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# Trends in maternal use of snus and smoking tobacco in pregnancy. A register study in Southern Norway

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# Abstract

Background The use of tobacco products including Swedish snus (moist snuff) in pregnancy may give adverse health outcomes. While smoking prevalence has decreased among fertile women in Norway, snus use has increased during the last years. We investigated whether these trends were reflected also during pregnancy in a population of women in Southern Norway. Methods Data on smoking tobacco and snus use at three time points before and during pregnancy for 20 844 women were retrieved from the electronic birth record for the years 2012-2017. The results for the three-year period 2015-2017 were compared with a previously studied period 2012-2014. Prevalence and quit rates of tobacco use within groups of age, parity and education were reported. Within the same groups adjusted quit rates were analyzed using logistic regression. Mean birthweight and Apgar score of offspring were calculated for tobacco-users and non-users. Results There was an increase of snus use before pregnancy from the period 2012-2014 to the period 2015-2017 from 5.1% (CI; 4.6 to 5.5) to 8.4% (CI; 7.8 to 8.9). Despite this, the use of snus during pregnancy did not increase from the first to the second period, but stabilized at 2.8% (CI; 2.5 to 3.2) in first trimester and 2.0% (CI; 1.7 to 2.2) in third trimester. Cigarette smoking decreased significantly both before and during pregnancy. Snus use and smoking during pregnancy gave a reduction in average birthweight, but no significant effects on Apgar scores. Odds ratios for quitting both snus and smoking tobacco during pregnancy were higher for women aged 25-34 years, for the primiparas and for those with a high level of education. Pregnant women were more likely to have quitted tobacco use in the last period compared to the first. Conclusions While smoking during pregnancy was decreasing, the use of snus remained constant, levelling off to around 3% in first trimester and 2% in third trimester. Approximately 25% of those that used snus, and 40% that smoked before pregnancy, continued through pregnancy. This implies the need for a continuous watch on the use of snus and other nicotine products during pregnancy.


# Background

The use of smoking tobacco has declined for decades in Norway. At the same time, the use of Swedish snus (moist snuff) has increased among young adults and especially in the last decade for women. In 2017, 15% of Norwegian women aged 16-44 years used snus daily or occasionally and 14% used smoking tobacco.[1,2] The health consequences from cigarette smoking in pregnancy are well known.[1,3-5] Adverse health outcomes from use of snus during pregnancy is documented in recent years, especially from large population studies based on the Swedish Medical Birth Registrer. Snus use during pregnancy may increase risks of stillbirth, premature birth and small-for-gestational-age,[3,6-9] and is also associated with increased risk of oral cleft malformation and apnea in the newborn.[4,10,11]

Due to long traditions of using and manufacturing snus, Sweden is granted a permanent exemption from the sales ban on snus in the European Union. Since Norway is not a member of the EU, snus is legally sold here too. Smoking in pregnancy has been reported in the Medical Birth Registry (MBR Norway) since 1999, and the prevalence has declined since the registration started.[12] National data on the use of snus in

pregnancy is still not reported in the MBR Norway, although it has been registered in the electronic birth records (EBRs) and in the Health card for pregnant women nationally since 2014. Thus, there is little knowledge on the extent of snus use in pregnancy in Norway. A register study from Southern Norway including the years 2012- 2014,[13] showed that the use of snus almost doubled during those three years, where 2% of the women used snus and 7% smoked tobacco through pregnancy. In a questionnaire study from Scandinavia, 11.3% used snus or other nicotine products at some time in pregnancy, but a majority stopped when recognizing their pregnancy.[14]

The aims of this study were to investigate self-reported tobacco use before and during pregnancy in the period 2015-2017, and to compare with the period 2012-2014 in the same region in Southern Norway,[13] and further to identify potential predictors of tobacco use and cessation in sociodemographic groups. On the basis of the general trends in society,[1,2] and the previous study,[13] our hypothesis was that there would be an increase in the proportion of snus use in pregnancy, but that a larger proportion of tobacco users would quit snus than cigarette smoking during pregnancy. As there is an ongoing shift from smoking tobacco to snus and newer nicotine products among young women of reproductive age in many countries, there is a need for more knowledge about the use in pregnancy and its consequences in clinical and preventive medicine.

