

# Lifetime psychiatric morbidity and maternal smoking behavior in consecutive pregnancies: A Finnish register study

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## Abstract

**Introduction:** Despite the adverse effects of smoking during pregnancy, a large proportion of women who smoke during their first pregnancy endure smoking also in their subsequent one. Previous studies have made efforts to explore associated factors, such as maternal mood and stress. This observational register-based historical cohort study aims to investigate the association between prior psychiatric morbidity and maternal smoking during consecutive pregnancies.

**Material and Methods:** The study population comprised all women who smoked during their first pregnancy and had two singleton live births between January 1, 2006 and December 31, 2019 in Finland ( $n=29\,683$ ). The smoking information was obtained from the Finnish Medical Birth Register, categorized as “no smoking,” “quit smoking” (during the first trimester), or “continued smoking” (beyond the first trimester). Maternal psychiatric diagnoses (from the age of 15 until the second delivery) were derived from the Finnish Hospital Discharge Register. The association between (I) any psychiatric diagnosis, (II) separate diagnosis groups, and (III) psychiatric burden (diagnoses from 0 to 5 different diagnosis groups) and maternal smoking during the second pregnancy was analyzed using logistic regression.

**Results:** The smoking prevalence during the first pregnancy was 16.0%. Women who continued smoking during their first pregnancy ( $n=15\,588$ ) were likely smokers in their second: 54.9% continued, and 12.4% quit smoking. Most women who quit smoking during their first pregnancy ( $n=14\,095$ ) were non-smokers during their second (73.2%). Women who continued smoking during their first pregnancy and had any previous psychiatric diagnosis were more likely to continue smoking (beyond the first trimester) during their second pregnancy (OR 1.44, 95% CI 1.32–1.57) compared to those without such a diagnosis. A similar association was found between psychiatric burden and continued smoking (OR 1.20, 1.14–1.25). Women who quit smoking during their first pregnancy and had any diagnosis or burden showed a similar trend for continued smoking but were not more likely to quit smoking during the second pregnancy.

**Abbreviations:** CI, confidence interval; ICD-10, International Classification of Diseases, 10th edition; OR, odds ratio; SDP, smoking during pregnancy.

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**Conclusions:** Any prior psychiatric diagnosis seems to be associated with continued smoking during the second pregnancy among first-pregnancy smokers. Psychiatric and smoking cessation support should be targeted particularly to women who smoke during their first pregnancy and have psychiatric conditions in their medical history.

**KEYWORDS**

cigarette, consecutive pregnancies, mental health, psychiatric burden, smoking cessation, smoking during pregnancy

## 1 | INTRODUCTION

Smoking during pregnancy (SDP) disrupts the fetal growth and development.<sup>1-3</sup> The prevalence of SDP is declining, and recent estimates from Europe and America are between 6% and 8%.<sup>4</sup> However, a similar decreasing trend was unapparent among pregnant women who screened positive for major psychological distress in a US study population from 2008 to 2014.<sup>5</sup> SDP is more common among young women,<sup>6</sup> who are single and primiparous, have a lower socioeconomic status,<sup>7</sup> and have little or no education.<sup>8</sup>

In the general population, a lifetime psychiatric diagnosis seems to be associated with higher smoking and lower cessation rates, as well as current psychiatric disorders, when compared to the population without such a diagnosis.<sup>9</sup> According to our previous study, 30% of women who smoked after the first trimester had received psychiatric hospital treatment during pregnancy.<sup>10</sup> Also, pregnant smokers more often report a history of mental health problems.<sup>11</sup> Previous studies have explored the prevalence of depressive symptoms among pregnant smokers with contradictory results.<sup>12-14</sup> In a US study, the association between SDP and depressive symptoms attenuated when adjusting for demographic factors.<sup>13</sup> A Finnish register study found that SDP was also associated with current major depression and a history of major depression.<sup>14</sup>

Many women who succeed in smoking cessation in their first pregnancy resume after childbirth and potentially smoke during their subsequent pregnancy. According to the previous studies, about 30%–40% of women who smoke during their first pregnancy abstain during their second.<sup>15-17</sup> Women who persist smoking in consecutive pregnancies are more likely to be single, younger, and have a lower socioeconomic status,<sup>18</sup> and are more likely to have a smoking partner.<sup>16</sup> A nationwide Irish study investigated two successive pregnancies of women who gave birth twice between 2011 and 2015 and found that persistent smokers had higher rates of reported psychological problems, including anxiety and current depression, which was almost three times more likely compared to persistent non-smokers.<sup>19</sup> It is essential to investigate more thoroughly how maternal psychiatric morbidity is associated with smoking during consecutive pregnancies, as this would allow improved interventions to be tailored accordingly.

