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ORIGINAL ARTICLE

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Cumulative incidences of hospital-treated psychiatric disorders are increasing in five Finnish birth cohorts

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ABSTRACT

Objective: The aim of this study was to explore changes in the incidences of childhood and early adulthood hospital-treated psychiatric disorders in five large Finnish birth cohorts of individuals born between 1966 and 1997.

Methods: The five birth cohorts were as follows: Northern Finland Birth Cohort 1966 (NFBC 1966) and 1986 (NFBC 1986), 1987 Finnish Birth Cohort (FBC 1987) and 1997 (FBC 1997), and Finnish 1981 Birth Cohort Study (FBCS 1981). Incidences of hospital-treated psychiatric disorders in each cohort were calculated separately for males ($N = 71{,}209$) and females ($N = 65{,}190$). Poisson regression was used to test difference in proportions of psychiatric disorders in wide range of diagnosis classes separately in childhood and adolescence, and early adulthood.

Results: The total incidences of psychiatric disorders in childhood and adolescence among males has increased in the birth cohorts over decades (Incidence Rate Ratio, IRR = 1.04 (1.04–1.05); $p < 0.001$). Similar result was seen among females (IRR = 1.04 (1.03–1.04); $p < 0.001$). In early adulthood, there was significant increase among females (IRR = 1.04 (1.03–1.05); $p < 0.001$), but among males, the change was not significant (IRR = 0.99 (0.99–1.00), $p = 0.051$).

Conclusions: The main finding was that the cumulative incidence of hospital-treated psychiatric disorders increased over the decades in Finland. The increasing trend in hospital-treated psychiatric disorders in early adulthood was detected in females but not in males. In the youngest cohorts, the cumulative incidence of hospital-treated psychiatric disorders was at the same level in males and females, whereas in oldest cohort, males had higher incidence than females.

KEYWORDS

anxiety, child and adolescent psychiatry, depression, first episode

1 | INTRODUCTION

Finnish psychiatric health policy has aimed to reduce psychiatric inpatient treatment since 1980 s. The reduction of inpatient treatment was conducted by rehabilitation program for long-stay patients to be able to be taken care in outpatient facilities or nursing homes[1] and by increasing psychiatric outpatient services to be able to treat more patients with severe psychiatric illness without hospital services.[1,2] This policy has been effective.[2] The number of psychiatric beds has also been reduced to approximately from the 20,000 beds in 1970 s to 3500 beds in 2019.[1,3,4] At the same time, the aim has been to increase outpatient services for people with psychiatric disorders.[1,4]

The first national dehospitalization program (the Finnish Schizophrenia Project) took place in 1981-1997. Its aim was to decrease long-term inpatient treatments of schizophrenia patients. The project was successful, and the number of new long-stay schizophrenic patients in psychiatric hospitals decreased by 60% and the old long-stay schizophrenic patients by 68% between 1982 and 1992.[5] On the other hand, a study of the dehospitalization program indicated that patients discharged between 1987 and 1991 had a high risk of being readmitted to psychiatric hospital.[6]

The prevalence of psychiatric varies by sex. Neurodevelopmental disorders are more common among males than females whereas females are about twice as likely to get diagnosed to anxiety disorders and are more likely to suffer from major depression than males.[7–9] On the other hand, males are more likely to be hospitalized due to psychotic disorders and substance use disorders than women.[10,11] In Finland, psychiatric inpatient treatments were more common among adolescent females than males and in adulthood more common in males than females.[12]

Significant outcomes

- Cumulative incidence of hospital-treated psychiatric disorders increased over the decades in Finland, which is somewhat opposite to the Finnish psychiatric health policy plan aiming to treat people with psychiatric disorders mainly in outpatient service.
- The increasing trend in hospital-treated psychiatric disorders was detected in females but not in males.
- In the youngest cohorts, the cumulative incidence of hospital-treated psychiatric disorders was at the same level in males and females, whereas in oldest cohort, males had higher incidence than females

Limitations

- The Care Register for Health Care, from where the outcome variable was derived, did not have complete registration of personal identification numbers until 1969, so there is a three-year gap in diagnosis in the oldest cohort.
- Two of the cohorts used in the study do not represent the population in Finland, only population born in northern Finland. There has been some regional difference at least from 1970 to 1990 in the use of psychiatric beds in Finland.

1.1 | Aims of the study

The aim of this study was to explore changes in the incidences of childhood and early adulthood hospital-treated psychiatric disorders in five large Finnish birth cohorts of subjects born between 1966 and 1997 separately in males and females. Trends in hospital-treated psychiatric disorders were studies in wide range of diagnosis classes.

