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REGULAR ARTICLE

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Maternal use of nicotine products and breastfeeding 3 months postpartum

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Abstract

Aim: We aimed to determine the prevalence of and factors associated with maternal use of nicotine products in relation to breastfeeding.

Methods: Nicotine use 3 months postpartum was determined in the Scandinavian PreventADALL mother-child birth cohort study recruiting 1837 women from 2014 to 2016. Electronic questionnaires at 18 weeks pregnancy and 3 months postpartum provided information on snus use, smoking or other nicotine use, infant feeding and socio-economic factors. The risk of nicotine use in relation to breastfeeding was analysed with logistic regression.

Results: Overall, 5.6% of women used snus (2.9%), smoked (2.7%) or both (n = 2) 3 months postpartum, while one used other nicotine products. Among the 1717 breastfeeding women, 95.1% reported no nicotine use, while 2.4% used snus, 2.5% smoked and one dual user. Compared to 3.7% nicotine use in exclusively breastfeeding

Abbreviations: PreventADALL, Preventing Atopic Dermatitis and ALLergies in children; NRT, Nicotine replacement therapy; Snus, Moist tobacco product placed below the upper lip; E-cigarettes, Electronic cigarettes.

See On behalf of the PreventADALL study group (alphabetical order) members are given in Appendix 1

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women (n = 1242), the risk of nicotine use increased by partly (OR 2.26, 95% CI 1.45-3.52) and no breastfeeding (OR 4.58, 95% CI 2.57-8.21). Nicotine use before (14.5% snus, 16.4% smoking) or in pregnancy (0.2% snus, 0.4% smoking) significantly increased the risk of using nicotine during breastfeeding.

Conclusion: Few breastfeeding women used snus or smoked 3 months postpartum, with increased risk by nicotine use before or during pregnancy.

KEYWORDS

birth cohort, breastfeeding, maternal smoking, pregnancy, snus use

1 | INTRODUCTION

Exposure to cigarette smoking and other nicotine products in early life, including preconceptional period and during pregnancy, may cause adverse health outcomes in the infant.[1-3] Moreover, breastfed infants exposed to smoking or snus by their nursing mothers are exposed to high levels of nicotine through the breast milk.[4,5] Nicotine may remain in the breast milk for 12.5 hours after the last snus dose and 4 hours after the last cigarette.[5] Smoking during breastfeeding has been shown to reduce the health promoting properties of breast milk including lower fat concentration, reduced milk production possibly through reduced levels of prolactin, shorter breastfeeding periods[6] and may affect the taste of the breast milk. Moreover, an increased risk for several conditions has been observed in the smoke-exposed infant, including colic, sleep disruption,[7] allergies, respiratory disorders,[6,8] neurobehavioural disorders,[7] sudden infant death syndrome,[6,7] altered heart rate variability,[9] and overweight and obesity later in life.[7]

In contrast to smoking during and after pregnancy, information on the use of snus and other nicotine products in relation to breastfeeding is largely lacking.[2] In a study conducted in 2009 in Italy, 8.1% of around 3700 women reported smoking 3 months postpartum, with a prevalence of 5.2% among breastfeeding women.[10] Further, 12 months postpartum, the corresponding rates were 10.9% and 6.6%, respectively.[10] Recent Swedish statistics reported maternal smoking among 3% one month postpartum and 4% eight months postpartum.[11] We are unaware of data related to the use of snus or nicotine replacement therapies (NRT) during breastfeeding.

Risk factors for postpartum smoking include smoking or exposure to second-hand smoking prior to, or during pregnancy, lower education, younger age, multiparity, stress, depression or anxiety, and not breastfeeding.[12,13] Risk factors for snus or NRT use postpartum are not known. A Swedish register study recently reported that 1.1% of women used snus in early pregnancy.[14] Among the women recruited to the Preventing Atopic Dermatitis and ALLergies study (PreventADALL), 0.6% reported snus use at approximately 18 weeks and 0.3% at 34 weeks of pregnancy.[15] Although 11.3% reported use of any nicotine-containing product of whom 6.5% used snus and 4.1% reported smoking in the first 34 weeks of pregnancy, most women stopped using nicotine-containing products when they recognised their pregnancy.[15] The breastfeeding rates in Scandinavia are high, with 84%-86% reporting exclusively or partly breastfeeding in the first 2-3 months postpartum in Norway[16] and Sweden.[11] Despite reduced female smoking rates in the recent decades, the breastfeeding infant is faced with an unknown threat due to increased nicotine use seen as snus use in the Scandinavian countries and as electronic cigarettes (e-cigarettes) in the USA.[17]

