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## Time trends in the incidence of diagnosed depression among people aged 5–25 years living in Finland 1995–2012

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### ABSTRACT

**Background:** Knowledge of time trends for depression is important for disease prevention and health-care planning. Only a few studies have addressed these questions regarding the incidence and cumulative incidence of diagnosed depression from childhood to early adulthood and findings have been inconclusive.

**Aim:** The aim of this national register-based Finnish study was to report the time trends of the age-specific and gender-specific incidence and cumulative incidence of diagnosed depression.

**Methods:** The study sample included all 1,245,502 singletons born in Finland between 1 January 1987 and 31 December 2007 and still living in Finland at the end of 2012. The participants were divided into three cohorts by birth year: 1987–1993, 1994–2000 and 2001–2007. Depression diagnoses (ICD-9: 2961; ICD-10: F32, F33) given in 1995–2012 were available and identified from the Care Register for Health Care.

**Results:** Ten percent of the females and five percent of the males were diagnosed with depression in specialized services by age 25 years. The cumulative incidence of depression by age 15 years rose from 1.8% (95% CI 1.8–1.9) to 2.9% (95% CI 2.8–3.0) in females and from 1.0% (95% CI 1.1–1.2) to 1.6% (95% CI 1.6–1.7) in males when the cohorts born 1987–1993 and 1994–2000 were compared.

**Conclusions:** A larger proportion of young people in Finland are diagnosed with depression in specialized services than before. This can be due to better identification, more positive attitudes to mental health problems and increased availability of the services.

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Incidence; depression; time trends; young people; register-based study

## Introduction


Depression is a leading cause of disability worldwide [1] and early diagnosis and treatment are essential to reduce the global burden of depression [2]. Community-based studies have reported a wide variability in the lifetime prevalence of depression from 4% to 45% [3]. Depression is relatively rare during childhood and the incidence increases after puberty [4], but depression during childhood and adolescence carries a high risk of recurrence [5,6]. The number of young persons with diagnosed depression who have used mental health services in the past 20 years has risen [7,8]. However, the number of studies on temporal changes in the incidence of diagnosed depression in this age group is small, but this information is important for planning of mental health services.

The few available studies in this research area have reported inconsistent findings. In a large UK study, based on primary care diagnoses of depression, the incidence per 1000 person-years among subjects aged 3–18 years were 2.2, 3.0 and 2.0 in 1995, 2002 and 2005, respectively [9]. There have been two

register-based time-trend studies on the incidence or cumulative incidence of diagnosed depression in childhood and adolescence in the Nordic countries, one in Denmark and one in Finland [10,11]. The Finnish register-based study focused on birth cohorts born in 1987 and 1997 and it reported that the cumulative incidence of diagnosed unipolar depression and unspecified affective disorders increased during adolescence [11]. However, only diagnoses after the age of 12 years were considered. The Danish study, using a broad definition of depression that included dysthymia, investigated children and adults aged 4–29 years from 1995 to 2010 and reported 6.7–7.5% annual, age-related increase in the incidence of diagnosed depression [10]. These studies highlight the fact that the definitions of depression varied across studies and that gender differences have not been studied by age groups.

As the proportion of children with depression is similar in boys and girls before puberty [12], but is higher in females after puberty [13–16], there is a need for gender specific studies of diagnosed depression. The main objective of this

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study was to report the incidence and cumulative incidence of diagnosed depression among males and females aged 5–25 years. We did this by breaking the subjects down into three birth cohorts between the years 1987 and 2007. Given the differences in how depression has been defined in previous studies [9–11], we also report the numbers of cases by different definitions of depression.

## Materials and methods

This study is based on data from the Finnish Prenatal Study of Depression (FIPS-D) and consists of all live singleton children born in Finland between 1 January 1987 and 31 December 2007 and living in Finland at the end of 2012. FIPS-D is a national nested case-control study; for this article, we used only cases. The information on any depressive disorder, i.e. depressive episode or recurrent depression (ICD-10: F32, F33; ICD-9: 2961), in the study sample was obtained from the Care Register for Health Care. To be able to study the time trends in the incidence and cumulative incidence of diagnosed depression, we divided the original study sample into three cohorts by birth year: 1987–1993, 1994–2000 and 2001–2007.

### National registers

The Care Register, which was used to identify the cases, has been computerized since 1969 and covers information from all inpatient wards in somatic and psychiatric hospitals, local health care centers, private and prison hospitals and military wards. Since 1998, it has also covered outpatient care in public hospitals [17].