2 | MATERIAL AND METHODS

2.1 | Cohorts

We used data from five different Finnish birth cohorts: Northern Finland Birth Cohort 1966 (NFBC 1966), 1987 Finnish Birth Cohort (FBC 1987), Finnish 1981 Birth Cohort Study (FBCS 1981), Northern Finland Birth Cohort 1986 (NFBC 1968), and 1997 Finnish Birth Cohort (FBC 1997). This study is part of the Finnish psychiatric birth cohort consortium (PSYCOHORTS) project.[13]

Northern Finland Birth Cohorts cover the people born with certain expected date of birth in former two northern-most provinces in Finland, Oulu, and Lapland. NFBC 1966 includes the people born with the expected date in the year 1966, comprising of 12,231 children (96.3% of all births during 1966 in the area). NFBC 1986 comprises the people born with the expected date of birth of between July 1, 1985, and June 30, 1986, including 9479 children (99% of all the deliveries taking place in the target period of the cohort) (Table S1).[14,15] From NFBC 1966 four subjects and from NFBC 1986 15 subjects have denied the use of data.

Finnish 1981 Birth Cohort is based on a random sample including 10% ($N = 5417$) of the Finnish children born in 1981 (Table S1). The sample was drawn in a two-stage procedure in the catchment areas of the five child psychiatric departments of the university hospitals in Finland (Helsinki, Kuopio, Oulu, Tampere, and Turku).[16]

Finnish Birth Cohort studies follow cohorts born in 1987 and 1997, excluding those that died during the perinatal period. FBC 1987 comprises 59,476 children and FBC 1997 of 58,802 children (Table S1). The FBC studies are register-based and all the collected data are obtained from several registers.[17]

2.2 | Psychiatric disorders

The main outcome in the present study was first hospitalization due to a specific psychiatric disorder. Primary diagnosis was used to identify those, who were treated in hospital due to a psychiatric disorder. The data of psychiatric disorders were obtained from the Care Register for Health Care (CRHC), previously named Finnish Hospital Discharge Register (FHDR), maintained by the Finnish Institute for Health and Welfare (THL). The CRHC is one of the oldest individual-level hospital discharge registers. It has nationwide hospital discharge information on inpatient visits starting from year 1969). From 1994 onwards, the register also includes the information on specialized outpatient care. The CRHC covers the whole country and all hospitals are obligated to report all hospital visits by law. Several studies indicate that the register quality of CRHC is high.[18] In the present study, we analyzed hospitalizations due to psychiatric disorders in broad range of ICD-diagnosed (International Statistical Classification of Diseases and Related Health Problems) psychiatric disorders classified in several classes in two different age groups: in childhood and adolescence (under 18 years) and in early adulthood (age of 18–28 years) (Table S2). The CRHC data covered the years from 1969 to 2017.

2.3 | Study population

Final dataset included in total 145,405 subjects, 71,209 males and 65,190 females (Table S1). The follow-up for the study subjects was from age 0 to 18 years in all five birth cohorts and from age 18 to 28 years in all other cohorts except FBC 1997, for they have not yet reached the age of 28 years.

2.4 | Statistical analysis

From all the 2,785,149 hospital visits in CRHC 32,153 identical rows were removed. There were total 24,791 hospital visits including ICD-8 codes, 103,964 visits including ICD-9 codes and 2,656,394 visits including ICD-10 codes. From these visits, one ICD-8 diagnose code included additional character and three diagnose codes were incorrect. Respective numbers in visits including ICD-9 diagnosis were two and three, and visits including ICD-10 diagnosis codes 856 and five. Total of 50 discharge dates were removed due to a discrepancy in date of entry and discharge.

We analyzed the first hospitalization due to psychiatric disorder in three different time period: in childhood and adolescence (under 18 years old), in young adulthood (18–28 years) and in age from 0 to 28 years. Analysis of childhood and young adulthood was treated independently; in young adulthood, the incidence is new hospitalizations due to certain disorder disregarding whether there have been previous psychiatric contacts before age of 18. Disorders usually diagnosed during childhood were not included in the early adulthood analysis. In childhood and adolescence, organic psychiatric disorders or disorders of adult personality were excluded from the analysis. In post-traumatic stress disorder, autism spectrum disorder, learning and coordination disorders and ADHD, there was no ICD-8 code, so the NFBC 1966 was not included in analysis of those diagnosis classes. The cumulative incidence of first hospital-treated psychiatric disorder in each cohort was calculated. Pearson's chi-squared test was conducted to assess equality of proportions. We analyzed the difference of proportions using Poisson regression with offset variable. The model was created using number of subjects with first hospitalization due to a specific psychiatric disorder as a dependent variable, a cohort year as independent variable and logarithmic number of populations as an offset variable and incidence rate ratios (IRR) with 95% confidence interval (CI) are reported. The IRR estimates the change in proportions per birth cohort. All analysis was conducted separately in males and females. The risk ratio with 95% confidence interval for sex was also calculated to compare the sex difference in different cohorts. In diagnosis classes, other substance use disorder, schizophrenia, mania and bipolar, obsessive-compulsive disorder, post-traumatic stress disorder and Tic disorder, the number of cases was too low to be analyzed properly in childhood and adolescence in both sex, and in anxiety disorders in males and other non-affective psychosis, autism spectrum disorders and ADHD in females. In young adulthood in diagnosis classes, organic mental disorders, obsessive-compulsive disorders, post-traumatic stress disorder, paranoid personality disorder, schizoid personality disorder, and dissocial personality disorder, the number of cases was too low to be analyzed properly in both sexes and in eating disorder in males. Analyses were performed using SAS 9.4 and R version 3.6.2.