This study aims to investigate the association between maternal psychiatric morbidity and maternal smoking status in the second

### Key message

Women who smoke throughout their first pregnancy are likely to smoke also in their second pregnancy. Women who have previous psychiatric morbidity are more likely to smoke during their second pregnancy regardless of their smoking status during the first pregnancy.

pregnancy among women who smoked during their first pregnancy. We hypothesized that successful smoking cessation during the first trimester of the first pregnancy predicts a smoke-free second pregnancy compared to those who continued smoking during their first pregnancy, especially in the absence of a previous psychiatric diagnosis. Additionally, we hypothesized that pregnant women who have any psychiatric diagnosis or suffer from psychiatric burden are more likely to continue smoking during their second pregnancy compared to those without a diagnosis.

## 2 | MATERIAL AND METHODS

### 2.1 | Data sources

The Finnish Medical Birth Register includes data regarding all live births and stillbirths from the gestational age of 22+0 or birth-weight over 500g. The data concerning maternal and fetal health is received from the delivery hospitals or the midwives assisting in infrequent home births. The register contains both the mother's and child's personal identification numbers and information about maternal background, pregnancy, obstetric care, and delivery. The register also includes data about maternal diagnoses during pregnancy, which are collected according to the 10th version of the International Statistical Classification of Diseases and Related Health Problems (ICD-10) in delivery hospitals. These include information from primary healthcare and hospitals. According to the data quality studies, the Medical Birth Register data corresponds well or satisfactorily with hospital records.<sup>20,21</sup>

Since 1967, the Finnish Hospital Discharge Register has held information pertaining to all episodes of inpatient care at public and private hospitals. From January 1998 onwards, outpatient

visits to public hospitals have been included. The register contains information on patients' background, the dates of admission and discharge, the number of hospitalization days, performed procedures, and primary and secondary diagnoses as ICD-10 codes from January 1996 onwards. A systematic review showed that the completeness and accuracy of the register range from satisfactory to very good.<sup>22</sup>

## 2.2 | Study sample

The data included primiparous women who gave birth to their first and second child ( $n=185\,147$ ) during the study period between January 2006 and December 2019 in Finland. Only singleton live births were included. Multiple pregnancies were excluded, as well as the pregnancies where the data on smoking were missing in one or both. Women not smoking during their first pregnancy ( $n=151\,979$ ; 82.1%) were excluded.

Maternal background factors were derived from the Finnish Medical Birth Register. Information on SDP was collected by midwives and nurses based on mothers' self-reports in the following groups: (1) non-smoking, (2) quit smoking during the first trimester (later referred to as "quit smoking"), and (3) continued smoking beyond the first trimester (later referred to as "continued smoking"). The register lacks data on more specific smoking duration, hence it is inconclusive if women quit smoking during the second or third trimester. The socioeconomic status was divided into the following categories: upper white-collar workers, lower white-collar workers, blue-collar workers, and others based on occupation.

The total smoking prevalence during the first pregnancy was 16.0%, and the final study sample comprised 29 683 smoking pregnant women. Of these, 52.5% ( $n=15\,588$ ) had continued smoking after the first trimester, whereas 47.5% ( $n=14\,095$ ) quit smoking during the first trimester. Both smoking groups were then further

divided into three subgroups according to the smoking status in the subsequent pregnancy: non-smoking, quit smoking, or continued smoking in the second pregnancy (Table 2).

## 2.3 | Psychiatric diagnoses

The information on the psychiatric diagnoses was retrieved from the Hospital Discharge Register as ICD-10 codes and linked to the Finnish Medical Birth Register using pregnant women's personal identification numbers. The information about hospital treatments was retrieved until the birth of the second child. Diagnoses that were received before the age of 15 were excluded.

Chapter V of the ICD-10 classification comprises mental, behavioral, and neurodevelopmental disorders (F00–F99). Table 1 presents the ICD-10 diagnoses that were included in the analysis. Diagnoses concerning organic mental disorders (F00–F09), behavioral syndromes associated with physiological disturbances and physical factors (F50–F52, F54–F59), mental retardation (F70–F79), and disorders of psychological development (F80–F89) were excluded, as they were considered less relevant to smoking behavior due to their different etiologies. As the documentation of nicotine addiction (F17) for smokers is deficient in these registers, it was not included. The ICD-10 code O99.3 for mental disorders and diseases of the nervous system complicating pregnancy, childbirth, and puerperium was included in the overall analysis, as well as F53 for mental and behavioral disorders associated with the puerperium, not elsewhere classified.