The Population Register contains basic information about Finnish-born citizens and foreign citizens residing permanently in Finland and the data it provides includes their address and citizenship.

The Birth Register was established in 1987 and includes comprehensive standardized data on the perinatal and prenatal period and for neonates up to 7 d of age who are born alive or stillborn. This Register has good coverage and has been described in detail [17–19]. The information on maternal socio-economic status (SES) was obtained from this Register.

Demographic variables were obtained from Statistics Finland, which was founded in 1965. It is a public authority that produces official statistics for the country. The information in all the national registers is linked by the personal identification number given to every resident at the time of birth or immigration to Finland.

### Depression

The cases of depression were drawn from the nationwide Finnish Prenatal Study on Depression (FIPS-D). The subjects in this study sample were diagnosed with depressive episode or recurrent depression according to the ninth and tenth versions of the International Classification of Diseases (ICD-9 and ICD-10), ICD-9 code 2961 and ICD-10 codes F32.0–F32.9

Table 1. Diagnoses of depression by gender.

Diagnosis	Total, N (%)	Females, N (%)	Males, N (%)
Any depression <sup>a</sup>			
At least one visit	37,682 (100.0)	24,691 (100.0)	12,991 (100.0)
Two visits or more	29,601 (78.6)	19,958 (80.8)	9643 (74.2)
Moderate or severe depression <sup>b</sup>			
At least one visit	24,512 (65.1)	16,640 (67.4)	7872 (60.6)
Two visits or more	19,056 (50.6)	13,235 (53.6)	5821 (44.8)
Depression with psychotic features <sup>c</sup>			
At least one visit	2579 (6.8)	1742 (7.1)	837 (6.4)
Two visits or more	1609 (4.3)	1112 (4.5)	497 (3.8)

<sup>a</sup>ICD-9:2961, ICD 10: F32.X, F33.X.

<sup>b</sup>ICD-9: 2961 C-E, ICD-10: F32.1-F32.3, F33.1-F33.3.

<sup>c</sup>ICD-9: 2961E, 2968 A, ICD-10: F32.3, F33.3.

and F33.0–F33.9. We also examined a number of subjects with moderate depression, severe depression and depression with psychotic features. The ICD codes used in this study are shown in Table 1. We excluded cases who had severe and profound mental disabilities (ICD-9 codes: 3181, 3182; ICD-10 codes: F72, F73), together with multiple births twins and those diagnosed with depression before age five years.

### Demographic variables

The maternal SES was obtained from the Birth Register. SES was defined as upper-white collar worker, lower white-collar worker, blue-collar worker and other, following the national Finnish classification on occupations and socio-economic groups [20,21]. Upper white-collar workers include experts and managers, lower white-collar workers include clerical workers, blue-collar workers include manual workers and other entrepreneurs, students, people who are unemployed and housewives and househusbands. If the SES category was missing, it was classified according to the mother's educational level in line with the previous FIPS study [22]. For example, a mother with a university degree was categorized as an upper white-collar worker and one with a vocational degree was categorized as a lower white-collar worker. The place of birth was obtained from the Population Register and defined as urban, semi-urban or rural, according to the classification of Statistics Finland [23]. The region of birth was defined as Southern, Eastern, Northern or Western Finland. Data on date of birth, death and emigration (if applicable) were obtained from Statistics Finland.

### Statistical analyses

Two separate analyses were performed to estimate the incidence and cumulative incidence of diagnosed depression. The denominator, or the population at risk, in both analyses was the Finland-born population who was born alive and living in Finland at the end of 2012.

The outcome was the incidence of depression from age 5 years, with the maximum age ranging between the three cohorts, based on the end of follow-up in 2012. The original FIPS-D study sample was split into three cohorts by birth year: 1987–1993 (participants aged 19–25 years at the end of

follow-up), 1994–2000 (aged 12–18 years) and 2001–2007 (aged 5–11 years).

First, the cumulative incidence was calculated separately for males and females, by adding the number of newly diagnosed depression cases per 100 persons at risk for the 1987–1993 cohort, from the age of 5 to 25. The same was done for the 1994–2000 and 2001–2007 cohorts using the maximum ages 18 and 11 years, respectively. Time-to-event analyses were performed to estimate the 95% confidence intervals (95% CI) of the cumulative incidence.