3 | RESULTS

The cumulative incidence of hospital-treated psychiatric disorder increased among females from the cohort born in the 1966 to cohort born in the 1997, but among males' similar trend was not found (Figure 1). The total cumulative incidences of psychiatric disorders before age of 28 were 6.2% in NFCB

1966, 9.0% in FBC 1981, 8.5% in NFBC 1986, and 7.4% in FBC 1987 (IRR:1.01, 95% CI. 1.01–1.02) among males (Table S3) and 3.4% in NFCB 1966, 5.4% in FBC 1981, 6.7% in NFBC 1986, and 7.6% in FBC 1987 (IRR: 1.04, 95% CI. 1.03–1.05) among females (Table S4). In childhood and adolescence, the cumulative incidences of any psychiatric disorders in males were 1.7% in NFBC 1966, 3.2% in FBCS 1981, 4.4% in NFBC 1986, 4.2% in FBC 1987 and 6.3% in FBC 1997 (IRR: 1.04, 95% CI. 1.04–1.05) (Table 1). Respective numbers among female were 1.6%, 2.3%, 4.1%, 4.0% and 5.5% (IRR:1.04 (1.03–1.04)) (Table 2). In early adulthood, the cumulative incidences of any psychiatric disorders in males were 4.4% in NFBC 1966, 6.7% in FBCS 1981, 4.8% in NFBC 1986, and 3.9% in FBC 1987 (IRR:0.99 (0.99–1.00)) (Table 3). Respective numbers among female were 1.8%, 3.6%, 3.5% and 4.5% (IRR:1.04 (1.03–1.05)) (Table 4).

In childhood and adolescence, statistically significant increase in the incidences, both in males and in females, was found in several diagnosis classes: mental and behavioral disorders due to psychoactive substance use; mood disorders; depression; neurotic, stress-related, and somatoform disorders; disorders usually diagnosed in childhood or in adolescence; learning and coordination disorders; conduct and oppositional disorders and in any psychiatric disorders (Tables 1 and 2). The significant increase only in males was found in autism spectrum disorders, learning, and coordination disorders and in ADHD (Table 1), and in females in anxiety disorders; behavioral syndromes associated with eating, sleep, or puerperium and in eating disorders (Table 2). In early adulthood among both sexes, the significant increase in the incidences was seen in several classes: mental and behavioral disorders due to psychoactive substance use; other substance use disorders; mood disorders and depression (Tables 3 and 4). In males, the significant decrease was found in neurotic, stress-related and somatoform disorders; anxiety disorders; disorders of adult personality and in emotionally unstable personality disorders (Table 3). In females, the significant increase was detected in neurotic, stress-related and somatoform disorders; anxiety disorders; behavioral syndromes associated with eating, sleep, or puerperium; eating disorder; emotionally unstable personality disorder and in any psychiatric or neurodevelopmental disorder (Table 4). In the NFBC 1966, the young adult males years had a 2.27-fold (95% CI: 1.83–2.82) risk to be hospitalized due to any psychiatric disorders compared to females and the risk decreased from 1.28 (0.92–1.76) in FBCS 1981, 1.34 (1.10–1.64) in NFBC 1986 to 0.88 (0.81–0.95) in FBC 1987. Males had 1.90-fold (1.11–3.24) risk to be hospitalized due to a depressive disorder compared to females in NFBC 1966, 0.63 (0.30–1.30) in FBCS 1981, 0.70 (0.48–1.02) in NFBC 1986, and 0.57 (0.50–0.65) in FBC 1987. At age of 18 to 28 years, males in NFBC 1966 had 3.97-fold (2.42–6.54) risk to be hospitalized due to disorder of adult personality compared to females, and the risk decreased from 0.64 (0.33–1.23) in NFBC 1986 to 0.30 (0.21–0.43) in FBC 1987.

In the NFBC 1966, children and adolescent males had a 1.07-fold (0.81–1.41) risk to be hospitalized due to any psychiatric disorder compared to females. The risk was statistically nonsignificant even in FBCS 1981 (RR 1.34, 0.97–1.85), NFBC 1986 (1.09, 0.90–1.32), and FBCS 1987 (1.04, 0.96–1.12), but not for FBSC 1997 (1.14, 1.07–1.21). Males had increased risk for hospitalization due to a depressive disorder (1.43, 0.24–8.54) compared to females in NFBC 1966, but the risk was decreased for males in the other cohorts: 0.66 (0.32–1.37) in FBCS 1981, 0.43 (0.26–0.69) in NFBC 1986, 0.33 (0.27–0.40) in FBC 1987, and 0.35 (0.31–0.43) in FBC 1997.