# Materials And Methods

De-identified data were retrieved from the EBR for all women aged 16-44 years who gave birth in the years 2012-2017 at the three maternity wards at Sørlandet Hospital in Southern Norway. Snus use and smoking were registered as “on a daily basis” or “occasionally”. In this study we report daily and occasional tobacco use combined. We also report dual use of both snus use and smoking, which includes either a combination of both products occasionally, or one product daily and the other occasionally or both products daily. The registration of tobacco use “before pregnancy” was reported to primary care personnel on the Health card for pregnant women and later transferred to the EBR. Tobacco use “in the first trimester” was registered into EBR by midwifes at the routine ultrasound check-up around week 18. Tobacco use “in the third trimester” was registered into EBR at the admission in the maternity ward. All information was collected by health personnel interviewing the pregnant women, and not by questionnaires. Since no objective measures confirmed quitting or abstinence, the information is referred to as self-reported.

The self-reported highest achieved educational level at the time of pregnancy was recorded in three groups at the registration “before pregnancy” as 1) primary/lower secondary education (less than high school), 2) upper secondary (high school) or 3) higher education (university education or more than 4 years of college). When presenting tobacco use according to educational levels, the youngest age group (16-24 years) was omitted, due to presumably low rates of completed education at this age.

# Statistical analysis

Data retrieval was undertaken by Sykehuspartner (the Hospital's ICT Trust), transferred to the Norwegian Institute of Public Health, and analyzed with STATA (version 15).

The three-year-periods 2015-2017 and 2012-2014 were analyzed separately and compared. The use of snus and smoking tobacco before pregnancy, in the first and third trimester were presented as prevalence (95% CI) in groups of age, parity, and education. The "Quit rates" (95% CI) were estimated as the proportion of users who quitted tobacco from before pregnancy to the first trimester, and from before pregnancy to the third trimester.

Using logistic regression, the study population for the whole period 2012-2017 was included in separate analyses for snus use and smoking tobacco, with outcome variable "Quit rate" and outcome measures "Odds Ratios" (OR). The ORs were given with confidence intervals (95% CI) and P-values. The regression outcome variables for both snus use and smoking were coded 0 for "had not quitted by third trimester" versus 1 "had quitted by third trimester". In the regression analyses, the predictor variables age, parity and education were categorized as explained in Table 3 (Results). Time period was included as predictor-variable with the years 2015-2017 versus the years 2012-2014.

# Results

In the period 2012-2017 there were 20 844 births at Sørlandet hospital, comprising 5.9% of all births in Norway in these years. Missing values for snus use before pregnancy, in first trimester and in third trimester were 1.2%, 2.2% and 3.2%, respectively. Correspondingly, missing values for smoking tobacco were 1.1%, 0.5% and 2.5%; for Apgar score 1 minute and 5 minutes 0.3% for both time points, and for Apgar score 10 minutes 1.4%. For birthweight, missing information constituted 0.3%, including omitted births with infant weight below 500 grams (N = 58). Missing information on education was 6.9%.

Women below age 16 (n=2) and above age 44 (n=40), were excluded from the study population. Only women with complete data at all three registration points were included, and were followed from "before pregnancy" to "first trimester" and to "third trimester". Thus, the study population cohort constituted 19 767 women (95% of all 20 844) who had complete reports of tobacco use, 9 912 in the period 2012-2014 and 9 855 in 2015-2017.

The proportion of snus use before pregnancy more than doubled in the period 2012 to 2017, from 4% to 9% (Figure 1). However, the use of snus during pregnancy did not increase correspondingly, but leveled off to around 3% in the first trimester, and 2% in the last trimester. In the same period, the use of smoking tobacco was approximately halved, from 20% to 11% before pregnancy and from 9% to 4 % in the last trimester (Figure 1).

Comparing the three-year period 2015-2017 to the previously studied period 2012-2014, there was an increase in the self-reported snus use before pregnancy from 5.1 % (CI; 4.6 to 5.5) to 8.4% (CI 7.8 to 8.9) (Table 1, Supporting Information Table S1). Despite this, use of snus during pregnancy in the last period remained unchanged compared to the first period, with 2.8% in the first trimester and 2.0% in the third

trimester. For cigarette smoking there was a reduction before pregnancy from 19.2% (CI; 18.5 to 20.0) in the first period to 12.8% (CI; 12.1 to 13.5%) in the last period. In the third trimester the reduction was from 8.1% (CI; 7.6 to 8.7) to 5.0% (CI; 4.6 to 5.5) (Table 1, Supporting Information Table S1).

## Pregnancy tobacco use in the period 2015-2017

In the age group 16-24 years approximately one of five used snus before pregnancy, which was almost three times the prevalence of snus use before pregnancy among women aged 25-34 years. (Table 1). Also, one of five of the youngest smoked before pregnancy, the corresponding prevalence for the 25-34 year group was one in eight (Table 1).