Key notes

- The use of various nicotine products during breastfeeding is not well known.
- Among breastfeeding women 3 months postpartum, 95% did not use nicotine products, the lowest rates of snus use (1.9%) or smoking (1.9%) were observed in exclusively breastfeeding women and the risk of nicotine use during breastfeeding increased by nicotine use before and in pregnancy.
- Young women should be discouraged from ever using nicotine products.

The primary aim of the present study was therefore to determine the prevalence of maternal smoking and use of nicotine products during breastfeeding. The secondary aim was to determine whether nicotine use differed among exclusively, partly or non-breastfeeding women, and to identify factors associated with use of nicotine products 3 months postpartum.

2 | SUBJECTS AND METHODS

2.1 | Study design

The present study used data from the Scandinavian, PreventADALL study, a prospective general population-based mother-child cohort established in December 2014, investigating the effects of primary prevention strategies for reducing allergic diseases, as well as assessing early life factors involved in development of allergic and other non-communicable diseases.

All pregnant women scheduled for routine 18-week gestational age (GA) ultrasound screening at hospitals in Oslo and Østfold (Norway) and Stockholm, Sweden, were invited to participate in the study. Overall, 2697 women with 2701 pregnancies were enrolled within 22 months, 2149 in Norway and 552 in Sweden.[18] Inclusion criteria were singleton or twin pregnancies at 16-22 gestational weeks and sufficient Scandinavian language skills. Exclusion criteria were severe maternal or foetal disease, or plans to move from the area within the first year of the child's life. Their healthy infants born at GA of at least 35.0 weeks were enrolled at birth, totalling 2397 mother-child pairs.[18]

The enrolment visit in connection with the ultrasound screening included signing the written informed consent, a brief interview, as well as height, weight and blood pressure measurement. Shortly after enrolment, women completed an extensive electronic questionnaire including socio-economic, demographic, lifestyle and medical history data.

The infants were included at the maternity ward after obtaining signed informed consent by both parents, whenever possible. Obstetric history and birth outcomes were retrieved from electronic hospital charts by dedicated study personnel. The infants attended follow-up visits at 3, 6 and 12 months of age, including clinical investigations and biological sampling. Electronic questionnaires with information of health and disease in the mother, child and the family, lifestyle, environment, stress, diet and maternal use of nicotine products were completed by the mother at the infant age of 3 months, with further follow-up studies not reported in the present study.[18]

2.2 | Subjects

The present study included all 1837 women who completed the 18 weeks pregnancy questionnaire as well as the 3 months postpartum questionnaire (Figure 1). With the exception of a smaller proportion having low income, lower educational attainment level, younger age, several previous pregnancies, use of snus and smoking prior to pregnancy, the included women were largely similar to the 863 women who were not included in the present study (Table S1).

2.3 | Methods

Electronic questionnaires were developed in collaboration with the University Center for Information Technology of the University of Oslo[18] and sent by e-mail to the participating women at 18 and