4 | DISCUSSION

4.1 | Main findings

The main finding of the study was that the cumulative incidence of first-admission inpatient-treated psychiatric disorders increased over the decades in Finland. This is somewhat

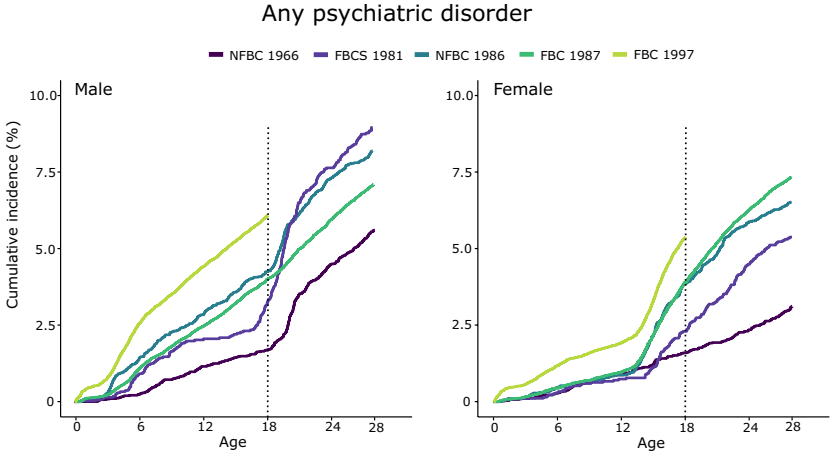

FIGURE 1 Cumulative incidence of first-admission hospital-treated psychiatric and neurodevelopmental disorders at age of 0 to 28 years [Colour figure can be viewed at wileyonlinelibrary.com]

TABLE 1 Childhood and adolescence (age of 0 to 18 years) proportion (N), Pearson's chi-squared statistic and results of Poisson regression of hospital-treated psychiatric disorders in males

Diagnosis group	NFBC 1966	FBCS 1981	NFBC 1986	FBC 1987	FBC 1997	χ^2	*p*-value	IRR (95% CI.)	*p*-value
Mental and behavioral disorders due to psychoactive substance use	0.1 (5)	0.3 (8)	0.4 (22)	0.3 (90)	0.3 (96)	14.59	0.006	1.02 (1.01–1.04)	0.007
Alcohol	0.0 (1)	0.1 (2)	0.4 (18)	0.2 (66)	0.2 (70)				
Other substances	0.1 (4)	0.2 (6)	0.1 (4)	0.1 (25)	0.1 (27)				
Schizophrenia, schizotypal, and delusional disorders	0.1 (6)	0.2 (6)	0.1 (5)	0.3 (79)	0.2 (66)	9.61	0.048	1.02 (1.00–1.04)	0.115
Schizophrenia	0 (3)	0.1 (3)	0 (1)	0.1 (19)	0 (5)				
Other non-affective psychosis	0 (3)	0.1 (3)	0.1 (5)	0.2 (70)	0.2 (64)				
Mood disorders	0.1 (4)	0.4 (12)	0.5 (24)	0.5 (146)	0.7 (205)	40.62	<0.001	1.05 (1.03–1.07)	<0.001
Mania and bipolar	0 (0)	0 (0)	0 (1)	0 (13)	0 (14)				
Depression	0 (3)	0.4 (12)	0.4 (24)	0.4 (136)	0.6 (185)	35.94	<0.001	1.05 (1.03–1.06)	<0.001
Neurotic, stress-related, and somatoform disorders	0.4 (24)	0.4 (11)	0.4 (19)	0.3 (99)	0.6 (169)	19.8	<0.001	1.03 (1.02–1.05)	<0.001
Obsessive-compulsive disorder	0 (1)	0 (1)	0 (2)	0 (12)	0.1 (23)				
Anxiety disorders	0.1 (9)	0.1 (2)	0.1 (5)	0.1 (33)	0.2 (70)				
Post-traumatic stress disorder		0 (0)	0 (2)	0 (3)	0 (13)				
Behavioral syndromes associated with eating, sleep, or puerperium	0 (0)	0.1 (4)	0 (2)	0.2 (60)	0.4 (128)				
Eating disorder	0 (0)	0 (0)	0 (1)	0.1 (19)	0 (14)				
Disorders diagnosed in childhood or in adolescence	0.9 (55)	1.6 (43)	2.9 (144)	2.7 (835)	4.4 (1327)	289.67	<0.001	1.05 (1.05–1.06)	<0.001
Autism spectrum disorders		0.1 (3)	0.2 (8)	0.2 (61)	0.5 (159)	76.97	<0.001	1.11 (1.08–1.13)	<0.001
Learning and coordination disorders		0.9 (24)	1.6 (80)	1.2 (355)	2.1 (618)	175.45	<0.001	1.05 (1.04–1.06)	<0.001
ADHD		0.3 (7)	0.2 (12)	0.3 (84)	0.4 (132)	28.55	<0.001	1.05 (1.02–1.07)	<0.001
Tic disorders	0 (0)	0.0 (1)	0 (1)	0.1 (20)	0.1 (24)				
Conduct and oppositional disorders	0.1 (7)	0.2 (6)	0.7 (32)	0.9 (264)	1.1 (334)	77.75	<0.001	1.05 (1.04–1.06)	<0.001
Any psychiatric or neurodevelopmental disorder	1.7 (107)	3.2 (86)	4.4 (216)	4.2 (1217)	6.3 (1814)	314.69	<0.001	1.04 (1.04–1.05)	<0.001