Second, the yearly incidence of diagnosed depression per 100 persons at risk was estimated for males and females in the three cohorts using the same years and age ranges. In this analysis, the numerator for the incidence was calculated as the annual number of newly diagnosed depression cases in the three cohorts. The statistical analysis was performed using the SAS software version 9.4 (SAS Inc., Cary, NC).

## Results

### Characteristics of study population

The sample population of this study comprised 1,240,062 persons. There were 37,682 individuals with a depression diagnosis who had visited mental health care services at least once. Altogether 29,601 (78.6%) of them had made two or more visits (Table 1). As shown in Table 1, 65.1% had moderate or severe depression and 6.8% had depression with psychotic features.

Table 2 shows that the majority of cases diagnosed with depression were females (65.5%), born in families with mothers who were lower white-collar worker (63.5%), living in Southern Finland (45.9%) and in urban areas (55.8%).

### Cumulative incidence of diagnosed depression by gender

Figure 1 shows the cumulative incidences of diagnosed depression for males (Figure 1(A)) and females (Figure 1(B)) by the birth years 1987–1993, 1994–2000 and 2001–2007. Only the first cohort was followed up until the age of

25 years, the other cohorts to 18 and 11 years. Judging from the first cohort, the cumulative incidence of depression was 5.5% (95% CI 5.4–5.7) among males and 10.4% (95% CI 10.3–10.6) among females. The cumulative incidence by age 15 years in the 1987–1993 cohort was 1.0% (95% CI 1.1–1.2) and it increased in the 1994–2000 cohort to 1.6% (95% CI 1.6–1.7) among males and from 1.8% (95% CI 1.8–1.9) to 2.9% (95% CI 2.8–3.0) among females.

We were able to compare the age of 10 years in all three cohorts. The cumulative incidence among females was 0.1% (95% CI 0.1–0.1) and it was the same in all three cohorts. Among males, the corresponding figures were 0.2% (95% CI 0.2–0.2), 0.4% (95% CI 0.4–0.4) and 0.3% (95% CI 0.3–0.4).

### Incidence of diagnosed depression by gender and age

To examine the age-specific changes in the incidence of diagnosed depression, we further analyzed the yearly incidence by gender and age group (Figure 2). Among males, the incidence increased steadily over the age span 8–20 years (Figure 2(A)), but among females, it increased rapidly at age 11–12 to 15–16 years (Figure 2(B)). After this, the incidence remained relatively stable among males, but decreased among females. It is interesting to note that the peak incidence occurred at age 16 years among females born 1987–1993 but at 15 years among females born in 1994–2000.

In an additional analysis, the incidence of diagnosed depression in the age groups 5–12, 13–18 and 19–25 years was analyzed. For example, in 2012 the incidence was 0.2% for both genders at age 5–12 years, 0.8% at age 13–18 years and 0.6% at age 19–25 years (Supplementary Table 1).

## Discussion

A major finding of this study was that 10% of the females and 5% of the males were diagnosed with depression in specialized services by the age of 25 years. Interestingly, when we compared those born in 1987–1993 with those born in 1994–2000, the incidence by age 15 years increased from 1.0% to 1.6% in males and from 1.8% to 2.9% in females. The peak age when females were diagnosed with depression was earlier in the 1994–2000 cohort than in the 1987–1993 cohort (15 and 16 years, respectively).

The increase in the cumulative incidence and incidence of diagnosed depression over time during childhood and adolescence is in line with earlier studies [10,11]. However, we also recorded a slight decrease in incidence rates after the age of 16 years among females. Interestingly, a 1995–2009 UK study on children and adolescents aged 3–18 years reported increases as well as decreases in the incidence rates of diagnosed depression in this group over time. The authors speculated that the decrease could have been explained by changes in diagnostic practices [9]. In our study, the increase in the incidence of diagnosed depression was more pronounced than the decrease, and this requires further examination. Possible explanations for the increase in the number of children and adolescents diagnosed with depression

Table 2. Descriptive characteristics of the cases.

