trajectories likewise concur with previous longitudinal studies showing that the peak age of diagnosis of neurodevelopmental disorders is earlier among boys than girls, and that affective diagnoses are more common and diagnosed later among girls compared to boys (Dalsgaard *et al.*, 2020). Children in the 'Neurodiverse' trajectory received most of the diagnoses and psychotropic prescriptions. This trajectory was also the one with the highest proportion of parents with a registered psychiatric diagnosis. Social inequality and mental health are strongly associated (Fryers *et al.*, 2003), so it was not surprising that we found that the parents of children in the 'Neurodiverse' trajectory had the lowest educational level and more often lived without a partner. It was, however, unexpected to find two trajectories with similarly increased emotional and behavioural problem scores (Early Behavioural Problems and Neurodiverse for boys/Non-clinical Behavioural Problems and Neurodiverse for girls), but with only one of them receiving psychiatric diagnoses and redeeming psychotropic medication prescriptions. While the overall differences between these two trajectories are small, children who receive a diagnosis are more likely to have parents with psychiatric diagnoses. These patterns could be explored in more detail by sex to determine whether clearer differences emerge.

The identification of the trajectories is dependent on the way diagnoses are registered in datasets. Children's psychiatric diagnoses are only traceable in our data through hospital contacts. Although research suggests that most individuals with ADHD do not fully recover from the condition (Ismail and Shapiro, 2019), we can only track the psychiatric diagnoses of children and adolescents as long as they received some kind of management in a hospital setting. However, this does not necessarily mean that their psychiatric conditions have resolved. The trajectories are also a product of our categorization of each diagnosis and the dimensions required to perform the group-based multi-trajectory model.

Our study has some major strengths: The modelling of trajectories from infancy to late adolescence was based on a unique combination of questionnaire-based reporting of emotional and behavioural difficulties, clinically registered psychiatric diagnoses

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and prescriptions in an exceptionally large cohort. Linking our cohort data to register data enabled us to weight our GBMTM analyses, thereby limiting bias due to the inevitable selective attrition.

This study also has some limitations. We have given an overview of how both diagnosed neurodevelopmental, affective and mixed diagnoses develop during childhood and adolescence, so trajectories of specific psychiatric diagnoses, such as autism, or small variations within dimensions would not be clear from our study. The limit of six dimensions precluded us from including SDQ prosocial scale scores as well as specific psychotropic medications. SDQ reports came from different informants over time, which was not accounted for in the analysis. Ideally, data from multiple respondents at each time point would have been used (Bergström and Baviskar, 2021), although this was not feasible. Likewise, we were unable to account directly for changes in diagnostic and prescription patterns during the examined period caused, for example, by overall rates of psychotropic medication use among individuals with autism spectrum disorder increasing over time (Rasmussen *et al.*, 2018). Furthermore, psychiatric diagnoses from private practice psychiatrists and GPs were not included in our data (Mors *et al.*, 2011; Madsen *et al.*, 2015); thus, our outcome measure will capture the more severe cases of psychopathology. This might exclude some children with mild symptoms treated by GPs without a registered diagnosis or children treated elsewhere, which may affect the external validity of our results. Before 2012, GPs could prescribe these medications independently, but subsequently, psychiatrists in Denmark were required to initiate treatment for those under 18 (The Ministry of the Interior and Health, Denmark, 2012). We included children diagnosed by private psychiatrists who were prescribed psychotropic medication by including data on psychotropic prescriptions; however, only allowing one annual count could have impacted our findings.

Our findings demonstrate that 6–8% of children/adolescents have substantial persistent mental health difficulties and utilize mental health services. Two of the trajectories experience similar emotional and behavioural difficulties, but children in only one of these trajectories receive psychiatric treatment, specifically those who are characterized by a higher burden of recorded familial psychiatric diagnoses. Future studies should extend our work by examining how the trajectories are associated with general well-being, mental health, educational attainment and social status later in life. Factors associated with resilience to adverse outcomes could also be examined. Finally, research that aims to find early predictors of the membership of different trajectories is desirable to identify children at risk of mental health problems at an early stage.

Supplementary material. The supplementary material for this article can be found at https://doi.org/10.1017/S2045796026100596.

Availability of data and materials. This study is based on data from the Danish National Birth Cohort. Researchers can apply for the use of these data at http://www.dnbc.dk. The data analysis was performed using SAS 9.4 using proc traj. The code utilized in this study corresponds to the code provided in the proc traj statement. It has been sourced from the official public repository, accessible at https://www.andrew.cmu.edu/user/bjones/index.htm, ensuring fidelity to the original methodology and implementation. Figures were created in R.

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Competing interests. There are no competing interests to declare.

Ethical standards. The Committee on Biomedical Research Ethics approved the DNBC, and all women who participated in the study gave informed written consent. The participants born into DNBC were informed about their participation, rights and how to drop out when turning 18 years old. This study was approved by the DNBC steering committee (ref. 2020-06).

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