TABLE 2 Childhood and adolescence (age of 0 to 18 years) proportion (N), Pearson's chi-squared statistic, and results of Poisson regression of hospital-treated psychiatric disorders in females

Diagnosis group	NFBC 1966	FBCS 1981	NFBC 1986	FBC 1987	FBC 1997	χ^2	*p*-value	IRR (95% CI.)	*p*-value
Mental and behavioral disorders due to psychoactive substance use	0.1 (4)	0.3 (8)	0.4 (19)	0.2 (69)	0.3 (80)	14.02	0.007	1.02 (1.01–1.05)	0.014
Alcohol	0 (3)	0.2 (6)	0.4 (17)	0.2 (46)	0.2 (62)				
Other substances	0 (1)	0.1 (2)	0 (2)	0.1 (23)	0.1 (19)				
Schizophrenia, schizotypal, and delusional disorders	0 (2)	0.2 (5)	0.3 (16)	0.3 (88)	0.2 (62)	18.58	0.001	1.02 (1.00–1.04)	0.106
Schizophrenia	0 (2)	0 (1)	0.1 (3)	0.1 (22)	0 (10)				
Other non-affective psychosis	0 (0)	0.2 (5)	0.3 (15)	0.2 (72)	0.2 (57)				
Mood disorders	0 (2)	0.7 (18)	1.2 (55)	1.5 (424)	1.8 (526)	125.68	<0.001	1.05 (1.04–1.06)	<0.001
Mania and bipolar	0 (0)	0 (0)	0.1 (4)	0.1 (21)	0.1 (31)				
Depression	0 (2)	0.7 (18)	1.2 (53)	1.4 (402)	1.7 (498)	117.07	<0.001	1.05 (1.04–1.06)	<0.001
Neurotic, stress-related, and somatoform disorders	0.3 (18)	0.5 (13)	0.5 (22)	0.6 (165)	1.1 (331)	93.53	<0.001	1.06 (1.04–1.07)	<0.001
Obsessive-compulsive disorder	0 (2)	0 (1)	0.1 (3)	0 (10)	0.1 (26)				
Anxiety disorders	0 (1)	0.1 (2)	0.2 (9)	0.2 (52)	0.4 (106)	39.92	<0.001	1.08 (1.06–1.11)	<0.001
Post-traumatic stress disorder		0 (1)	0.1 (3)	0 (9)	0.1 (35)				
Behavioral syndromes associated with eating, sleep, or puerperium	0.1 (4)	0.3 (8)	0.4 (19)	0.5 (148)	0.8 (234)	61.96	<0.001	1.06 (1.05–1.08)	<0.001
Eating disorder	0.1 (4)	0.3 (7)	0.4 (18)	0.4 (121)	0.5 (149)	25.78	<0.001	1.04 (1.03–1.06)	<0.001
Disorders diagnosed in childhood or in adolescence	0.8 (50)	0.7 (19)	1.5 (70)	1.4 (420)	2.2 (623)	91.61	<0.001	1.03 (1.03–1.04)	<0.001
Autism spectrum disorders		0 (1)	0.1 (4)	0.1 (15)	0.2 (49)				
Learning and coordination disorders		0.3 (9)	0.2 (11)	0.4 (117)	0.8 (226)	71.7	<0.001	1.07 (1.05–1.09)	<0.001
ADHD		0.1 (2)	0 (1)	0.1 (20)	0.1 (28)				
Tic disorders	0 (0)	0 (0)	0 (1)	0 (6)	0 (5)				
Conduct and oppositional disorders	0.1 (6)	0.1 (3)	0.9 (39)	0.5 (158)	0.4 (117)	46.24	<0.001	1.02 (1.00–1.03)	0.030
Any psychiatric or neurodevelopmental disorder	1.6 (95)	2.3 (63)	4.1 (186)	4 (1164)	5.5 (157)	237.73	<0.001	1.04 (1.03–1.04)	<0.001

TABLE 3 Early adulthood (age of 18 to 28 years) proportion (N), Pearson's chi-squared statistic, and results of Poisson regression of hospital-treated psychiatric disorders in males