The main variable, "any psychiatric diagnosis ever," included the psychiatric diagnoses presented in Table 1 with dichotomized categorization (yes or no). In addition, the major diagnosis groups; mood (F30–F39), anxiety (F40–F48), and personality disorders (F60–F62, F68–F69) were analyzed separately. Furthermore, a continuous variable, "psychiatric burden," was formed to represent the number of different diagnostic groups women have received a psychiatric

ICD-10 codes	Diagnoses
F10–F16, F18–F19 <sup>a</sup>	Mental and behavioral disorders due to psychoactive substance use
F20–F29 <sup>a</sup>	Schizophrenia, schizotypal and delusional disorders
<b>F30–F39<sup>a</sup></b>	<b>Mood (affective) disorders</b>
<b>F40–F48<sup>a</sup></b>	<b>Anxiety, dissociative, stress-related, somatoform and other nonpsychotic mental disorders</b>
F53	Mental and behavioral disorders associated with the puerperium, not elsewhere classified
<b>F60–F62, F68–F69<sup>a</sup></b>	<b>Disorders of adult personality and behavior</b>
F90, F91–F98 <sup>a</sup>	Behavioral and emotional disorders with onset usually occurring in childhood and adolescence
O99.3	Mental disorders and diseases of the nervous system complicating pregnancy, childbirth and the puerperium

**TABLE 1** The diagnoses included in the analysis for any (I) psychiatric diagnosis ever, (II) psychiatric burden, and (III) separate diagnosis groups derived from the ICD-10 Chapter V for mental, behavioral, and neurodevelopmental disorders (F00–F99).

Note: For the diagnosis groups marked in bold, also a separate analysis was conducted.

<sup>a</sup>Diagnosis group included in the psychiatric burden analysis.

TABLE 2 The characteristics of the study population according to the maternal smoking status in the first and second pregnancies.

Smoking status in the second pregnancy	Quit smoking in the first pregnancy					Continued smoking in the first pregnancy				
	Total	No smoking	Quit	Continued	Missing	Total	No smoking	Quit	Continued	Missing
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
Total	14095 (100%)	9994 (70.9%)	2629 (18.7%)	1037 (7.4%)	435 (3.1%)	15588 (100%)	4909 (31.5%)	1868 (12.0%)	8238 (52.9%)	573 (3.7%)
Age (years)										
<20	1255 (8.9%)	709 (56.5%)	296 (23.6%)	205 (16.3%)	45 (3.6%)	2852 (18.3%)	651 (22.8%)	323 (11.3%)	1753 (61.5%)	125 (4.4%)
20-24	5283 (37.5%)	3534 (66.9%)	1121 (21.2%)	452 (8.6%)	176 (3.3%)	7393 (47.4%)	2303 (31.2%)	925 (12.5%)	3922 (53.1%)	243 (3.3%)
25-34	7144 (50.7%)	5424 (75.9%)	1157 (16.2%)	364 (5.1%)	199 (2.8%)	5027 (32.3%)	1844 (36.7%)	585 (11.6%)	2404 (47.8%)	194 (3.9%)
35 or more	413 (2.9%)	327 (79.2%)	55 (13.3%)	16 (3.9%)	15 (3.6%)	316 (2.0%)	111 (35.1%)	35 (11.1%)	159 (50.3%)	11 (3.5%)
Marital status										
Married or cohabiting	11894 (84.4%)	8484 (71.3%)	2256 (19.0%)	788 (6.6%)	366 (3.1%)	11490 (73.7%)	3739 (32.5%)	1430 (12.5%)	5897 (51.3%)	424 (3.7%)
Single	2201 (15.6%)	1510 (68.6%)	373 (17.0%)	249 (11.3%)	69 (3.1%)	4098 (26.3%)	1170 (28.6%)	438 (10.7%)	2341 (57.1%)	149 (3.6%)
Socioeconomic status										
Upper white collar	1027 (7.3%)	823 (80.1%)	148 (14.4%)	31 (3.0%)	25 (2.4%)	502 (3.2%)	222 (44.2%)	55 (11.0%)	215 (42.8%)	10 (2.0%)
Lower white collar	4430 (31.4%)	3136 (70.8%)	892 (20.1%)	283 (6.4%)	119 (2.7%)	3636 (23.3%)	1340 (36.9%)	481 (13.2%)	1688 (46.4%)	127 (3.5%)
Blue collar worker	2252 (16.0%)	1544 (68.6%)	454 (20.2%)	195 (8.7%)	59 (2.6%)	3081 (19.8%)	982 (31.9%)	335 (10.9%)	1644 (53.4%)	120 (3.9%)
Other	6386 (45.3%)	4491 (70.3%)	1135 (17.8%)	528 (8.3%)	232 (3.6%)	8369 (53.7%)	2365 (28.3%)	997 (11.9%)	4691 (56.1%)	316 (3.8%)
Year of the second delivery										
2006-2009	4632 (32.9%)	3231 (69.8%)	838 (18.1%)	448 (9.7%)	115 (2.5%)	7485 (48.0%)	2286 (30.5%)	760 (10.2%)	4202 (56.1%)	237 (3.2%)
2010-2014	7097 (50.4%)	4980 (70.2%)	1434 (20.2%)	484 (6.8%)	199 (2.8%)	6537 (41.9%)	2062 (31.5%)	907 (13.9%)	3336 (51.0%)	232 (3.6%)
2015-2019	2366 (16.8%)	1783 (75.4%)	357 (15.1%)	105 (4.4%)	121 (5.1%)	1566 (10.1%)	561 (35.8%)	201 (12.8%)	700 (44.7%)	104 (6.6%)
Time between deliveries										
<2 years	8208 (58.2%)	6062 (73.9%)	1407 (17.1%)	502 (6.1%)	237 (2.9%)	8167 (52.4%)	2488 (30.5%)	884 (10.8%)	4500 (55.1%)	295 (3.6%)
2-5 years	4778 (33.9%)	3214 (67.3%)	1001 (21.0%)	417 (8.7%)	146 (3.1%)	5453 (35.0%)	1726 (31.7%)	691 (12.7%)	2831 (51.9%)	205 (3.8%)
>5 years	1109 (7.9%)	718 (64.7%)	221 (19.9%)	118 (10.6%)	52 (4.7%)	1968 (12.6%)	695 (35.3%)	293 (14.9%)	907 (46.1%)	73 (3.7%)
Any psychiatric diagnosis <sup>a</sup>										
Yes	2446 (17.4%)	1635 (66.8%)	475 (19.4%)	243 (9.9%)	93 (3.8%)	4023 (25.8%)	1063 (26.4%)	473 (11.8%)	2341 (58.2%)	146 (3.6%)