Only 1.4% of the women reported dual use of both snus and smoking tobacco before pregnancy, and the proportion was below 1% during pregnancy. Dual use was most marked among the youngest aged 16-24 years, approximating to 5% before pregnancy (Table 1).

Table 1 (see Supplementary Files). Snus use and cigarette smoking among pregnant women 2015-2017. Percent, 95% Cl. N=9855

While the prevalence of snus use was highest in women with upper secondary education, cigarette smoking was most prevalent among woman with primary/lower secondary education (Table 1). Around 6% of women with higher education were tobacco users prior to pregnancy (snus and/or smoke), but the prevalence was only 1-2% during pregnancy (Table 1).

The average birthweight for children of tobacco-free mothers in the third trimester (n=9213) was 3524 g (CI; 3513 to 3535). The average birthweight for children of mothers who had been daily or occasional smokers during third trimester (n=506) was 3278 g (CI; 3229 to 3328), thus a statistically significant reduction of 246 g in birthweight. Average birthweight for children of mothers who had used snus daily or occasionally in the third trimester (n=201) was 3418 g (CI; 3338 to 3498), thus a smaller, but also a statistically significant reduction in average birthweight of 106 g. There were no statistically or clinically significant differences in Apgar scores in children of mothers who had used snus or smoked cigarettes during pregnancy compared to the non-tobacco users.

Out of 824 women who had used snus prior to pregnancy in the period 2015-2017, two-thirds had quitted by the first trimester and more than three quarters by the third trimester (Table 2 in the Supplementary Files). Out of 1259 who smoked before pregnancy, more than half had quitted by the first trimester and three out of five by the third trimester. Thus, a larger proportion had quitted snus than smoking tobacco during pregnancy (Table 2). Also, compared to the previous three-year period 2012-2014 (Supporting Information Table S2), a larger proportion had quitted snus by first trimester in the period 2015-2017: 66.4% (CI; 63 to 70) vs 51.3% (CI; 47 to 56). Correspondingly, in the third trimester the figures were 76.7% (CI; 74 to 80) vs 66.1% (CI; 62 to 70), respectively. The proportions that quitted smoking by first trimester were 52.6% (CI; 50 to 55) in the last period compared to 44.9% (CI; 43 to 47) in the first period.

Corresponding figures for the third trimester were 60.5% (CI; 58 to 63) vs 57.7% (CI; 55 to 60), respectively. Hence, the bivariate analyses showed higher quit rates for snus use during pregnancy in the last period compared to the first, while the same was not true for smoking by the third trimester (Table 2, Supporting Information Table S2).

Table 3 shows unadjusted quit rates in percent and adjusted ORs for quitting snus use and smoking during pregnancy for the whole period 2012-2017. Women aged 25-34 years had higher ORs for quitting both snus and smoking tobacco than women aged 16-24 years. Women with no previous children (parity 0) were more likely to quit snus and smoking tobacco than those with previous births. Women with higher education were most likely to quit snus or smoking during pregnancy, however more so for smoking (OR >5) than for snus use (OR >4). Pregnant women were more likely to have quitted tobacco use during pregnancy in the last period (2015-2017), compared to the first.

Table 3 (in the Supplementary Files). Quit rates* for tobacco use during pregnancy 2012-2017, expressed as percent (unadjusted) and OR (adjusted).

# Discussion

This study on self-reported tobacco use showed that the proportion that used snus *before* pregnancy more than doubled from 2012 until 2017. The proportion that used snus *during* pregnancy increased moderately in the years 2012-2014, but then remained quite constant from 2015 to 2017. This implies that the increase in snus use in the general population in the period 2015-2017 was not mirrored by a corresponding increase during pregnancy. The use of smoking tobacco declined both before pregnancy and during pregnancy in the same period. A larger proportion of tobacco users quitted snus than smoking tobacco during pregnancy in both time periods.

The strength of this study lies in the large study population, with complete information about tobacco use at three time points before and during pregnancy from the participating cohort of woman. Another strength is the low rates of missing information. It would be a further strength if the study had been nationwide, but National reporting of snus use in pregnancy is still not implemented in Norway. An objective measure of quitting/abstinence from snus or smoking (cotinine) would also have increased the validity and the general applicability of our results.