Diagnosis group	NFBC 1966	FBCS 1981	NFBC 1986	FBC 1987	χ^2	*p*-value	IRR (95% CI.)	*p*-value
Organic, including symptomatic, mental disorders	0.2 (11)	0 (1)	0.1 (4)	0 (12)				
Mental and behavioral disorders due to psychoactive substance use	1.1 (72)	2.1 (56)	1.9 (93)	1.5 (453)	15.95	0.001	1.01 (1.00–1.02)	0.043
Alcohol	1 (63)	0.8 (23)	1.3 (65)	0.8 (242)	14.85	0.002	0.99 (0.98–1.01)	0.236
Other substances	0.2 (12)	1.3 (36)	0.8 (39)	0.9 (261)	40.48	<0.001	1.06 (1.04–1.08)	<0.001
Schizophrenia, schizotypal, and delusional disorders	1.1 (68)	1.6 (43)	1 (48)	1.2 (366)	5.97	0.113	1.00 (0.99–1.02)	0.647
Schizophrenia	0.6 (38)	0.8 (23)	0.3 (14)	0.5 (152)	12.01	0.007	0.99 (0.97–1.00)	0.127
Other non-affective psychosis	0.8 (49)	1.2 (32)	0.8 (41)	1 (294)	4.07	0.254	1.01 (0.99–1.02)	0.245
Mood disorders	0.7 (44)	1.9 (53)	1.1 (54)	1.3 (397)	27.74	<0.001	1.02 (1.01–1.04)	0.001
Mania and bipolar	0 (2)	0.1 (4)	0.2 (8)	0.3 (77)				
Depression	0.6 (40)	1.8 (49)	1 (47)	1.1 (334)	25.68	<0.001	1.02 (1.01–1.04)	0.006
Neurotic, stress-related, and somatoform disorders	1.3 (81)	2.5 (67)	1.3 (62)	0.6 (176)	131.76	<0.001	0.97 (0.96–0.98)	<0.001
Obsessive-compulsive disorder	0 (0)	0 (1)	0 (2)	0 (7)				
Anxiety disorders	0.7 (43)	0.6 (16)	0.4 (21)	0.3 (87)	26.28	<0.001	0.96 (0.95–0.98)	<0.001
Post-traumatic stress disorder		0 (1)	0 (1)	0 (2)				
Behavioral syndromes associated with eating, sleep or puerperium	0.1 (4)	0.1 (2)	0.4 (19)	0 (10)	67.76	<0.001	1.00 (0.96–1.06)	0.895
Eating disorder	0 (0)	0 (0)	0 (1)	0 (3)				
Disorders of adult personality	1.3 (80)	0.3 (8)	0.3 (15)	0.1 (42)	206.83	<0.001	0.91 (0.89–0.92)	<0.001
Paranoid personality disorder	0.1 (5)	0 (0)	0.1 (3)	0 (0)				
Schizoid personality disorder	0.1 (4)	0 (1)	0 (0)	0 (4)				
Dissocial personality disorder	0.1 (7)	0 (1)	0 (2)	0 (8)				
Emotionally unstable personality disorder	0.3 (16)	0.1 (3)	0.1 (6)	0 (14)	26.89	<0.001	0.93 (0.90–0.96)	<0.001
Any psychiatric or neurodevelopmental disorder	4.4 (273)	6.7 (183)	4.8 (234)	3.9 (1175)	56.44	<0.001	0.99 (0.99–1.00)	0.051

opposite to the Finnish mental health policy plan aiming to treat people with psychiatric disorders mainly in outpatient services. Since the treatment period has shortened, the reduced number of beds is enough for shorter treatment periods, but the number of people hospitalized due to psychiatric disorder has not diminished. The increasing trend in hospitalizations due to psychiatric disorders was detected in females but not in males.

TABLE 4 Early adulthood (age of 18 to 28 years) proportion (N), Pearson's chi-squared statistic and results of Poisson regression of hospital-treated psychiatric disorders in females

