

Smoking and snus use among Norwegian students: Demographic, personality and substance use characteristics

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Abstract

Background and aim: Smoking rates are decreasing in Norway while the use of snus has increased. We aimed to investigate the co-occurrence of, and the socio-demographics, personality and substance use characteristics associated with, student smoking and snus use. **Methods:** Survey data were collected among students in higher education in Bergen, Norway in 2015 ($N = 11,236$, response rate 39.4%). Multinomial regression analyses comparing snus users and smokers to non-users and non-smokers, respectively, on demographic, personality and substance use variables were conducted. Regression analyses comparing current dual users to current smokers

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and current snus users and comparing daily smokers to daily snus users, on demographic, personality and substance use variables were also conducted. **Results:** In total 67.9% of ever snus users identified themselves as non-smokers (past and current). Several demographic, personality and substance use characteristics associated with smoking and snus use were identified (all = $p < .05$), some of which were common for both (e.g., use of cannabis) and some which were exclusively associated with either smoking (e.g., neuroticism) or snus use (e.g., extroversion). **Conclusion:** The current study contributes with several novel findings regarding traits associated with smoking and snus use. Though limited by a cross-sectional design, the current findings may suggest that the group of students using snus consists of a combination of previous smokers, students who would have smoked if snus was not available and a new segment who may not have used nicotine if snus was not available.

Keywords

alcohol, cannabis, demographics, nicotine, personality, smoking, snuff, snus, students, tobacco

Tobacco smoking is strongly associated with a range of serious and potentially life-threatening diseases, such as cancer, chronic obstructive pulmonary disease and coronary heart disease (Mannino & Buist, 2007; Murray & Lopez, 1997; Rehm et al., 2006; Sasco et al., 2004; Yusuf et al., 2001). Smokeless tobacco for oral use, such as snus, is commonly used in Scandinavia (Folkehelseinstituttet [Norwegian Institute of Public Health], 2019). Snus is a low-nitrosamine Swedish type of smokeless tobacco consisting of a moist powder of pasteurised finely ground tobacco leaves. Snus is most often used in the form of pre-baked portions wrapped in cellulose and is placed behind the upper lip. Like cigarettes, snus contains harmful substances such as carcinogens, but delivers these in lower doses than other tobacco products (Folkehelseinstituttet [Norwegian Institute of Public Health], 2019; Hatsukami et al., 2004). Nicotine is delivered on a level similar to, or even higher than that of cigarettes, and as with cigarettes, snus use can become an addiction (Digard et al., 2012; Folkehelseinstituttet [Norwegian Institute of Public Health], 2019). Though there are likely health harms associated with snus use (e.g., cancer risk, harm to unborn fetuses and poorer myocardial infarction survival rates), snus is notably less harmful than cigarettes (Fisher et al., 2019; Lee, 2013; Rostron et al., 2018; SCENIHR, 2008).

Changes in tobacco use trends

In Norway, the trends in tobacco use have changed dramatically over the last 50 years. The proportion of men smoking peaked at 65% in the 1960s, while a corresponding peak for women at 35% occurred in 1975 (Lund & Lund, 2014; Lund et al., 2009). There has since been a strong reduction in smoking among both sexes, and in 2018, 12% of Norwegians smoked cigarettes daily (11% of women and 12% of men) (Lund et al., 2009; Statistisk sentralbyrå [Statistics Norway], 2019). While the large reduction in smoking led to a significant reduction in overall tobacco consumption from 1985 to 2012, the market share of snus increased from 4% to 28% (Lund & Lund, 2014). In 2018, 12% of Norwegians reported daily snus use, paralleling the percentage reporting daily smoking (Statistisk sentralbyrå [Statistics Norway], 2019).

The relationship between smoking and snus use

The causal relationship between smoking and snus use is not fully understood, but several causal pathways have been suggested.

For one, smoking may cause snus use (i.e., the exit route). One way of interpreting the changes in tobacco use is that the increased

availability of snus has lowered the rates of smoking by aiding transfer to a less harmful form of nicotine dependence (Folkehelseinstituttet [Norwegian Institute of Public Health], 2019). This claim is supported by findings suggesting snus to be a commonly used and often preferred method for smoking cessation and that snus use may increase the probability of successful smoking cessation compared to medical nicotine products (Lund & Lund, 2014; Lund, 2013; Lund et al., 2010). Accordingly, the largest segment of snus users in Norway is made up of former smokers (Lund, 2013).