<sup>a</sup>Received after the age of 15 until second delivery.

diagnosis from (classification 0–5 as only a small number of women had received a diagnosis from five or six different diagnosis groups; thus, these were combined).

## 2.4 | Statistical analyses

The statistical analysis was performed using a logistic regression analysis. The association between maternal psychiatric morbidity and the maternal smoking status in the second pregnancy was analyzed separately for women who quit smoking and for those who continued smoking in their first pregnancy. Moreover, women who quit smoking and who continued smoking in the second pregnancy were separately compared to those who did not smoke in their second pregnancy. In the models, maternal psychiatric diagnoses (any psychiatric diagnosis or a diagnosis from a designated group of ICD-10 diagnosis codes) and psychiatric burden were analyzed separately, with the maternal smoking status in the second pregnancy as the dependent variable.

Several covariates were added as independent variables. These included maternal age (continuous) as younger women are more likely to smoke during pregnancy, time between deliveries (continuous, in years, rounded to the nearest whole year) in order to control time bias, as the longer the interval between births, the longer time there is available for psychiatric diagnoses. Smoking could be more likely if the two deliveries are very approximate to one another. The year of the second delivery (continuous) was incorporated to avoid the possible effect of differences in data collection across the study period and the lowering prevalence of SDP. Marital status and socioeconomic status were included as categorical variables, as single women and women belonging to lower social classes are more likely to smoke during pregnancy.

The differences in the results were assessed using 95% confidence intervals (CIs) and *p*-values. Non-overlapping CIs and *p*-values < 0.05 were considered statistically significant. The data analysis was performed with commercially available software (SAS, version 9.4; SAS Institute Inc., Cary, North Carolina).

## 3 | RESULTS

Table 2 depicts the characteristics of the study population. The majority of women who continued smoking in their first pregnancy also continued smoking in their second one (54.9%, *n* = 8238), and 12.4% quit smoking (*n* = 1868). Only one-third were non-smokers in the second pregnancy (32.7%, *n* = 4909). In contrast, women who quit smoking in their first pregnancy were highly likely to be non-smokers in their second (73.2%, *n* = 9994), whereas 19.2% quit smoking (*n* = 2629), and only 7.6% (*n* = 1037) continued smoking during their second pregnancy. The smoking information in the second pregnancy was missing from 3.4% of the study population (*n* = 1008).

One in every four (25.8%, *n* = 4023) pregnant women who continued smoking in their first pregnancy had received at least one psychiatric diagnosis in contrast to 17.4% (*n* = 2446) of those who quit smoking in their index pregnancy. The numbers of the different psychiatric

diagnoses grouped according to ICD-10 diagnosis codes and the smoking status in the first and second pregnancies are presented in Table S1. Of those women who continued smoking in their first pregnancy and had received any psychiatric diagnosis, 54.8% (*n* = 2206) had a diagnosis from one diagnosis group only, and 17.6% (*n* = 709) had received a diagnosis from three or more diagnosis groups. In contrast, among first-pregnancy quitters, a greater proportion of women had received a psychiatric diagnosis from one diagnosis group only (61.4%, *n* = 1503), and fewer women had a diagnosis from three or more diagnosis groups (12.4%, *n* = 303). Please see Table S2 for more details.