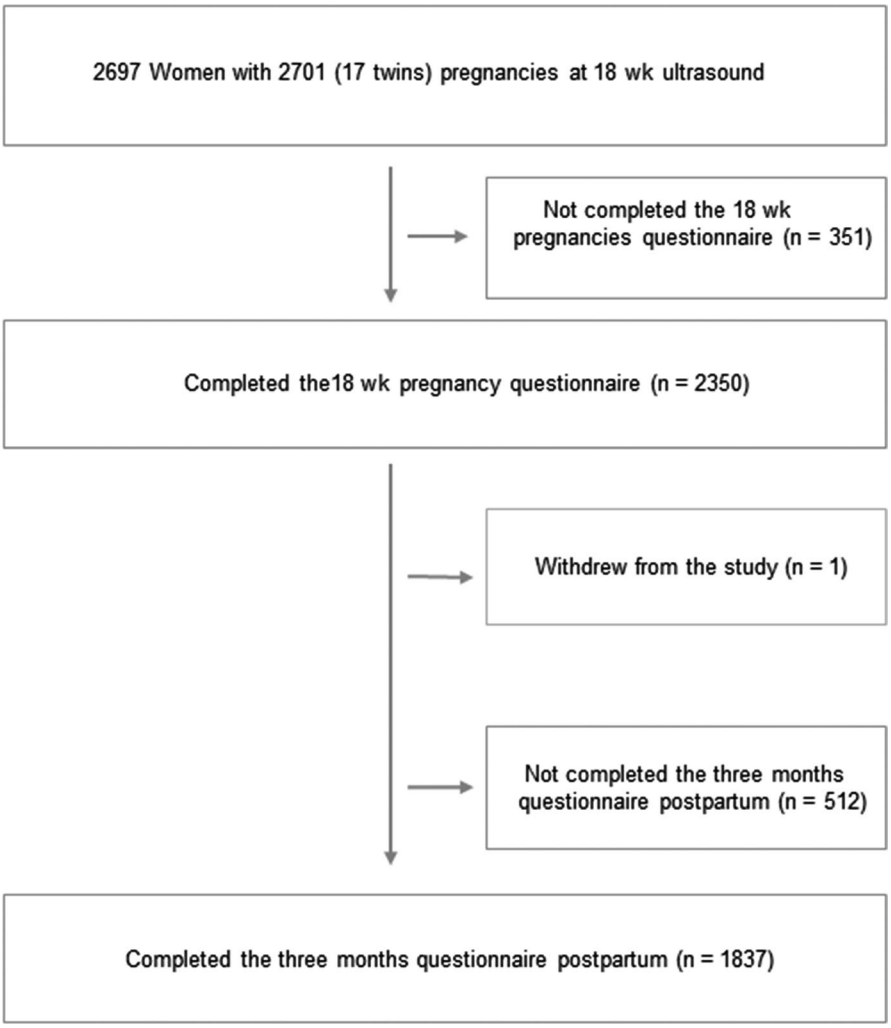

FIGURE 1 Flow chart of the PreventADALL study and number of women who completed the 18 wks pregnancy questionnaire and 3 mo postpartum questionnaire

34 weeks of pregnancy and at 3 months postpartum. The 18 weeks pregnancy questionnaire included data on demographic characteristics, medical history and lifestyle. All questionnaires focused on maternal smoking, use of snus and other nicotine products including, but not limited to e-cigarettes, NRT, cigar/cigarillo or pipe, before and during pregnancy. The 3 months postpartum questionnaire also included detailed information on infant feeding, proportion of breastfeeding, bottle feeding, use of infant formula or other food.

Smoking or use of nicotine products was recorded in relation to the time up to enrolment in the 18 weeks pregnancy questionnaire, from enrolment to presently in the 34 weeks pregnancy questionnaire from 34 weeks to delivery as well as for the last 3 months in the 3 months postpartum questionnaire. The women were asked whether they had smoked or used any nicotine products ever in the 18 weeks pregnancy questionnaire. If yes, they responded to the following mutually excluding categories; for smoking, snus use or other nicotine use; I stopped several years ago, I stopped just before the pregnancy, I stopped when recognising pregnancy, I have smoked/used snus or other nicotine products during the pregnancy. In the 3 months postpartum questionnaire, the women reported any use of nicotine products with the following options; no, yes or do not know, followed by further questions if answering yes; in which they recorded daily or occasional smoking or use of snus. The following mutually exclusive categories were used; less than once per month, less than weekly, approximately 1-2 days per week, approximately 3-5 days per week or daily. Further, they recorded the number of cigarettes or snus doses per day and per month.[15] For other nicotine products, the categories were as follows: never, less than monthly, 1-3 times per month, once weekly, 1-5 times per day, 6-10 times or >10 times per day.

Use of smoking and nicotine product is reported in terms of smoking, snus use, dual users (smoking and snus use), e-cigarettes, NRT (patches or gum/lozenges/spray) and other nicotine products (cigar/cigarillo, pipe, other).