Contradicting this, some have suggested that snus use may cause or precede smoking. The gateway hypothesis posits that the use of legal or softer drugs, such as alcohol or tobacco, precedes and increases the risk of use of illegal or harder drugs, such as for instance cannabis, and subsequently, heroin (Etter, 2018; Kandel, 1975; Vanyukov et al., 2012). In more recent years, the gateway hypothesis has been discussed in relation to nicotine-releasing products (Etter, 2018). Suggested explanations of how use of softer substances may increase the risk of use of harder substances include pharmacological effects of the softer substances sensitising the brain for drug effects, that use of softer substances may increase the availability of harder substances through participation in milieu associated with substance use, and that use of softer substances may change the user's attitudes towards substance use in a more lenient direction (Etter, 2018; Kandel, 2003). In support of the notion of snus use as a contributor to subsequent smoking, studies from Norway and Sweden suggest that snus use in early adolescence is associated with increased risk of subsequent smoking (Grøtvedt et al., 2019; Grøtvedt et al., 2013; Joffer et al., 2014; Lund & Scheffels, 2014). However, snus use does not seem to precede smoking among adults (Lund & Scheffels, 2014; Lund et al., 2017; Ramström et al., 2016).

Alternatively, smoking and snus use could be caused by the same underlying factors (i.e.,

no direct causal relationship between smoking and snus use). The common liability to addiction theory posits non-specific liability, e.g., genetic factors, to all drug addictions, regardless of the order of initiation (Vanyukov, & Ridenour, 2012; Vanyukov et al., 2012). In support of the common liability theory, several findings suggest that snus users and smokers share some common traits (e.g., truancy) that may predispose them to substance use and controlling for such common traits may weaken the association between snus use and smoking (Engström et al., 2010; Galanti et al., 2008; Grøtvedt et al., 2008; Kendler et al., 2019; Kvaavik et al., 2015; E. Larsen et al., 2013; Lund et al., 2008; Pedersen & von Soest, 2014). However, the set of underlying confounders that researchers have access to are normally limited. Hence, remaining associations between snus use and smoking (after controlling for confounders) might be attributed to unmeasured confounders. According to the common liability theory, one can speculate that a lack of association between snus use and smoking may be explained by snus users consisting of individuals who would have smoked if snus was not available (in accordance with the diversion hypothesis) (Lund et al., 2020).

Finally, one could speculate that snus use and smoking could be unrelated, at least in some cases, and that snus and cigarettes may recruit different populations to nicotine use.

Currently, the literature prohibits conclusions regarding the causal relationship between smoking and snus use (Etter, 2018). Also, proving or disproving potential causal pathways between smoking and snus use is difficult or even impossible. To prove the gateway hypothesis, for instance, one would have to demonstrate that some smokers would not have smoked if it had not been for their prior experience with snus (Lund et al., 2020). Further, the relationship between smoking and snus use is complex (see Lund et al., 2020, for a more detailed description of possible links between smoking and snus use).

It is likely that all the suggested causal pathways between snus use and smoking are occurring in the population. Smoking may increase the risk of snus use in some, while snus use may increase the risk of smoking in others (although ecological trend data, showing an increase in snus use to be paralleled with a decline in smoking, suggest this pathway to be less prevalent). Common underlying vulnerabilities may explain smoking and/or snus use for some, while some smokers/snus users may not have used the other product if their preferred product was not available. Still, understanding which pathway is most prevalent is important for the development of optimal prevention strategies.

Characteristics of smokers and snus users

Knowledge of characteristics associated with smoking and snus use among young people can provide useful information for prevention initiatives. Further, such knowledge might shed light on the causality (or lack of causality) between smoking and snus use. If snus users display characteristics similar to smokers, the common liability theory (suggesting no causal relationship between the two) is supported. In contrast, if characteristics significantly differ between smokers and snus users, this may indicate that snus users constitute a different population (than smokers) that may not have smoked if snus was not available. The hypotheses suggesting that snus use may cause smoking (i.e., the gateway hypothesis) or that smoking may cause snus use (i.e., the exit route) do not provide clear predictions regarding the degree of overlap in characteristics between smokers and snus users. As smokers and snus users under these hypotheses often are the same individuals, some characteristics should be the same. At the same time, characteristics might also differ due to temporal effects (i.e., the existence of snus users who have not yet started to smoke or vice versa). The validity of these two causal hypotheses may be better illuminated by investigating the proportions of former snus users among smokers and vice versa.