### 3.1 | Women who continued smoking during their first pregnancy

Women who continued smoking during their first pregnancy and had received any psychiatric diagnosis were more likely to continue smoking in their second pregnancy (odds ratio [OR] 1.44; 95% CI 1.32–1.57) or quit smoking in their second (OR 1.14; 1.01–1.30) compared to women without a prior diagnosis. In the psychiatric burden analysis, as the number of different diagnosis groups from which the women had a diagnosis increased, the likelihood of smoking in the second pregnancy increased for both “continued smoking” (OR 1.20; 1.14–1.25) or “quit smoking” (OR 1.08; 1.01–1.15). Table 3 depicts the results of separately analyzed diagnosis groups for different psychiatric disorders. Please see Table S3 for more comprehensive results. If pregnant women had been diagnosed with a mood (F30–F39), anxiety (F40–F48), or personality disorder (F60–F62, F68–F69), they were more likely to continue smoking in their second pregnancy. A prior mood disorder diagnosis (F30–F39) was also associated with a higher likelihood of quitting smoking in the subsequent pregnancy, but the other diagnosis groups were not.

### 3.2 | Women who quit smoking during their first pregnancy

Women who quit smoking during their first pregnancy and had ever received any psychiatric diagnosis were more likely to continue smoking in their second pregnancy (OR 1.37; 1.17–1.60) as were those who had psychiatric burden (OR 1.20; 1.10–1.30). However, no association was observed with quitting smoking in the second pregnancy in these analyses (Table 3). When different diagnostic groups were analyzed separately, a diagnosis was associated with continued smoking in the second pregnancy in all different diagnosis groups, where the most profound association was found with the diagnoses for personality disorders (OR 1.82; 1.23–2.70). An anxiety disorder diagnosis was also associated with a higher likelihood of quitting smoking in the second pregnancy (OR 1.16; CI 1.01–1.34). Figure 1 summarizes our findings for the association between psychiatric morbidity and the smoking status in the second pregnancy.

We accounted for the available covariates. The time between deliveries varied from below 1 year to 13 years. Among first-pregnancy

**TABLE 3** The association of different psychiatric disorders grouped by ICD-10 classification codes and the maternal smoking status in the second pregnancy.

1. Pregnancy smoking status	2. Pregnancy smoking status	Ref.	Any psychiatric diagnosis	Mood disorder (F30–F39)	Anxiety <sup>a</sup> disorder (F40–F48)	Personality disorder (F60–F62, F68–F69)	Psychiatric burden <sup>b</sup>
			OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
Quit smoking <sup>c</sup>	Quit smoking	1	1.08 (0.96–1.21)	1.04 (0.91–1.20)	1.16 (1.01–1.34)	0.91 (0.64–1.31)	1.05 (0.98–1.12)
	Continued smoking		1.37 (1.17–1.60)	1.30 (1.07–1.57)	1.38 (1.14–1.68)	1.82 (1.23–2.70)	1.20 (1.10–1.30)
Continued smoking <sup>d</sup>	Quit smoking	1	1.14 (1.01–1.30)	1.17 (1.01–1.36)	1.13 (0.96–1.32)	1.12 (0.82–1.53)	1.08 (1.01–1.15)
	Continued smoking		1.44 (1.32–1.56)	1.31 (1.19–1.45)	1.30 (1.17–1.45)	1.38 (1.12–1.71)	1.19 (1.14–1.25)