The PreventADALL study was approved by the Regional Committee for Medical and Health Research Ethics in South-Eastern Norway (2014/518) and in Sweden (2014/2242-31/4) as well as registered at clinicaltrials.gov (number NCT02449850).

2.4 | Outcomes, definitions and explanatory variables

The main outcome was maternal smoking and/or use of other nicotine products, defined as daily or occasional use during the first three postpartum months.

Possible explanatory variables for smoking or use of nicotine products during breastfeeding included maternal age by three categories: 16-24, 25-34, >35 years. Maternal and paternal education level were reported by three categories as primary or high school only, higher education of <4 years and higher education of more than 4 years. Marital status was categorised into married, cohabitant, and single or separated or other. Country of origin was given as Norway, Sweden, other Nordic and other countries. Total household income was classified as low, middle and high based upon conversion into <30 000, 30 000-100 000 and >100 000 Euros, respectively. Living environment was categorised into densely populated city, city less densely populated, suburb, village or countryside outside village. The number of previous pregnancies was given as none, one or more than one. Maternal smoking and snus use were classified as use before pregnancy and use during pregnancy.

2.5 | Statistical analysis

Categorical variables are presented as number and percentages, and continuous variables as means and minimum-maximum. Possible differences between categorical variables were analysed with the chi-square test. Associations between the use of nicotine products postpartum and breastfeeding, as well as for exploration of factors associated with use of nicotine during breastfeeding, were estimated using multiple logistic regression analyses. The results are expressed as odds ratios (OR) with 95% confidence intervals (CI). Significance level was set to 0.05. All tests were two-sided. Since all analyses were exploratory, no correction for multiple testing was made. All analyses were performed by SPSS statistics version 25 (IBM).

3 | RESULTS

The baseline characteristics of the participating women at 18 weeks of pregnancy are given in Table S1. The mean age at enrolment was 32.5 years, and the majority of women were born in Norway or Sweden.

The vast majority of women breastfed their infant at 3 months of age, with 1242 (67.7%) exclusively and 475 (25.9%) partly breastfeeding, while 120 (6.5%) women did not breastfeed (Table 1).

Use of nicotine prior to and/or during pregnancy is outlined in Table S1. Briefly, snus use was reported by 14.5% before pregnancy, while the majority stopped at the time of recognising the pregnancy. Only 0.2% used snus at approximately 18 week pregnancy. The corresponding figures for smoking were 16.4% before pregnancy and 0.4% in mid-pregnancy.

At 3 months postpartum, the majority of mothers (94.4%) did not report use of any nicotine product, while 102 (5.6%) reported use of any nicotine products; 50 (2.7%) reporting smoking, 54 (2.9%) reporting snus use and two were dual users. One breastfeeding woman reported use of other non-specified nicotine products (Table 2).

Among all 1717 breastfeeding women, 84 (4.9%) reported use of snus or smoking 3 months postpartum, with 2.4% reporting smoking, 2.5% used snus, and one was a dual user. Most women reported occasional smoking or snus use, with daily snus use in 0.9% of women and daily smoking in 0.4% (Table S2). The use of snus and smoking was similar in Norway and Sweden (Table S3). None of the breastfeeding women reported use of NRT or e-cigarettes, while one woman reported use of other non-specified nicotine

TABLE 1 Background characteristics of the included women in relation to breastfeeding groups 3 mo postpartum