The research literature has identified both similarities and differences between smokers and snus users. Similarities include health risk factors, where both smoking and snus use are associated with higher alcohol consumption and more use of illegal drugs, poorer dietary habits, more adverse socioeconomic background and less favourable school adjustment (Engström et al., 2010; Kvaavik et al., 2015; E. Larsen et al., 2013; Lund et al., 2008; Pedersen & von Soest, 2014; Sæbø, 2013). Snus users appear, however, to display the common risk factors to a lesser degree compared to smokers. Compared to smokers, snus users seem better adjusted at school, they use cannabis less often, are more involved in sport, and may have a better socioeconomic status (Engström et al., 2010; Kvaavik et al., 2015; E. Larsen et al., 2013; Pedersen & von Soest, 2014; Sæbø, 2013). Further, older individuals tend to be more likely to smoke, while younger age and male sex are associated with snus use (Engström et al., 2010; Grøtvedt et al., 2008; Kvaavik et al., 2015; Lund & Lund, 2005).

While there are known similarities and differences between smokers and snus users regarding demographic factors and health risk factors, there are no previous studies comparing the two groups in terms of personality traits. The Five-Factor Model's taxonomy, including extroversion, agreeableness, conscientiousness, neuroticism, and openness, is considered to be the most acknowledged and empirically supported model of personality traits (R. J. Larsen et al., 2013; McCrae & John, 1992). A rather large number of studies have investigated the associations between the Five-Factor Model's personality traits and smoking, employing both short and more extensive measures of the Five-Factor Model's personality traits (Malouff et al., 2006; Otten et al., 2008; Zvolensky et al., 2015). Higher scores on neuroticism and lower scores on agreeableness and conscientiousness have been most consistently linked with smoking, while some studies have found higher extroversion and openness scores to predict smoking as well (Malouff et al., 2006;

Otten et al., 2008; Zvolensky et al., 2015). Low scores on agreeableness and conscientiousness and higher scores on neuroticism have further been associated with a range of other risk behaviours (e.g., alcohol use, gambling, cannabis use and physical inactivity) as well (Dash et al., 2019; Malouff et al., 2007; Sutin et al., 2016). So far, no study investigating personality traits of snus users has been conducted.

The importance of students' consumer patterns

With regard to establishment of new, societal consumer patterns, students may be of particular importance. Students are characterised by many of the social and demographic characteristics that also identify innovators and early adopters of new trends within culture, fashion and lifestyle (Pedersen, 2015). Early adopters are in general thought of as intelligent, sociable, more cosmopolitan and as having higher aspirations for education and occupation than others (Rogers, 1995) – all traits which are likely to be prevalent among students. Hence, it is conceivable that consumer patterns established in the student community may easily spread to other groups, making the understanding of smoking and snus use among students highly important.

So far, little is known about smoking and snus use in the Norwegian student population. A study from 2006 indicated that Norwegian students are less likely to smoke and more likely to use snus (the latter found only among women) compared to same-age non-students (Lund et al., 2008). Though this could point to future developments in the general population, the study was conducted more than 10 years ago, and the authors argued that while snus use among young men might have reached a peak, snus use might still be spreading among young women (Lund et al., 2008). Hence, more recent patterns of smoking and snus use among Norwegian students should be investigated.

Study objectives

In summary, several pathways through which smoking and snus use may be related (or unrelated) have been suggested. These include that snus use may cause smoking or vice versa, that both snus use and smoking are caused by the same third variables, and that snus use and smoking are unrelated. The current study aimed to investigate the following research questions (RQs): (RQ1) How large is the co-occurrence between smoking and snus use among students? and (RQ2) What characterises smokers and snus users in terms of demographics, personality, and substance use, compared to non-users, each other and dual users? Investigating the co-occurrence of smoking and snus use may give an indication as to whether snus use may cause smoking or vice versa, as one can expect a high degree of co-occurrence of smoking and snus use if the relationship is causal. Further, specifically comparing characteristics between snus users and smokers may provide an indication as to whether smokers and snus users in large can be considered to be part of the same group or whether snus may recruit a new segment of users who otherwise not would have used nicotine.

Methods

Procedures and sample

Data were collected through an online survey during fall 2015. Email invitations to participate in the survey were sent to all full-time students enrolled at the four largest institutions of higher education in Bergen, Norway. No exclusion criteria were employed, but the survey was in Norwegian, hence students who did not master written Norwegian are unlikely to have participated. The institutions included three public institutions – the University of Bergen (UiB), Bergen University College (HiB), Norwegian School of Economics (NHH) – and one private institution, Norwegian Business School (BI, campus Bergen). A total of 11,236 students (39.4%) agreed to participate.

Participants took part in a lottery where two iPhone 6s and 50 gift cards each worth 500 NOK (~61 USD/53 EUR) were the prizes. The study was approved by the Regional Committee for Medical and Health Research Ethics, health region Western Norway (project number 2015/1154).