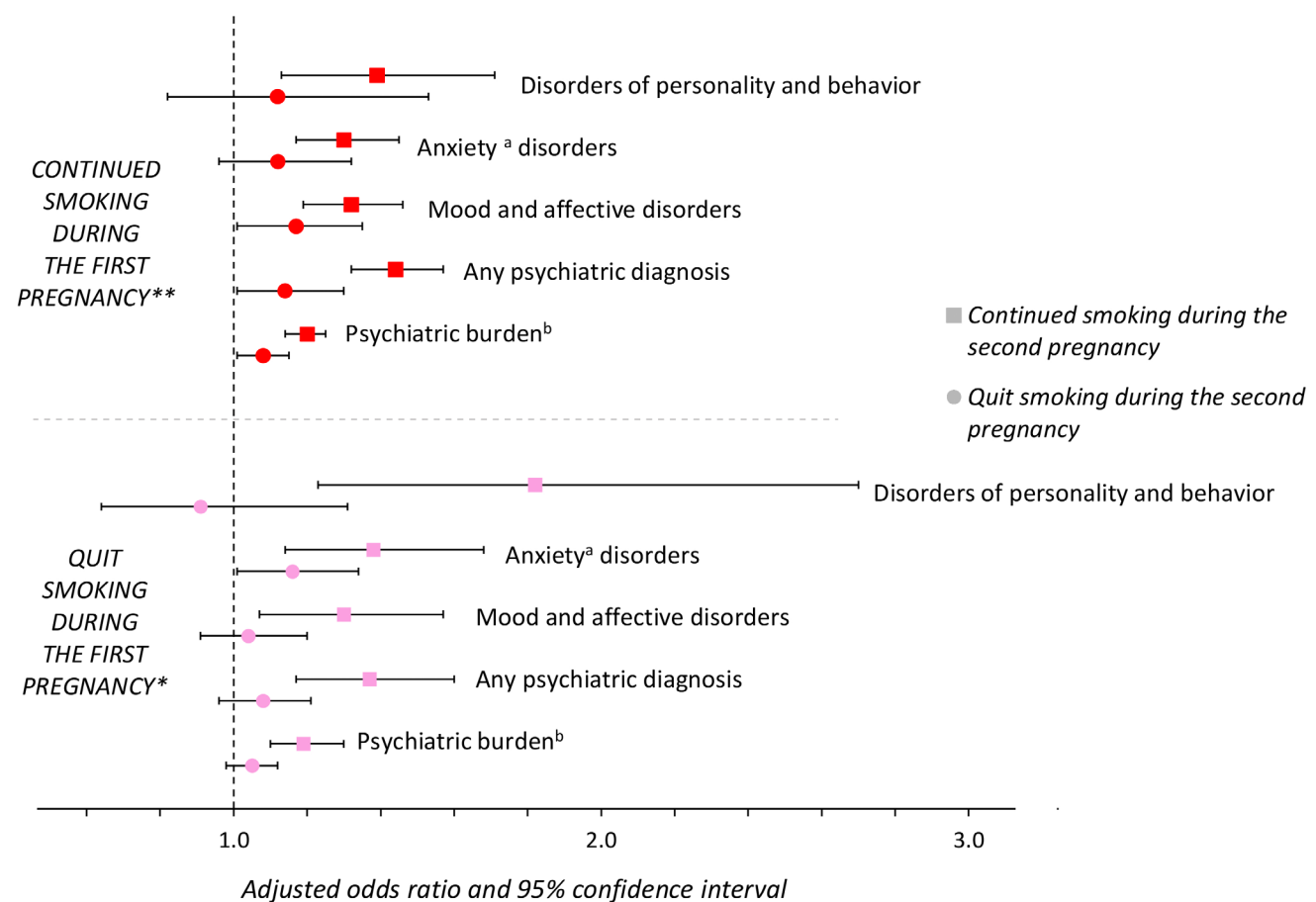
Note: Please see [Table S3](#) for the sensitivity analysis.

<sup>a</sup>Anxiety, dissociative, stress-related, somatoform, and other nonpsychotic mental disorders.

<sup>b</sup>Burden=from how many different diagnosis groups (0–5) a woman has a diagnosis from.

<sup>c</sup>Reference=Quit smoking in the first pregnancy and non-smoker in the second pregnancy.

<sup>d</sup>Reference=Continued smoking in the first pregnancy, and non-smoker in the second pregnancy.



**FIGURE 1** The association between maternal psychiatric morbidity and smoking in the second pregnancy according to different psychiatric diagnosis groups among women who smoked in their first pregnancy. <sup>a</sup>Anxiety, dissociative, stress-related, somatoform, and other nonpsychotic mental disorders. <sup>b</sup>Burden; from how many different diagnosis groups (0–5) women have received a diagnosis. \*Quit smoking in the first, no smoking in the second pregnancy; reference=1. \*\*Continued smoking in the first, no smoking in the second pregnancy; reference=1.

continued smokers, the increasing time between deliveries increased the likelihood of quitting and decreased the likelihood of continued smoking in the second pregnancy. A later birth year lowered the odds of continued smoking regardless of the smoking status during the first pregnancy. A higher maternal age decreased the odds of both quitting and continuing smoking in the second pregnancy in both smoking groups. Please see [Table S3](#) for the analysis of the different covariates.

## 4 | DISCUSSION

As expected, women who continued smoking after the first trimester of their first pregnancy more often smoked in their second pregnancies compared to those women who succeeded in quitting smoking in their first pregnancy. The novel aim of this study was to investigate the psychiatric morbidity and smoking patterns of women during their first two pregnancies. This study setting allowed us to examine the association between a history of mental health problems and SDP beyond one pregnancy. As we hypothesized, the presence of any psychiatric diagnosis was associated with continued smoking in the second pregnancy despite the duration of smoking in the first pregnancy. The prior psychiatric burden was also associated with continued smoking in the second pregnancy.