Background characteristics	No.	Exclusive breastfeeding n = 1242	Partly breastfeeding n = 475	Not breastfeeding n = 120
Median maternal age–year(min-max)		32.5 (21-45)	32.7 (20-48)	32 (21-43)
Age, mother*-n (%)	1837			
16-24 y		18 (1.4)	10 (2.1)	7 (5.8)
25-34 y		869 (70.0)	308 (64.8)	77 (64.2)
35-44 y		353 (28.4)	155 (32.6)	36 (30.0)
>45 y		2 (0.2)	2 (0.4)	0 (0.0)
Education mother*-n (%)	1700			
Primary school		4 (0.3)	1 (0.2)	5 (4.6)
High school		82 (7.1)	51 (11.6)	28 (25.7)
Higher education < 4 y		348 (30.3)	132 (29.9)	40 (36.7)
Higher education > 4 y		716 (62.3)	257 (58.3)	36 (33.0)
Education partner*-n (%)	1632			
Primary school		11 (1.0)	5 (1.2)	3 (2.9)
High school		178 (16.1)	85 (20.0)	36 (35.0)
Higher education < 4 y		323 (29.3)	133 (31.3)	32 (31.1)
Higher education > 4 y		592 (53.6)	202 (47.5)	32 (31.1)
Marital status*-n (%)	1709			
Married		498 (43.0)	178 (40.4)	36 (41.7)
Cohabitant		639 (55.2)	252 (57.1)	68 (61.3)
Single		12 (1.0)	10 (2.3)	4 (3.6)
Other		8 (0.7)	1 (0.2)	3 (2.7)
Country of origin*-n (%)	1709			
Norway		803 (69.4)	272 (61.7)	68 (61.3)
Sweden		237 (20.5)	125 (28.3)	25 (22.5)
Other Nordic		17 (1.5)	3 (0.7)	1 (0.9)
Other		100 (8.6)	41 (9.3)	17 (15.3)
Family income*-n (%)	1686			
Low		5 (0.4)	4 (0.9)	4 (3.8)
Middle		594 (51.8)	254 (58.7)	66 (62.3)
High		548 (47.8)	175 (40.4)	36 (34.0)
Living environment*-n (%)	1709			
City, densely populated		458 (39.6)	186 (42.2)	31 (27.9)
City, less dense populated		448 (38.7)	146 (33.1)	49 (44.1)
Suburb		168 (14.5)	85 (19.3)	18 (16.2)
Countryside, in village		28 (2.4)	7 (1.6)	1 (0.9)
Countryside, outside village		55 (4.8)	17 (3.9)	12 (10.8)
Previous pregnancy-n (%)	1837			
0		597 (48.1)	259 (54.5)	69 (52.5)
1		334 (26.9)	113 (23.8)	23 (19.2)
>1		311 (25.0)	103 (21.7)	34 (28.3)
Snus use-n (%)	1837			
No		982 (79.1)	369 (77.7)	98 (81.7)
Use before pregnancy		183 (14.7)	71 (14.9)	12 (10.0)
Stop when recognised pregnancy		73 (5.9)	35 (7.4)	10 (8.3)

(Continues)

TABLE 1 (Continued)

Background characteristics	No.	Exclusive breastfeeding n = 1242	Partly breastfeeding n = 475	Not breastfeeding n = 120
Use in pregnancy		4 (0.3)	0 (0.0)	0 (0.0)
Use before pregnancy and relapse		5 (0.4)	5 (1.1)	1 (0.8)
Stop when recognised pregnancy and relapse		13 (1.0)	14 (2.9)	8 (6.7)
Use in pregnancy and persistent use postpartum		3 (0.2)	0 (0.0)	0 (0.0)
No use before pregnancy but use postpartum		2 (0.2)	1 (0.2)	2 (1.7)
Use daily postpartum		8 (0.6)	2 (0.4)	6 (5.0)
Use occasionally postpartum		15 (1.2)	18 (3.8)	5 (4.2)
Smoking *-n (%)	1837			
No		1001 (80.6)	364 (76.6)	99 (82.5)
Use before pregnancy		203 (16.3)	83 (17.5)	15 (12.5)
Stop when recognised pregnancy		34 (2.7)	27 (5.7)	4 (3.3)
Use in pregnancy		4 (0.3)	1 (0.2)	2 (1.7)
Use before pregnancy and relapse		5 (0.4)	4 (0.8)	1 (0.8)
Stop when recognised pregnancy and relapse		7 (0.6)	9 (1.9)	2 (1.7)
Use in pregnancy and persistent use postpartum		4 (0.3)	1 (0.2)	2 (1.7)
No use before pregnancy but use postpartum		7 (0.6)	5 (1.0)	3 (2.5)
Use daily postpartum		3 (0.2)	1 (0.2)	3 (2.5)
Use occasionally postpartum		20 (1.6)	18 (3.8)	5 (4.2)