Measurements

Demographics. The participants were asked to report year of birth, sex (man; woman), place of birth (Norway; North of Europe; other parts of Europe; Asia; Africa; Central/South America; North America; Oceania) and relationship status (single; in a relationship, but living alone; cohabitant; married/registered partnership; other) (items as used in Nedregård and Olsen, 2014).

Personality was assessed with the Mini-International Personality Item Pool (Mini-IPIP) (Donnellan et al., 2006). The Mini-IPIP has been used to assess personality in other studies assessing associations with risk behaviours and/or tobacco use (e.g., Cabriaes et al., 2016; Zhang et al., 2015). The Mini-IPIP includes 20 items measuring the Five-Factor Model's personality traits, i.e., extroversion, agreeableness, conscientiousness, neuroticism and openness. The scale consists of statements concerning typical behaviour (e.g., being the life of the party, easily becoming upset), and responders are asked to rate to which degree each of the statements describes their own behaviour on a scale from 1 (very inaccurately) to 5 (very accurately). There are four statements for each of the five personality traits, giving a composite score ranging from 4 to 20 for each trait. In the current study the items measuring extroversion, agreeableness, conscientiousness, neuroticism and openness obtained Cronbach's alphas of 0.83, 0.77, 0.69, 0.75 and 0.74, respectively.

Nicotine use was assessed by items concerning smoking and snus use. The students were asked "Do you smoke?" and "Do you use snus/chewing tobacco or similar products?" (yes,

daily; yes, sometimes; no, I have quit; no) (as used in Nedregård & Olsen, 2014).

Alcohol use was measured using the 10-item Alcohol Use Disorders Identification Test (AUDIT) (Babor et al., 2001; Bohn et al., 1995). The AUDIT includes items assessing alcohol consumption (e.g., frequency of drinking), alcohol dependency symptoms (e.g., increased salience) and alcohol harm (e.g., blackouts). Total scores range from 0 to 40. In the current study, the items of AUDIT had a Cronbach's alpha of 0.78.

In terms of assessment of *illegal substance use*, the students were first asked whether they had ever used illegal substances, including prescription drugs without their own prescription. The students who affirmed illegal substance use were further asked how many times the last six months (i.e., never; used previously, but not the last six months; 1–4 times; 5–50 times; more than 50 times) they had used a range of substances (i.e., cannabis; synthetic cannabis; amphetamine/methamphetamine; ADHD medication (without prescription); cocaine (crack); ecstasy; LSD/hallucinogens; heroin; synthetic heroin (without prescription); sedatives (without prescription); inhalants (e.g., paint thinner, glue); anabolic steroids; other illegal substances or prescription drugs without prescription) (as used in Nedregård & Olsen, 2014).

Analyses

All analyses were carried out with IBM SPSS Statistics, version 24. Missing data were deleted listwise. A total of 1,845 cases (16%) were deleted from the main analyses due to missing data on some of the included variables. Listwise deletion was chosen because the missing data primarily concerned the predictor variables. In such instances, listwise deletion in logistic regression analyses may cause less biased results compared to other common approaches for handling missing data (Allison, 2001, 2014).

First, the sample's mean tendency on the included variables were calculated, and a

cross-tabulation was run to investigate the co-occurrence between different levels of smoking and different levels of snus use. Further, a multinomial regression analysis was conducted with smoking as the dependent variable. The categories were non-smoker (reference category), ex-smoker, occasional smoker, and daily smoker. The independent variables were age, sex (man = 0, woman = 1), country of birth (country outside of Norway = 0, Norway = 1), relationship status (in a romantic relationship = 0, single = 1), extroversion, agreeableness, conscientiousness, neuroticism, openness, snus use (non-snus user (reference category), ex-user, occasional user, and daily user), alcohol use (AUDIT score), cannabis use, and use of other illegal substances (for the latter two variables: no use the last six months = 0, use the last six months = 1). The continuous independent variables (age, personality traits, and alcohol use) were entered as z-scores to ease comparison of different effect magnitudes. Z-score transformations provide each instrument a mean of 0 and a standard deviation of 1. Hence, the results therefore correspond to a one standard deviation increase of each measure, regardless of original values.

Further, a parallel multinomial regression analysis was conducted, with snus use as the dependent variable. The categories of snus use were non-snus user (reference category), ex-snus user, occasional snus user, and daily snus user. The same independent variables were entered in this analysis as in the analysis concerning smoking, but smoking (non-smoker (reference category), ex-smoker, occasional smoker and daily smoker), was included as an independent variable instead of snus use.