At the national level, the use of snus among non-pregnant women was higher than the observed prevalence before pregnancy in our study. One explanation may be that women in this region of Southern Norway traditionally have had lower prevalence of snus use and higher use of smoking tobacco than the national averages.[1,2] There could also have been an under-reporting in our study because of the stigma associated with tobacco use in pregnancy. Self-reported tobacco use in register studies have shown lower prevalence than in questionnaire studies.[15,16] Gunnerbeck et al. found that the Swedish MBR misclassified almost 45% of the cotinine-verified users of snus as non-users in late pregnancy.[15] Whether there is a possible, systematic underreporting of tobacco use in the MBRs is a task for further research.

Finally, we may assume that the lower snus prevalence seen in this study partly indicate that young women quit or restrain from tobacco products not only during pregnancy, but also prior to pregnancy, and especially in the period when they plan to get pregnant.[17] There has been increased focus in recent years on the harmful effects of snus in pregnancy through campaigns in media. We have scarce information whether snus use has become a topic in antenatal care in Norway. But revision of routines after 2014, where the Health card for pregnant women now also calls for registration of snus use from the first antenatal check-up, may have contributed to this.

Snus use among Norwegian non-pregnant women in fertile age was approximately the double of that in Sweden.[2,18] In our study population of pregnant women in Southern Norway the prevalence of snus use in the first trimester was about threefold of that in Sweden: 3,0% versus 1,2% in 2016.[19] This indicates that snus use among women has become a larger problem in Norway than in Sweden. The prevalence of smoking in Norway and Sweden was comparable, approximately 15% among non-pregnant women 16-44 years in 2016, and in the first trimester around 5% in both countries.[20]

The smaller reduction in birthweight by snus use compared to cigarette smoking seen in our study is in accordance with previous documentation showing that snus has less effect than smoking on fetal growth.[6,7] This may be attributed to the toxic effects of combustion products in smoking tobacco, especially the carbon monoxide levels in the plasma of smokers.[21] As for Apgar score, we found no differences between the cigarette smokers/snuff users and the tobacco-free groups. To our knowledge, this has not been reported on previously.

Cigarette smoking and snus use before and during pregnancy was most prevalent at young age and lower educational level. But snus use before and in pregnancy was also prevalent among women with intermediate education. This is consistent with findings among non-pregnant women in Norway.[22] Smokers with primary and upper secondary education constituted the bulk of tobacco use, both before and during pregnancy. Higher education was a powerful predictor of quitting, both regarding snus and smoking. The same was true for women delivering their first baby compared to those of previous parity. This was in accordance with findings in a study about smoking in pregnancy from the US.[23]

Although the proportion that quit snus and smoking tobacco increased in the last 3-year period, still a considerable proportion of women who smoked or used snus before pregnancy continued through pregnancy. A portion of snus, as it is sustained longer in the mouth, may result in a higher and longer-lasting concentration of nicotine in the blood than a smoked cigarette. Nicotine quickly passes through the placenta barrier, and in one study nicotine concentration was 15% higher in the fetal than in the maternal plasma.[24] Perinatal snus exposure has shown long-term effect on cardiovascular function in the child.[25] Since no lower threshold of harmful effect of nicotine on the fetus or child is known, this represents a potential public health challenge.[26] In North America there has been an increase in use of moist snuff and other nicotine delivery products.[27] A recent US Surgeon General Report has highlighted the previously unrecognized negative effects of nicotine on brain development in young people and in

pregnancy.[28] Advice on the harmful effects of all nicotine products should therefore be provided to adolescent girls. A possible arena for information may be in the context of consultations on contraception.

Assuming that the trends in the period 2015-2017 continue, our study may give a small indication that Norway might be heading towards tobacco-free pregnancies. However, we are by far there yet. Snus use is a relatively recent trend among women in Norway. Many have started at an early age and are not concurrent smokers.[22] Snus and new nicotine products like e-cigarettes are advocated as harm reduction products to cigarette smokers.[29] The Scandinavian countries, especially Sweden and Norway, have been a niche for the sale of snus. The tobacco industry is fighting to open legal sales in the rest of the EU. Unfortunately, often when snus is promoted as a less harmful substitute for smoked tobacco, the potential harmful effects in pregnancy seem clearly under-communicated.[30]

# Conclusion

While smoking decreased, the use of snus during pregnancy remained constant in this study. The quit rates for snus were higher than for smoking tobacco. The OR for quitting both snus and cigarettes were higher for women aged 25-34 years, for woman delivering their first baby and for those with higher education. Around one in four of the snus users and two of five of the smokers continued through pregnancy, which implies a need for surveillance and preventive measures regarding the use of snus and other nicotine products during pregnancy.