Diagnosis group	NFBC 1966	FBCS 1981	NFBC 1986	FBC 1987	χ^2	*p*-value	IRR (95% CI.)	*p*-value
Organic, including symptomatic, mental disorders	0.1 (5)	0 (1)	0 (0)	0 (7)				
Mental and behavioral disorders due to psychoactive substance use	0.4 (22)	0.9 (25)	0.7 (30)	0.8 (245)	16.44	0.001	1.04 (1.02–1.06)	<0.001
Alcohol	0.3 (16)	0.1 (4)	0.3 (16)	0.4 (114)	5.69	0.128	1.02 (1.00–1.05)	0.113
Other substances	0.1 (6)	0.9 (23)	0.3 (15)	0.5 (152)	30.02	<0.001	1.06 (1.03–1.10)	<0.001
Schizophrenia, schizotypal, and delusional disorders	0.7 (40)	0.7 (20)	0.6 (29)	0.9 (274)	8.13	0.044	1.02 (1.00–1.03)	0.057
Schizophrenia	0.3 (20)	0.3 (9)	0.3 (13)	0.4 (124)	3.01	0.390	1.01 (0.99–1.04)	0.358
Other non-affective psychosis	0.5 (32)	0.6 (15)	0.5 (21)	0.7 (198)	4.49	0.214	1.01 (0.99–1.03)	0.254
Mood disorders	0.4 (22)	2 (55)	1.7 (77)	2.3 (672)	99.82	<0.001	1.08 (1.06–1.10)	<0.001
Mania and bipolar	0 (2)	0.4 (12)	0.4 (18)	0.5 (146)	26.12	<0.001	1.11 (1.07–1.18)	<0.001
Depression	0.3 (20)	1.8 (48)	1.4 (63)	1.9 (562)	81.03	<0.001	1.08 (1.06–1.10)	<0.001
Neurotic, stress-related, and somatoform disorders	0.4 (23)	0.9 (24)	1.2 (56)	1 (277)	23.97	<0.001	1.04 (1.02–1.06)	<0.001
Obsessive-compulsive disorder	0 (1)	0 (1)	0 (0)	0.1 (18)				
Anxiety disorders	0.1 (8)	0.2 (5)	0.5 (23)	0.4 (105)	13.49	0.004	1.05 (1.02–1.09)	0.003
Post-traumatic stress disorder	0 (0)	0 (1)	0.1 (4)	0.1 (17)				
Behavioral syndromes associated with eating, sleep, or puerperium	0.1 (5)	0.3 (9)	0.1 (6)	0.3 (98)	15.64	0.001	1.06 (1.02–1.11)	0.004
Eating disorder	0 (2)	0.3 (7)	0.1 (4)	0.3 (80)	17.40	0.001	1.09 (1.04–1.17)	0.003
Disorders of adult personality	0.3 (19)	0.3 (9)	0.5 (22)	0.5 (133)	3.08	0.380	1.02 (1.00–1.04)	0.112
Paranoid personality disorder	0 (0)	0 (1)	0 (0)	0 (1)				
Schizoid personality disorder	0 (0)	0 (0)	0 (0)	0 (2)				
Dissocial personality disorder	0 (0)	0 (0)	0 (1)	0 (0)				
Emotionally unstable personality disorder	0.2 (11)	0.3 (7)	0.4 (18)	0.4 (102)	5.23	0.156	1.03 (1.00–1.07)	0.032
Any psychiatric or neurodevelopmental disorder	1.8 (107)	3.6 (98)	3.5 (161)	4.5 (1295)	100.09	<0.001	1.04 (1.03–1.05)	<0.001

4.2 | Sex difference

The increasing trend in hospitalizations due to psychiatric disorders was detected in young adult females but not in males. Currently, females are hospitalized due to a psychiatric disorder more often than males and decades ago the situation was opposite. Among young adult males, there was no significant change in hospitalization due to psychiatric disorders since cohort born in the 1966, whereas among females, a significant increase was seen. An Irish study report similar phenomena; over the course of the 50 years, males typically had higher admission rates than females, but in recent times, the gap had significantly closed to almost equal rates in Ireland.[19] An increase in self-harm among females in adolescent and young adulthood has been reported,[20,21] and this may be connected to our findings. Only most severe mental disorders are treated in hospitals, and danger to own health is one of the criteria for compulsory admission in Finland. The treatment procedures in Finland during past decades have reformed substantially, and the sex differences in the oldest cohort might be caused of different attitudes to males and females with mental disorders during 1970 s and 1980 s.

4.3 | Incidence of separate disorders during childhood and adolescent

The incidence of any psychiatric disorders increased significantly in males and females in childhood and adolescence. For females aged 12 to 14 years, there appears to be increase in incidence of hospital-treated psychiatric disorders in all cohorts, except the NFBC 1966 (Figure 1). Previous reports show median age of onset in childhood and adolescence for anxiety disorder to be 6 years and 13 years for mood disorders.[22] Mood disorder was the most or the second most common disorder in childhood or adolescence in all studied cohorts, except NFBC 1966, which explains the growth of diagnosis at the age of 12 to 14. Also, the above disorders were more common among females. Increase in depression in adolescence has also been reported elsewhere.[23,24]

An increase in eating disorders was found to be significant only among female. Eating disorders diagnosis codes have broadened since ICD-8 and the diagnosis codes have become more specific: In the 1970 s, the anorexia nervosa was the most common eating disorder, whereas nowadays, most of the eating disorders are diagnosed as eating disorders not otherwise specified. The rise of incidence of anorexia nervosa is widely debated. Meta-analysis pointed out that until the 1970 s the incidence increased and since then have remained rather stable.[25] Previous studies indicate a link between anxiety disorder and disordered eating.[26,27] The increase in anxiety disorder was significant among females, but not among males. Anxiety disorder rarely requires inpatient treatment and patients with anxiety disorders are mostly treated in outpatient care.[28]