Note: Data are presented as median (min-max) or n (%), No. =number

**P*-value < .05. Postpartum = is the time from birth to 3 mo.

TABLE 2 Use of nicotine-containing products at 3 mo postpartum according to breastfeeding group

Nicotine-containing products	Exclusive breastfeeding n = 1242	Partly breastfeeding n = 475	No breastfeeding n = 120	Total n = 1837
No use—n (%)	1196 (96.3)	437 (92.0)	102 (85.0)	1735 (94.4)
Any use	**46 (3.7)**	**38 (8.0)**	**18 (15.0)**	102 (5.6)
Snus	**23 (1.9)**	**20 (4.2)**	**11 (9.2)**	
Cigarette	23 (1.9)	19 (4.0)	8 (6.7)	
Dual users	0	1 (0.2)	1 (0.8)	
E-cigarette	0	0	0	
NRT	0	0	0	
Other nicotine product	1 (0.1)	0	0	

Note: P-value < .05 in bold.

products (Table 2). Women who did not breastfeed 3 months postpartum used snus or smoking significantly more often than women who were partly or exclusively breastfeeding (Table 2). Compared with exclusively breastfeeding women, partly breastfeeding women had 2.3 times higher odds for using snus or smoking (OR 2.26, 95% CI 1.45-3.52) while the odds were 4.6 times higher in non-breastfeeding women (OR 4.58, 95% CI 2.57-8.21), shown as estimated proportions (with 95% CI) (Figure 2).

In univariate logistic regression analyses, the following characteristics were all significantly associated with maternal smoking and use of snus during breastfeeding at 3 months postpartum: maternal age and education, partner's education, family income, and smoking

and/or use of snus before and during pregnancy. In multiple regression analyses adjusted for the significant explanatory variables, snus use before pregnancy, smoking and/or snus use during pregnancy and middle compared with high family income were most strongly association with use of snus or smoking during breastfeeding, as shown in Table 3.

4 | DISCUSSION

In this Scandinavian mother-child cohort with a 94% breastfeeding rate 3 months postpartum, 4.9% of the breastfeeding women reported use of snus or smoking, with 2.4% of women reporting smoking and 2.5% snus use. The lowest prevalence was 3.7% among exclusively breastfeeding women, with 8.0% of partly breastfeeding and 15.0% of non-breastfeeding women reporting use of snus or smoking 3 months postpartum. None reported use of NRT or e-cigarette. Use of snus before pregnancy, maternal smoking and/or use of snus during pregnancy and middle family income significantly increased the risk of maternal smoking and snus use during breastfeeding.

The prevalence of snus use 3 months postpartum is to our knowledge novel. However, our observed 3% smoking rate, similar to snus use, is in line with the reported smoking rates of 3% one month postpartum and 4% eight months postpartum in a recent Swedish nationwide survey.[11] The low rate of nicotine use in the PreventADALL cohort of well-educated mothers, compared with the 13% postpartum smoking rate reported from the USA two decades ago,[19] is likely to reflect the changing patterns over time of nicotine use among women of child bearing age.[1] In particular, our observation that snus use was at least as common as smoking during breastfeeding is in line with the observed increase in snus use and decreasing smoking rates over the recent years among young women in Scandinavia.[20,21]

The rates of snus use in exclusively breastfeeding women of 2% compared to 4% in partly breastfeeding and 9% in non-breastfeeding women are to the best of our knowledge the first documentation of use of nicotine products other than smoking during breastfeeding. Our results are supported by studies showing that breastfeeding duration was shorter among smokers compared with non-smokers.[19,22,23] Moreover, with the nicotine content in snus being at least as high as in cigarettes,[4,5] some adverse effects may be similar for snus use and smoking, including reduced milk production and shorter breastfeeding periods.[6] The rate of daily snus use or smoking 3 months postpartum was <1% in our study, and the observed breastfeeding rate of 93.5% is somewhat higher than the average breastfeeding rate of 86% at 3 months from Norwegian [16] and 84% at 2 months from Swedish general statistics.[11] This high rate may indicate a population selection in favour of well-educated urban women in the PreventADALL study.