Finally, a multinomial regression analysis comparing current (i.e., occasional or daily) dual users to current smokers and current snus users, and a binary logistic regression analysis comparing daily smokers to daily snus users, were conducted. The independent variables in these analyses were the same as described above. Current dual users and daily smokers constituted the reference categories,

Table 1. Sample characteristics, $N = 11,236$.

	Mean (SD) / % (95% CI)
Demographic variables	
Age	24.9 (6.5)
Sex (woman)	63.3% (62.4–64.2%)
Born in Norway	92.4% (91.9–92.9%)
Single	47.3% (46.3–48.2%)
Personality^a	
Extroversion	14.1 (3.6)
Agreeableness	16.8 (2.8)
Conscientiousness	14.7 (3.2)
Neuroticism	11.0 (3.6)
Openness	14.6 (3.2)
Substance use	
<i>Smoking</i>	
Daily smoking	2.1% (1.8–2.4%)
Occasional smoking	8.8% (8.3–9.4%)
Ex-smoking	8.5% (7.9–9.0%)
No smoking	80.6% (79.9–81.4%)
<i>Snus use</i>	
Daily snus use	17.8% (17.0–18.5%)
Occasional snus use	8.5% (7.9–9.0%)
Ex-snus use	7.2% (6.7–7.7%)
No snus use	66.6% (65.7–67.5%)
<i>Alcohol and illegal substances</i>	
Alcohol use (AUDIT) ^b	8.2 (4.9)
Cannabis use last six months	12.8% (12.2–13.5%)
Use of other illegal substances last six months	4.1% (3.7–4.6%)

Notes. SD = standard deviation; CI = confidence interval; AUDIT = Alcohol Use Disorders Identification Test.

^aTotal score range from 4–20 for each trait. ^bTotal score range from 0–40.

respectively. In the analysis comparing daily smokers to daily snus users, the 16 participants who reported to both smoke and use snus daily were excluded from the analysis.

Results

Descriptive information of the sample

The sample's characteristics are presented in Table 1. The mean age of the sample was 24.9 years, 63.3% were women and 92.4% were born in Norway. Altogether, 2.1% ($n = 213$) reported to smoke daily whereas 17.8% ($n =$

1,802) reported to use snus daily. The current sample had similar characteristics to other Norwegian student samples (e.g., in terms of sex, age and relationship status) (Nedregård & Olsen, 2014; Sivertsen et al., 2019). Further, the proportion of women in the current sample was similar to the proportion of women among all Norwegian students (i.e., approximately 60%) (Statistisk sentralbyrå [Statistics Norway], 2020).

Co-occurrence of smoking and snus use in the sample

An overview of the co-occurrence of smoking and snus use in the sample is presented in Table 2. The majority of students who were ever snus users were non-smokers (i.e., 67.9%), while 44.7% of ever smokers were non-snus users. A total of 16.5% of the daily snus users identified themselves as ex-smokers and 6.6% of daily smokers identified themselves as ex-snus users.

Demographic variables, personality traits, and substance use characteristics associated with smoking

Demographic, personality and substance use characteristics associated with smoking are illustrated in Table 3. Ex-smokers, occasional smokers and daily smokers were older than non-smoking students. Ex-smokers were also more likely to be women, less likely to have been born in Norway, and less likely to be single compared to non-smokers. Further, ex-smokers, occasional smokers, and daily smokers all scored lower on conscientiousness and higher on neuroticism and openness, compared to non-smokers.

Substance use differed greatly across smoking status. Ex- and occasional smokers were more likely to be ex-snus users, occasional snus users and daily snus users as compared to non-smokers. Daily smokers, however, were less likely to use snus daily compared to non-smokers. Ex-smokers, occasional smokers and

Table 2. The number of participants in the different smoking and snus use categories, *n* = 10,150.