	Males, N (%)	Females, N (%)	p Value
Maternal socio-economic status			.023
Upper white-collar workers	891 (6.9)	1714 (6.9)	
Lower white-collar workers	3178 (24.5)	6266 (25.4)	
Blue-collar workers	1699 (13.1)	3165 (12.8)	
Other <sup>a</sup>	1508 (11.6)	2645 (10.7)	
Missing	5715 (44.0)	10,901 (44.1)	
Region of birth			.002
Southern Finland	6041 (46.5)	11,251 (45.6)	
Western Finland	3684 (28.4)	7218 (29.2)	
Northern Finland	1622 (12.5)	2942 (11.9)	
Eastern Finland	1644 (12.7)	3279 (13.3)	
Missing	0 (0.0)	1 (0.0)	
Place of birth			.033
Urban	8384 (64.5)	15,531 (62.9)	
Semi-urban	2065 (15.9)	4012 (16.2)	
Rural	2452 (18.9)	5013 (20.3)	
Missing	90 (0.7)	135 (0.5)	

<sup>a</sup>Students, pensioners, unemployed, small business entrepreneurs, housewives and househusbands.

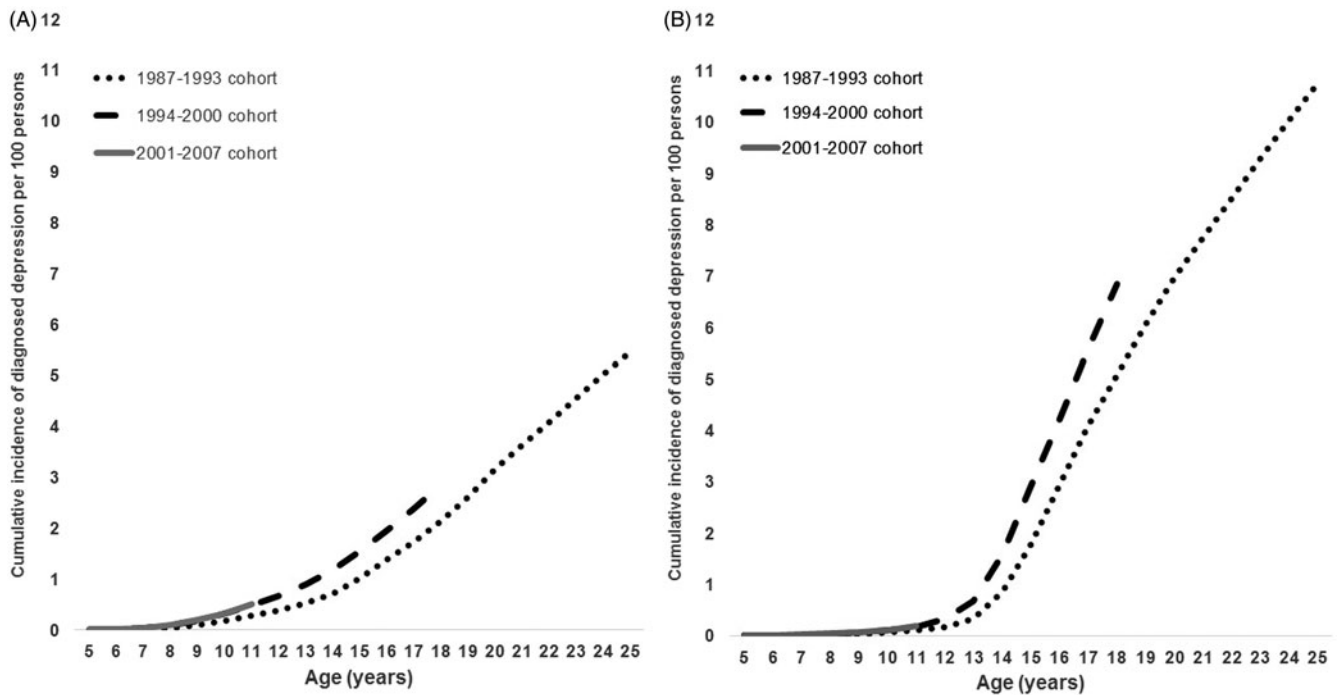


Figure 1. Cumulative incidence of diagnosed depression per 100 by gender. (A) Males; (B) Females.