Another novelty in our study was the observation that nicotine use other than smoking during breastfeeding was significantly associated with maternal smoking or use of snus in pregnancy. Our findings are supported by a recent meta-analysis including 31 studies showing that maternal smoking at the start of pregnancy, regardless of temporary quitting in pregnancy, predicted relapse to smoking postpartum.[12] The observed higher rate of nicotine use among non-breastfeeding women is in line with other studies showing a clearly increased risk of postpartum smoking relapse in women not breastfeeding.[6,12,13,24] Lower family income was associated with maternal smoking and snus use during breastfeeding in the univariate regression analysis, which is in line with a report from the Norwegian Institute of Public Health.[25] However, only middle socio-economic status was significantly associated with nicotine use in breastfeeding women in the final multivariate model. The low rates of nicotine use in our study limit the statistical study power, reducing our ability to identify significant risk factors for nicotine use during breastfeeding. However, socio-economic factors are inconsistent as predictors for relapse of smoking after childbirth.[12,26] Although maternal smoking before pregnancy was not significantly associated with smoking during breastfeeding in our study, the magnitude of the estimate supports an association and a lack of statistical power may explain the borderline significance level. Other studies report an association of

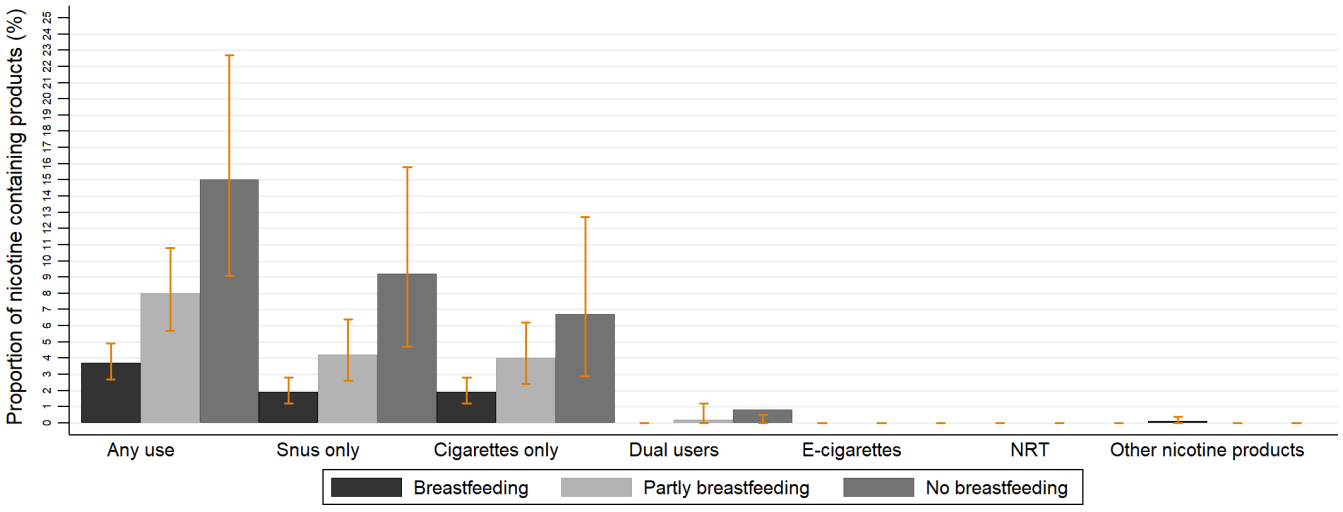

FIGURE 2 Maternal use of nicotine products in relation to breastfeeding

TABLE 3 The odds for the use of any nicotine-containing product during breastfeeding at 3 mo postpartum