	Non-snus users, <i>n</i> = 6,762	Ex-snus users, <i>n</i> = 727	Occasional snus users, <i>n</i> = 859	Daily snus users, <i>n</i> = 1,802	Ever* snus users, <i>n</i> = 3,388
Non-smokers, <i>n</i> = 8,184	5,884 (87.0 ^a , 71.9 ^b)	454 (62.4 ^a , 5.6 ^b)	619 (72.1 ^a , 7.6 ^b)	1,227 (68.1 ^a , 15.0 ^b)	2,300 (67.9 ^a , 28.1 ^b)
Ex-smokers, <i>n</i> = 860	334 (4.9 ^a , 38.8 ^b)	160 (22.0 ^a , 18.6 ^b)	69 (8.0 ^a , 8.0 ^b)	297 (16.5 ^a , 34.5 ^b)	526 (15.5 ^a , 61.2 ^b)
Occasional smokers, <i>n</i> = 894	390 (5.8 ^a , 43.6 ^b)	99 (13.6 ^a , 11.1 ^b)	144 (16.8 ^a , 16.1 ^b)	261 (14.5 ^a , 29.2 ^b)	504 (14.9 ^a , 56.4 ^b)
Daily smokers, <i>n</i> = 212	154 (2.3 ^a , 72.6 ^b)	14 (2.0 ^a , 6.6 ^b)	27 (3.1 ^a , 12.7 ^b)	17 (0.9 ^a , 8.0 ^b)	58 (1.7 ^a , 27.4 ^b)
Ever* smokers, <i>n</i> = 1,966	878 (13.0 ^a , 44.7 ^b)	273 (37.6 ^a , 13.9 ^b)	240 (27.9 ^a , 12.2 ^b)	575 (31.9 ^a , 29.2 ^b)	1,088 (32.1 ^a , 55.3 ^b)

*Ever represents ex-, occasional and daily smoking/snus use. ^aThe percentage of the participants in each category of snus use who are also non-smokers, ex-smokers, occasional smokers, daily smokers or ever smokers. ^bThe percentage of the participants in each category of smoking who are also non-snus users, ex-snus users, occasional snus users, daily snus users or ever snus users.

Table 3. The association between demographic variables, personality traits, substance use and smoking, $n = 9,391$. Multinomial logistic regression analysis, reference category: non-smokers ($n = 7,579$), $OR = 1$.

	Ex-smokers, $n = 792$ Adjusted OR (95% CI)	Occasional smokers, $n = 823$ Adjusted OR (95% CI)	Daily smokers, $n = 197$ Adjusted OR (95% CI)
Demographics			
Age	2.18 (2.04–2.33)***	1.46 (1.33–1.59)***	2.08 (1.87–2.31)***
Sex (woman, ref: man)	1.27 (1.05–1.55)*	1.02 (0.85–1.22)	1.23 (0.87–1.74)
Born in Norway (ref: country outside of Norway)	0.61 (0.46–0.80)***	0.80 (0.59–1.08)	0.69 (0.43–1.11)
Single (ref: in a romantic relationship)	0.72 (0.60–0.86)***	1.13 (0.96–1.33)	0.94 (0.69–1.29)
Personality			
Extroversion (Z)	0.93 (0.85–1.02)	1.09 (0.99–1.19)	0.92 (0.78–1.08)
Agreeableness (Z)	0.98 (0.89–1.07)	0.94 (0.86–1.02)	0.93 (0.79–1.09)
Conscientiousness (Z)	0.88 (0.81–0.95)**	0.79 (0.73–0.86)***	0.73 (0.63–0.84)***
Neuroticism (Z)	1.20 (1.10–1.30)***	1.13 (1.04–1.23)**	1.18 (1.00–1.38)*
Openness (Z)	1.30 (1.19–1.41)***	1.19 (1.09–1.29)***	1.43 (1.21–1.68)***
Substance use			
<i>Snus use</i>			
Ex-snus users (ref: non-snus users)	7.43 (5.80–9.53)***	2.15 (1.64–2.83)***	0.91 (0.49–1.69)
Occasional snus users (ref: non-snus users)	2.50 (1.83–3.40)***	2.47 (1.95–3.13)***	1.46 (0.92–2.34)
Daily snus users (ref: non-snus users)	5.24 (4.27–6.43)***	1.82 (1.50–2.21)***	0.41 (0.24–0.70)**
<i>Alcohol and illegal substances</i>			
Alcohol use (AUDIT, Z)	1.28 (1.17–1.41)***	1.63 (1.50–1.77)***	1.50 (1.28–1.74)***
Cannabis use last six months (ref: no cannabis use last six months)	1.72 (1.35–2.18)***	3.84 (3.18–4.64)***	4.05 (2.78–5.90)***
Use of other illegal substances last six months (ref: no use last six months)	2.04 (1.44–2.89)***	1.72 (1.29–2.30)***	2.41 (1.46–3.96)**

Model: $df = 45$, $p < .001$, $\chi^2 = 2212.820$, Cox & Snell = .210, Nagelkerke $R^2 = .283$.

Notes. OR = odds ratio; CI = confidence interval; Z based on z-scores; AUDIT = Alcohol Use Disorders Identification Test. * $p < .05$. ** $p < .01$. *** $p < .001$.

daily smokers all consumed more alcohol than non-smokers and were all more likely to have used cannabis and other illegal substances in the last six months.