Women who continued smoking in their first pregnancy were more likely to smoke in their subsequent pregnancy: 53% continued smoking and 12% quit smoking during the first trimester. Approximately, one-third were non-smokers during their second pregnancy. This quit rate of first-pregnancy continued smokers is in line with earlier studies.<sup>16,18,23</sup> According to a systematic review, after a successful cessation intervention, 40% of quitters relapse to smoking 6 months postpartum.<sup>24</sup> The women who quit between pregnancies might be light or occasional smokers.<sup>19,23</sup> Unfortunately, the heaviness of smoking cannot be studied in the scope of this study, as the number of cigarettes is not currently included in the Finnish Medical Birth Register.

The prevalence of any prior psychiatric diagnosis after the age of 15 years until the birth of the second child in our study population was 26% among those who continued smoking in the first pregnancy compared to 17% among those who quit smoking during the first trimester of their first pregnancy. Some previous research has accounted for SDP and prior mental health, and significantly higher prevalence numbers have been reported. In a US study, 48% of pregnant smokers reported previous mental health conditions (schizophrenia, depression, or bipolar disorder).<sup>11</sup> In another study, pregnant smokers were twice as likely to meet the diagnostic criteria for a psychiatric diagnosis in a screen for the past 12 months compared to non-smokers.<sup>25</sup> However, caution should be taken when considering the relationship between smoking and mental health, as the nature of this relationship is complex, and the direction cannot be verified.

Despite the high prevalence of mental health challenges among pregnant smokers, studies have reported ambiguous results regarding the relationship between their current mental health and SDP. A history of mental health problems has been found to contribute to

smoking continuation during pregnancy, but the current symptoms have always not.<sup>11</sup> Postpartum depressive symptoms were associated with a higher likelihood of a postpartum smoking relapse,<sup>26</sup> but the maternal self-reported mood was not.<sup>27</sup> In postpartum smoking relapse prevention, low symptoms predicted better success postpartum, but a previous disorder history did not have an effect.<sup>28</sup> However, based on our findings, the previous psychiatric morbidity based on diagnosed cases might reflect the relationship between mental health and the likelihood of SDP better than the current mental health assessment, which is often based on structured interviews of questionnaires in study settings.

It has been proposed that pregnant women who are unable to quit SDP would have higher smoking intensity, hence a stronger nicotine addiction. Only a few studies on SDP and mental health have accounted for nicotine dependence. A previous study showed that although almost half of the pregnant smokers screened positive for mental disorders, cigarette use without nicotine dependence was not associated with mental disorders.<sup>29</sup> In another study, the majority of those who screened positive for nicotine dependence had quit smoking after learning that they were pregnant, and only 19% of pregnant smokers were nicotine dependent, according to the screening. Interestingly, women who had quit smoking after learning they were pregnant were also more likely to screen positive for any disorder.<sup>25</sup> Due to the deficiency in reporting nicotine dependence within the Finnish Hospital Discharge register, it was excluded from the analysis and could not be assessed in this study.

Some studies have also investigated the relationship between smoking in consecutive pregnancies and mental health. In a Norwegian cohort study, pregnant smokers who reported increasing psychological distress between two pregnancies were less likely to quit smoking before their second pregnancy.<sup>16</sup> In a longitudinal Irish study, persistent smokers ( $n=609$ ) more likely reported previous and current depression, anxiety, and postnatal depression during both pregnancies compared to non-smokers. Women who quit smoking in between pregnancies ( $n=202$ ) were more likely to report current depression and anxiety in the first but not during the second pregnancy. The quitters did not differ in terms of postnatal depression and a history of depression from persistent smokers.<sup>19</sup> This interaction between prior mental health, current mental health, and smoking patterns during pregnancy remains ambiguous and intertwined, and caution should be taken in assessing the causality of these.

Our study offers insight into the smoking duration variation during consecutive pregnancies, as many previous studies on two pregnancies have accounted for dichotomized smoking only, and the smoking group might also include first-trimester quitters. As we did not have access to information about smoking before pregnancy, the non-smoking group may therefore include several pre-pregnancy quitters. A Finnish study found that over 30% of women planning a pregnancy had smoked within the year before conception, but more than 50% quit smoking before becoming pregnant.<sup>30</sup> The current study population was limited to women who smoked during their first pregnancy and had two consecutive deliveries. The information this study offers about psychiatric morbidity reflects the lifetime but not

the current mental health situation, as we have no access to information about different measures of mental health during pregnancy. The prevalence numbers are not directly comparable, as our study population remarks hospital-diagnosed cases only, which might be a substantially smaller amount than what would be traceable via screenings by standardized questionnaires or interviews often used in the previous research. However, given the study setting, this study population might reflect more severe psychiatric morbidity since the information about psychiatric diagnoses is from secondary and tertiary hospitals, as numerous psychiatric conditions are treated almost solely in primary care in Finland. It is worth noting that the diagnoses from the outpatient visits in the patient registers are available only from 1998 onwards; hence, these do not contain all the data preceding birth that might be relevant in assessing the lifetime burden as some pregnant women might lack the information from early adulthood.