	n	Univariate analyses (OR,95% CI)	Multivariate analyses (OR, 95% CI)
Age mother	1837		
16-24 y		**(3.23,1.04-10.01)**	(0.42, 0.03-5.29)
25-34 y		**(1.64, 1.00-2.68)**	(1.11, 0.56-2.19)
>35 y (ref)		1	
Education mother	1700		
Primary/high school		**(3.48, 1.96-6.15)**	(1.10, 0.42-2.86)
Higher education < 4 y		**(1.89, 1.17-3.04)**	(0.96, 0.51-1.81)
Higher education > 4 y (ref)		1	
Education partner	1632		
Primary/high school		**(4.23, 2.42-7.37)**	(1.56, 0.69-3.55)
Higher education < 4 y		**(2.65, 1.52-4.60)**	(1.75, 0.90-3.40)
Higher education > 4 y (ref)		1	
Marital status	1709		
Married (ref)		1	
Cohabitant		(1.18, 0.73-1.91)	
Single/separated/other		(1.53, 0.35-6.76)	
Country of origin	1709		
Norway (ref)		1	
Sweden/other Nordic		(0.97, 0.58-1.63)	
Other		(1.35, 0.69-2.62)	
Family incomes	1686		
Low		**(17.31, 4.89-61.19**)	(7.02, 0.93-52.85)
Middle		**(3.13, 1.86-5.25)**	**(1.92,1.01-3.64)**
High (ref)		1	
Living environment	1709		
City, densely populated (ref)		1	
City, less dense populated		(0.88, 0.54-1.42)	
Suburb		(0.82, 0.43-1.56)	
Village		(0.95, 0.22-4.14)	
Countryside, outside village		(1.03, 0.39-2.69)	
Previous pregnancies	1837		
0 (ref)		1	
1		(0.56, 0.30-1.06)	
>1		(1.37, 0.84-2.24)	
Snus use	1837		
No		1	
Use before pregnancy		**(2.32, 1.28-4.23)**	**(2.64, 1.24-5.61)**
Use in pregnancy		**(12.64, 7.46 - 21.44)**	**(16.15, 7.92-32.95)**
Smoking	1837		
No		1	
Use before pregnancy		**(3.38, 1.98-5.76)**	(1.84, 0.95-3.57)
Use in pregnancy		**(21.10, 11.57-38.47)**	**(31.54, 15.02-66.21)**

Note: P-value < .05 in bold. Results are shown by univariate and multivariate analyses, adjusting for factors that were significantly associated with the outcome in the univariate analyses.

Abbreviation: CI, confidence interval; OR, Odds ratio.

maternal smoking before pregnancy and relapse postpartum.[12,13,27] The inconsistency with other studies may be related to our limited study period of 3 months postpartum, as relapsing to postpartum smoking tends to increase over time from delivery.[13,22,27]

Generalisability of our results may be limited by several factors. The enrolled women in the PreventADALL study generally had a higher educational level than the respective national average,[18] which may affect smoking levels found to be higher among women with a lower educational level.[25] Moreover, the majority of the women lived in cities, in line with the observed high median incomes observed in metropolitan areas.[21] However, average maternal age in the PreventADALL study was comparable to the average age at delivery in Norway and Sweden.[11,20] The lack of reported use of nicotine-containing e-cigarettes in our study is probably because these have not been legally sold in Norway and Sweden during the study period, whereas snus on the other hand, being common in Sweden and increasingly used in Norway, is uncommon or illegal in most countries outside Scandinavia. Our study likely reflects national changes in use of tobacco products over time, with decreasing smoking rates, but increasing use of snus among women in the childbearing age.[20]

The lack of information about partner's nicotine use in this study may have had an impact on our results as women who have a partner who smokes are at greater risk of smoking relapse postpartum.[24]

Another potential limitation of our study is that data are based on self-reports with no objective validation of nicotine or cotinine levels in breast milk or infant sera. Studies have however shown that self-reports represent valid markers for tobacco exposure.[28,29]

5 | CONCLUSION

At 3 months postpartum, 5.6% of all women in our Scandinavian mother-child birth cohort study used any nicotine product with similar snus and smoking rates. None reported use of e-cigarettes or NRT, and one used a non-specified product. Among breastfeeding women, 95.1% did not use any nicotine products, snus and smoking rates were similar at 2.4 and 2.5% and exclusively breastfeeding mothers were least likely to use nicotine. Use of nicotine before and during pregnancy increased the risk of using snus or smoking during breastfeeding highlighting the need to target strategies to young women to prevent them from ever using nicotine products.

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CONFLICT OF INTEREST

The authors have no conflicts of interest to disclose.

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SUPPORTING INFORMATION

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

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APPENDIX 1

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