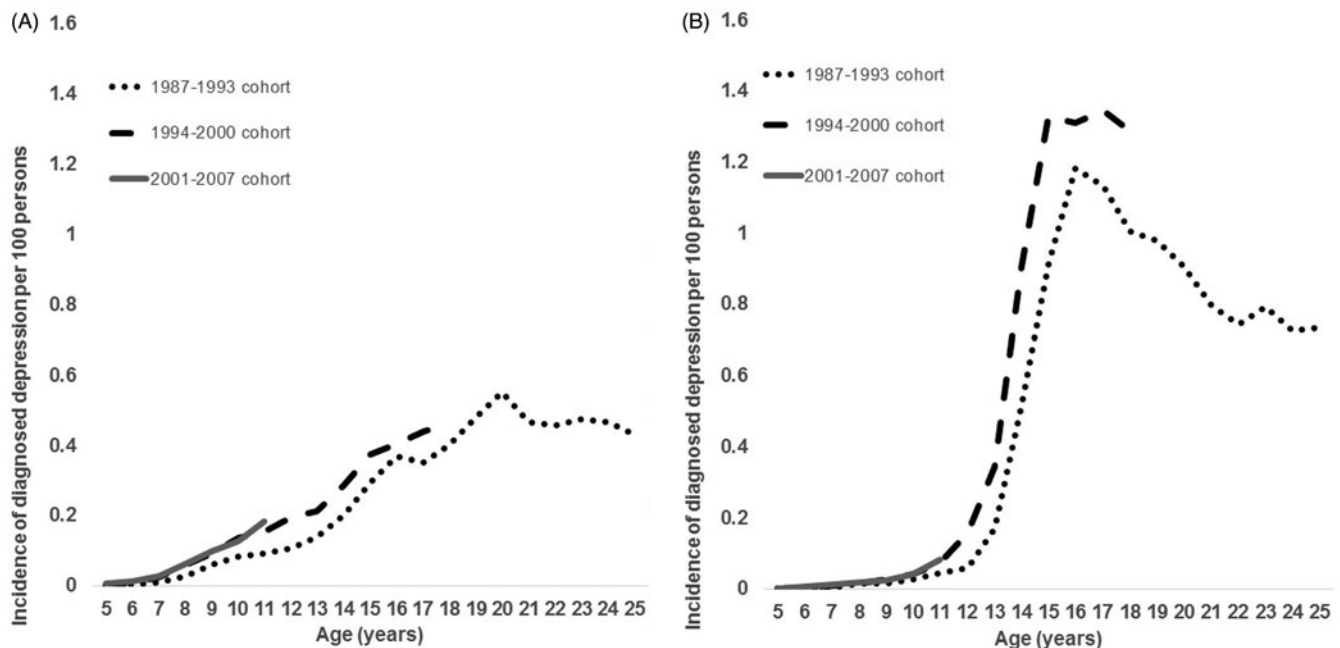


Figure 2. Incidence of diagnosed depression per 100 by gender. (A) Males; (B) Females.

include changes in depressive symptoms, awareness and stigma of depression, demands on the psychosocial surroundings and the health service system.

Finnish studies on persons aged 8–16 years have reported an increase in emotional problems among both girls as a whole and among female adolescents in particular; incidence changes among males were less pronounced [24–26]. However, these studies were based on questionnaires, which mean that conclusions about diagnosed depression in specialized services cannot be drawn. Thus, factors related to changes in the service system need to be considered. For instance, outpatient visits to child psychiatric services almost

tripled, and the number of inpatients in adolescent psychiatric care almost quadrupled in Finland between 1994 and 2008 [27]. Similar service use trends have been observed in many countries for various disorders [7,8,28,29]. It has also been suggested that the increased use of services might be due to better recognition of psychiatric problems and reduced stigma related to mental health [10,28,30].

Changes in depressive symptoms, increased help-seeking patterns and the incidence of diagnosed depression could have been affected by environmental changes among children and adolescents over the time period 1995–2012. Such environmental variables may include changes in emotional

factors, including increased peer victimization [31], school burnout [32,33] and fear of loneliness and relationships [30]. In addition, there have been changes in background factors, such as reduced sleep time [34], increased occurrence of parental depression [35] and increasing social inequalities [24,36]. Moreover, secular trends toward earlier onset of puberty, both in males and females, can be attributed to earlier identification of depression [37].