In males, the incidence of disorders diagnosed in childhood or adolescence increased significantly. Large meta-analysis indicates an increase in incidence of many disorders usually diagnosed in childhood in Western countries, such as neurodevelopmental disorders, as ADHD and autism spectrum disorders.[29] We found a significant positive linear trend in hospital-treated psychiatric disorders usually diagnosed in childhood among males. The increase of cumulative incidence in hospital-treated disorders usually diagnosed during childhood or adolescence is not necessarily caused by increased incidence of psychiatric disorders in population but rather due to changes in treatment-seeking behavior or changes in diagnostic criteria. For example, an increase in the cumulative incidence of autistic disorder might be explained by a broadening diagnostic criterion.[29] The broad of classification codes has changed via the different ICD classification, and the codes are not completely equal across the different ICD versions. For example, infantile autism was regarded as a part of schizophrenia in ICD-8 classification.[30]

4.4 | Disorders in young adulthood

In the early adulthood, the most remarkable increase in the cumulative incidence among females was in mood disorders. Among males, the increase was significant, but not as major as in females. Females are more likely to develop depression than men during a lifetime, and in Finland, the prevalence in depressive disorder has increased from 2000 to 2011, especially among females.[31,32]

We observed that the risk ratio of hospitalization due to a depressive disorder between male and female decreased in both studied age groups when comparing the cohort born in 1966 to the youngest cohort. In the cohort born in 1966, males were more likely to be hospitalized due to a depressive disorder, and in the cohort born in 1987, the opposite was found. Several studies have reported somewhat opposite results; there is no sex difference in prevalence of depression among boys and girls in preadolescent, and some studies suggest even higher prevalence for boys.[33] Large meta-analysis indicates that there is a sex gap in prevalence of depression diagnosis, peaking in adolescent, narrowing thereafter, and remaining stable in adulthood.[34]

Among males, there was a major decrease in hospital-treated personality disorders, whereas among females, no significant trend was found. A Spanish study pointed out that the trend in personality disorders diagnoses among hospitalized patients is dependent on the disorder. In a ten-year follow-up, there was an increase in borderline, dependent, anxious-avoidant and narcissistic personality disorders diagnosis, and a decrease in paranoid and histrionic personality disorder diagnosis and non-specific, antisocial, schizoid and obsessive-compulsive personality disorders diagnosis stayed stable.[35]

The sex difference in personality disorders is highly inconsistent, and studies have reported different findings depending on the study setting.[36] Our study reports time depending sex difference, in cohort born in the year 1966 males had 3.5-fold risk to be hospitalized due to disorder of adult personality compared to female, whereas in cohort born in the 1987 cohort, females had 2.9-fold risk compared to males.

4.5 | Strengths and limitations

The data used in this study were obtained from the Finnish healthcare registers, which are shown to be of good quality. It is obligatory for all healthcare providers to report the causes (ICD codes) for utilization of healthcare system.[18] Second strength of the study is the large sample size with long follow-up. Sample size made it possible to study psychiatric disorders widely in multiple diagnosis classes. A further strength

in this study is harmonization process and the validated datasets. The ICD-coded diagnoses were harmonized to present the same disorders. Even though the quality of Finnish registers is good, the harmonization process was needed to ensure comparable data.

However, the cohorts used in the study are not fully comparable. FBC studies are completely register-based studies, whereas NFBC studies and FBCS study are prospective birth cohorts with several follow-ups. There might be an unspecific intervention effect on birth cohorts with follow-ups. The trend of cumulative incidence in psychiatric disorders could reflect either period effects, cohort effects, or even intervention effect in prospective birth cohorts. Second, the CRHC did not have complete registration of PIN until 1969, so there is a three-year gap in diagnosis in NFBC 1966. This may affect especially to the cumulative incidence of disorders usually diagnosed in early childhood. Despite being minor, some of the found differences in incidences were statistically significant. The magnitude of difference varied in some diagnostic groups substantially. Also, while the study setting includes five different cohorts and wide different diagnosis groups are studied, the multiple testing problem may occur.

Also, the NFBC cohorts do not represent the population in Finland, only population born in northern Finland. There has been some regional difference at least from 1970 to 1990 in the use of psychiatric beds in Finland. The rate of inpatients in the year 1990 was highest in eastern and southern Finland. Among inpatient patients, the psychosis rate ranges from 1.5 per 1000 inhabitants per year in southwestern Finland to 2.3 per 1000 inhabitants per year in eastern Finland.[37] In schizophrenia and other psychosis, regional differences can be seen: The prevalence is highest in northern and eastern Finland and lowest in southwestern Finland.[38]

The main finding was that the cumulative incidence of hospital-treated psychiatric disorders increased over the decades in the five birth cohorts in Finland. This is somewhat opposite to the Finnish psychiatric health policy plan aiming to treat people with psychiatric disorders mainly in outpatient service. In the oldest cohort, males had higher incidence than females, whereas in the youngest cohorts, the cumulative incidence of hospital-treated psychiatric disorders was at the same level in males and females.

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CONFLICTS OF INTEREST

The authors declare that they have no conflict of interest.

PEER REVIEW

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DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from NFBC, Finnish Institute for Health and Welfare, and from University of Turku for researchers who meet the criteria for accessing confidential data. Restrictions apply to the availability of these data, which were used under license for this study. The data are not publicly available due to privacy or ethical restrictions.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section.
Table S1

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