# List Of Abbreviations

## List of abbreviations

MBR, Medical Birth Registry

EBR, Electronic Birth Record

# Declarations

## Ethical approval

The study was approved by the Regional Committee on Medical and Health Research Ethics (REK) (2014/654 REK South-East - 12.12.2017).

## Consent for publication

Not applicable. The Regional Committee on Ethics (REK) gave in its approval of 12.12.2017 also an exemption regarding confidentiality of patient information (the Health Personnel Law; Duty of Privacy).

## Availability of data and material

The data that support the findings of this study are available from Sykehuspartner (the Hospital's ICT Trust at Sørlandet Hospital), but restrictions apply to the availability of these data, which were used under license for the current study, and are therefore not publicly available. Data are however available from the authors upon reasonable request and with permission of the Regional Committee on Medical and Health Research Ethics.

## Competing interests

None of the authors have any conflicts of interests to declare


## Funding

The study has not received any funding


## Authors' contributions

ER conceived and designed the study, collected the data, contributed to data analyses and interpretation, and to writing the paper. FG conceived and designed the study, collected the data, contributed to data interpretation and to writing the paper. LG conceived and designed the study, performed the analysis, contributed to data interpretation and to writing the paper. All authors read and approved the final manuscript.


## Acknowledgements

Not applicable


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## Additional Files

Supporting Information, Table S1. Pregnancy snus use and cigarette smoking 2012-2014. Percent. 95% CI. N=9912

Supporting Information, Table S2. Quit rates for pregnancy snus use and cigarette smoking 2012-2014. Percent. 95% CI. N=9912

## Tables

Due to technical limitations, tables 1- 3 are only available as a download in the supplemental files section.

## Figures

Figure 1. Time trends in use of snus and cigarette smoking among pregnant women 2012-2017. Percent

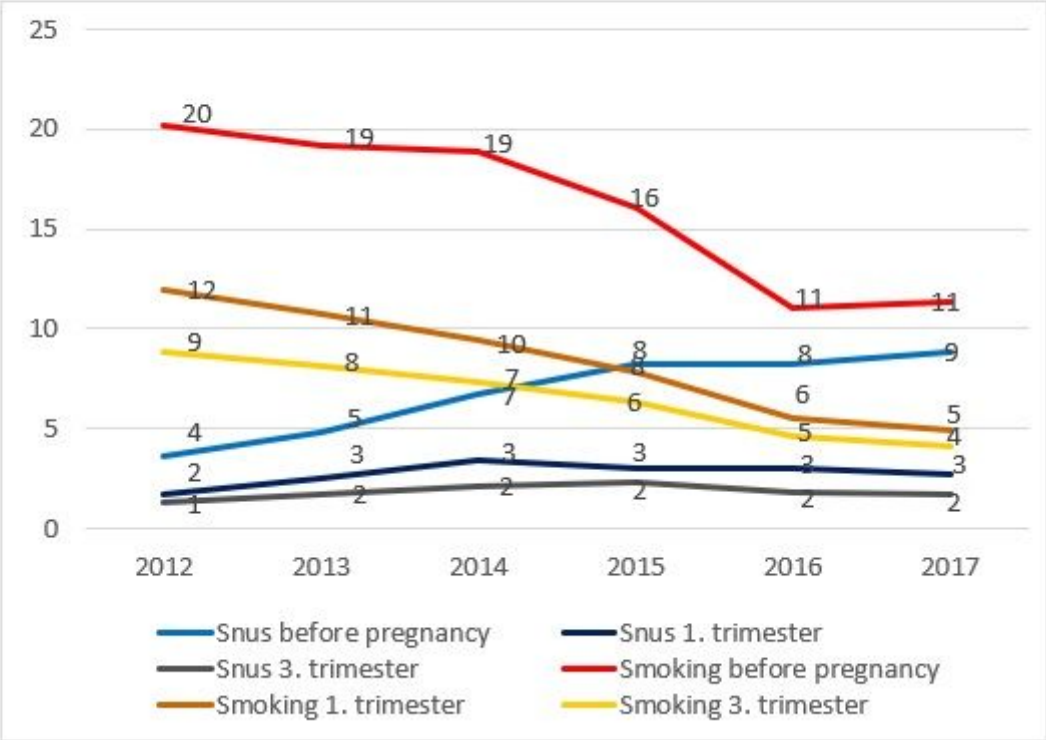


**Figure 1**

Time trends in use of snus and cigarette smoking among pregnant women 2012-2017. Percent

# Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

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