Demographic variables, personality traits, and substance use characteristics associated with snus use

Demographic, personality and substance use characteristics associated with snus use are shown in Table 4. Ex-snus users, occasional snus users, and daily snus users were younger than non-snus users. Ex-snus users and daily snus users were also less likely to be women,

more likely to have been born in Norway, and less likely to be single than non-snus users. Ex-snus users, occasional snus users, and daily snus users all scored higher on extroversion than non-snus users. Daily snus users scored higher on agreeableness and lower on conscientiousness, compared to non-snus users. Occasional and daily snus users scored lower on openness than non-snus users.

Substance use status differed greatly with snus use. Daily snus users were less likely to smoke daily but were more likely to smoke occasionally and to be ex-smokers compared to non-snus users. Also, ex-snus users and occasional snus users were more likely to smoke occasionally or be ex-smokers compared to

Table 4. The association between demographic variables, personality traits, substance use and snus use, $n = 9,391$. Multinomial logistic regression analysis, reference category: non-snus users ($n = 6,277$), $OR = 1$.

	Ex-snus users, $n = 663$ Adjusted OR (95% CI)	Occasional snus users, $n = 793$ Adjusted OR (95% CI)	Daily snus users, $n = 1,658$ Adjusted OR (95% CI)
Demographics			
Age	0.81 (0.73–0.89)***	0.80 (0.72–0.89)***	0.82 (0.76–0.89)***
Sex (woman, ref: man)	0.60 (0.49–0.73)***	1.20 (1.00–1.45)	0.73 (0.64–0.84)***
Born in Norway (ref: country outside of Norway)	2.47 (1.63–3.75)***	1.33 (0.97–1.84)	1.99 (1.51–2.62)***
Single (ref: in a romantic relationship)	0.49 (0.41–0.59)***	0.87 (0.74–1.02)	0.82 (0.73–0.93)**
Personality			
Extroversion (Z)	1.19 (1.08–1.31)***	1.30 (1.19–1.42)***	1.23 (1.15–1.31)***
Agreeableness (Z)	0.97 (0.88–1.06)	0.98 (0.90–1.07)	1.10 (1.02–1.17)**
Conscientiousness (Z)	0.98 (0.89–1.06)	0.98 (0.90–1.06)	0.83 (0.78–0.88)***
Neuroticism (Z)	1.09 (0.99–1.19)	0.95 (0.87–1.03)	0.97 (0.91–1.04)
Openness (Z)	0.95 (0.87–1.04)	0.88 (0.81–0.95)**	0.94 (0.88–0.99)*
Substance use			
<i>Smoking</i>			
Ex-smokers (ref: non-smokers)	6.76 (5.27–8.67)***	2.31 (1.70–3.15)***	4.76 (3.89–5.82)***
Occasional smokers (ref: non-smokers)	2.10 (1.60–2.77)***	2.40 (1.89–3.05)***	1.78 (1.46–2.16)***
Daily smokers (ref: non-smokers)	0.86 (0.46–1.61)	1.46 (0.91–2.33)	0.38 (0.22–0.65)**
<i>Alcohol and illegal substances</i>			
Alcohol use (AUDIT, Z)	1.58 (1.44–1.74)***	1.82 (1.67–1.98)***	1.76 (1.65–1.89)***
Cannabis use last six months (ref: no cannabis use last six months)	1.82 (1.43–2.31)***	1.32 (1.04–1.68)*	1.64 (1.38–1.96)***
Use of other illegal substances last six months (ref: no use last six months)	1.03 (0.70–1.53)	1.28 (0.89–1.85)	1.26 (0.95–1.67)

Model: $df = 45$, $p < .001$, $\chi^2 = 1776.762$, Cox & Snell = .172, Nagelkerke $R^2 = .201$.

Notes. OR = odds ratio; CI = confidence interval; Z based on z-scores; AUDIT = Alcohol Use Disorders Identification Test. * $p < .05$. ** $p < .01$. *** $p < .001$.

non-snus users. Compared to non-snus users, ex-snus users, occasional snus users, and daily snus users all consumed more alcohol and were more likely to have used cannabis during the last six months.

Comparing current smokers and current snus users to current dual users

Results from the analysis comparing current dual users to current smokers and current snus users are shown in Table 5. Current smokers were older, more likely to be women, and had a lower level of alcohol consumption compared to current dual users. Current snus users were

younger, more likely to have been born in Norway, had higher scores on conscientiousness, had lower scores on openness, had a lower level of alcohol consumption, and were less likely to have used cannabis in the last six months, compared to current dual users.

Comparing daily smokers and daily snus users

The results from the analysis comparing daily snus users to daily smokers are detailed in Table 6. Compared to daily smokers, daily snus users were younger, less likely to be women, and more likely to have been born in Norway.