While the focus of this study was time trends in diagnosed depression, we also examined the proportion of subjects diagnosed with depression in the total population by analyzing cumulative incidences. For example, by age 20 years the cumulative incidence of diagnosed depression was 7% in females and 3% in males. These figures are considerably higher than the ones in a Danish register-based study that used the same definition of depression—the reported rates were 3% among females and 1% among males [38]. When we compared the yearly incidence of diagnosed depression in Finland and Denmark, we noted similar differences in our data and the incidence rates in our study were higher among all age groups (5–12, 13–18 and 19–25 years). This contrasts to the results of the interview-based New Zealand Dunedin cohort study of adolescents aged 11–19 years, which reported that the annual incidence of depression in the community was 7% in males and 15% in females [14]. Also, the US national survey of adolescents aged 12–17 years reported a cumulative incidence of depression of 14% in males and 36% in females [39]. The differences between these studies and ours can be explained by the fact that we used cases from specialized services, who would have treated the more serious cases, while the other studies assessed depression in general community samples.

When we examined the incidence of diagnosed depression by age, we found that the incidence rates peaked during adolescence and then declined in early adulthood. This was different from a Danish register-based study from 1995 to 2010, which reported higher incidence rates in early adulthood than in adolescence [10].

In summary, despite the similar follow-up years and the use of national registers, there were considerable variations in both the incidence and cumulative incidence estimates between Finland and Denmark. The only difference in the definitions of depression was with Jensen et al. [10], who included dysthymia in their analysis, which we did not. However, although our study and the study by Wesselhoeft et al. [38] had the same definition of diagnosed depression (depressive episode or recurrent depression), the cumulative incidence by age 20 years was approximately twice as high in our study than by age 19 years in the Wesselhoeft et al. (7% vs. 3% among females and 3% vs. 1% among males). We cannot fully explain the reasons underlying these differences, but there are several potential explanations.

Firstly, data from the Finnish Care Register for Health Care contains diagnoses from a broad range of specialized services, while the Danish studies rely on Psychiatric Central Research Register data, which contain inpatient, and outpatient diagnoses from only psychiatric departments [10].

In addition, Finland has a higher number of child and adolescent psychiatrist per each young person compared to Denmark (36.0 vs. 10.3 per 100,000 persons) [40], and therefore, young people with depression may have better access to specialized care in Finland. When we analyzed cases of moderate or severe depression assessed at two visits or more, we found that the number of cases dropped by half. It is possible that patients with more than one visit are mostly treated in psychiatric services while single visits for any depression might be preferentially diagnosed in emergency rooms. Thus, the cumulative incidence in Finland was approximately twice as high as in Denmark [38], but only half of our cases had several visits due to moderate or severe depression.

Secondly, although the Nordic countries are considered relatively similar, there are differences in the well-being of the children. Psychosomatic symptoms analyzed from 1994 to 2014 among the Nordic countries showed the sharpest increase in the group of older adolescent girls in Sweden and Finland compared to Norway and Denmark [41]. Also, of the Nordic countries, Finland had the second highest increase in unemployment rates among the 15–24-olds after Sweden between 1990 and 2010 [42]. All these factors contribute to explaining the differences in the incidence of diagnosed depression between Finland and Denmark.

The strengths of this study were a large sample size, which covered all Finnish citizens born in 1987–2007 and still alive in 2012, and linkages with national registers. There are several study limitations that need to be considered when interpreting our findings. First, the diagnoses of depression were based on the national registers and most of the register data only included individuals with severe psychiatric diagnoses. Those with milder symptoms may not have been in contact with mental health services [43,44]. Second, we did not have access to primary care diagnoses. Thirdly, no specific data are available on the accuracy of the Care Register for recording depression, but the positive predictive value of other psychiatric disorders, such as schizophrenia and bipolar diagnoses in the same register, have been shown to be good [45]. Finally, only inpatient data were available for 1995–1997, so we may have underestimated the incidence in children aged 5–10 years born in 1987–1993.

## Conclusions

There was an increase in the cumulative incidence of diagnosed depression, when the cohort born in 1987–1993 was compared to 1994–2000 cohort, especially in females. We cannot provide explanations to the increase, but it might be due to improved access to services, which could reflect better identification and more positive attitudes to mental health problems. The rapid increase in children and adolescents diagnosed with depression poses a challenge for specialized mental health services, which needs to provide evidence-based treatment for a growing patient population.

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## Notes on contributors

*S. Filatova*, PhD did the analysis of the incidence, prepared the draft of the paper and revised it.

*A. Suominen*, MSc contributed with the analysis.

*S. Upadhyaya*, MSc PhD MD R. Chudal, PhD MD K. Kronström, PhD MD T. Luntamo, PhD MD D. Gyllenberg and Professor A. Sourander contributed with the manuscript planning and revision.

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