The strengths of this study include the large nationwide study population and the use of reliable registers. This study offers more detailed information about maternal psychiatric morbidity and smoking in addition to the apprehension of SDP beyond one pregnancy. It also accounts for the smoking duration. One considerable limitation of this study is that the smoking data are based on women's self-reports only and have not been verified by any tests. According to the studies on smoking, people often underestimate the number of cigarettes they smoke.<sup>31</sup> Hence, some real continued smokers might be misclassified as quitters or quitters as non-smokers. However, the accuracy of the SDP data on the Finnish Medical Birth Register has been evaluated to be sufficient for research,<sup>20</sup> and the data collection has been done in the same manner across the entire study period. Also, the classification of smoking data is not entirely thorough as the Medical Birth Register data do not differentiate whether the women quit smoking during the second or third trimesters; hence, the exact duration of smoking cannot be assessed using these data sources. Unfortunately, we did not have access to smoking information in between pregnancies or information about the use of other nicotine products. However, according to the latest national reports from 2022, the prevalence of Swedish snuff or electronic cigarettes use has remained low (under 1%–2%) among the adult female population in Finland.<sup>6</sup>

Unfortunately, the information concerning the smoking patterns of the partners of pregnant women is unavailable in the Finnish Medical Birth Register. As for women who persist on SDP in the general population, a non-smoking partner could be an important contributing factor for more permanent smoking cessation also for women who have prior mental health challenges. Previous studies have demonstrated that persistent smokers in two pregnancies also appear to engage in other disadvantageous lifestyle behaviors, such as alcohol consumption during pregnancy, compared to persistent non-smokers.<sup>19</sup> Unfortunately, there is no registration for the use of alcohol in Finland's current registers, but it is quite rare, as is drug use during pregnancy; hence, it was not included as a confounder in the analysis.

We suggest that, based on the current findings, the maternal mental health history should be considered during pregnancy as the focus in maternity care often is on current mental health problems and ongoing treatments. Preceding mental health challenges might

still influence smoking cessation attempts during pregnancy. Smoking cessation interventions should be tailored to account for mental health challenges also, and this support should continue after delivery in child health clinics. A previous study even suggests screening for personality disorders for pregnant smokers, as there appears to be an interaction between nicotine addiction and personality disorders.<sup>32</sup> Although an untargeted screening for prior mental health conditions for all pregnant women might not be beneficial or economical, a focused screening as a part of smoking cessation intervention could offer us new insight as to who is going to succeed in more permanent smoking cessation and who is at risk of a relapse or in need of more intense support. In the future, it would be essential to get more detailed data from maternity care clinics and primary care to assess the association of current mental health on smoking patterns during consecutive pregnancies, as well as the perinatal period, more thoroughly.

## 5 | CONCLUSION

Pregnant women who are unable to quit smoking during their first pregnancy are at a greater risk for persistent smoking in the future. The prior psychiatric morbidity is associated with smoking in the second pregnancy among first-pregnancy smokers regardless of the smoking duration during the first pregnancy. Based on our findings, psychiatric support and intense smoking cessation support and interventions should be targeted especially to women who smoke during their first pregnancy and have psychiatric conditions in their medical history. It is essential to continue this support also after birth.

### AUTHOR CONTRIBUTIONS

Hanna P. Wallin: Study design; writing the manuscript. Mika Gissler: Study design; statistical analysis; supporting writing the manuscript. Päivi E. Korhonen: Supporting writing the manuscript. Mikael O. Ekblad: Statistical analysis; study design; supporting writing the manuscript.

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### CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

### DATA AVAILABILITY STATEMENT

The data that support the findings of this study are not publicly available due to privacy or ethical restrictions. Researcher can apply for similar data from Findata, Finnish Social and Health Data Permit Authority <https://findata.fi/en/>.

### ETHICS STATEMENT

An ethical review is not required in register-based studies in Finland if the registered persons are not contacted. The Finnish Institute for

Health and Welfare is the current maintainer of the registers that were utilized and allowed the use of confidential health register data in scientific research as required by national data protection legislation. The statistical authority made the ethical evaluation and performed the data linkage, and only unidentifiable data was provided to the researchers.

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## SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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