Table 5. Comparison of current (i.e., occasional or daily) snus users and current smokers on demographic variables, personality traits, and substance use characteristics, $n = 3,059$. Multinomial logistic regression analysis, reference category: current dual users ($n = 411$), $OR = 1$.

	Current smokers, $n = 608$ Adjusted OR (95% CI)	Current snus users, $n = 2,040$ Adjusted OR (95% CI)
Demographics		
Age	1.47 (1.25–1.72)***	0.82 (0.70–0.95)**
Sex (woman, ref: man)	1.51 (1.12–2.03)**	1.18 (0.92–1.53)
Born in Norway (ref: country outside of Norway)	0.95 (0.59–1.53)	1.82 (1.17–2.83)**
Single (ref: in a romantic relationship)	1.08 (0.82–1.42)	0.90 (0.71–1.13)
Personality		
Extroversion (Z)	0.93 (0.81–1.07)	1.03 (0.91–1.17)
Agreeableness (Z)	0.93 (0.81–1.06)	1.07 (0.95–1.21)
Conscientiousness (Z)	1.10 (0.97–1.25)	1.23 (1.10–1.38)***
Neuroticism (Z)	1.06 (0.93–1.22)	0.92 (0.82–1.04)
Openness (Z)	1.08 (0.94–1.24)	0.83 (0.74–0.94)**
Substance use		
Alcohol use (AUDIT, Z)	0.74 (0.64–0.84)***	0.72 (0.64–0.81)***
Cannabis use last six months (ref: no cannabis use last six months)	1.09 (0.81–1.47)	0.39 (0.30–0.50)***
Use of other illegal substances last six months (ref: no use last six months)	1.06 (0.71–1.57)	0.87 (0.60–1.24)

Model: $df = 24$, $p < .001$, $\chi^2 = 464.400$, Cox & Snell = .141, Nagelkerke $R^2 = .172$.

Notes. OR = odds ratio; CI = confidence interval; Z based on z-scores; AUDIT = Alcohol Use Disorders Identification Test.

* $p < .05$. ** $p < .01$. *** $p < .001$.

Daily snus users also scored higher on extroversion and agreeableness and lower on openness compared to daily smokers. Daily snus users consumed more alcohol than daily smokers but were less likely than daily smokers to have used cannabis during the last six months.

Discussion

In this student sample, daily snus use (17.8%) was vastly more common than daily smoking (2.1%). In the Norwegian population as a whole, 12% report daily smoking and 12% report daily snus use (Statistisk sentralbyrå [Statistics Norway], 2019). As students may adopt new trends sooner than the general population (Pedersen, 2015; Rogers, 1995), the low rate of smoking and the rather high rate of snus use found in the current study might suggest that the prevalence of smoking in Norway is

still decreasing while the prevalence rates of snus use might still be increasing.

In total, 67.9% of ever snus users identified themselves as non-smokers (past and current), while 44.7% of ever smokers identified themselves as non-snus users (past and current). Hence, only smoking or only using snus appear to be rather common. It could be noted that there were more students who currently used snus than there were ex-snus users, while the opposite was true for smoking, suggesting cessation of snus use to be rare.

Several characteristics associated with smoking and snus use were identified, many in accordance with findings from previous studies. In the following discussion, the associations between personality traits and snus use will be presented and discussed first as this constitutes the most novel aspect of the study. Further an overall summary of similarities and differences

Table 6. Comparison of daily snus users and daily smokers on demographic variables, personality traits, and substance use characteristics, $n = 1,823$. Binary logistic regression analysis, reference category: daily smokers ($n = 181$), $OR = 1$.

	Daily snus users, $n = 1,642$ Adjusted OR (95% CI)
Demographics	
Age	0.42 (0.36–0.50)***
Sex (woman, ref: man)	0.48 (0.32–0.73)***
Born in Norway (ref: country outside of Norway)	3.57 (2.05–6.23)***
Single (ref: in a romantic relationship)	0.98 (0.68–1.40)
Personality	
Extroversion (Z)	1.29 (1.07–1.55)**
Agreeableness (Z)	1.22 (1.02–1.46)*
Conscientiousness (Z)	1.14 (0.97–1.35)
Neuroticism (Z)	0.90 (0.75–1.07)
Openness (Z)	0.71 (0.58–0.85)***
Substance use	
Alcohol use (AUDIT, Z)	1.22 (1.01–1.48)*
Cannabis use last six months (ref: no cannabis use last six months)	0.45 (0.29–0.68)***
Use of other illegal substances last six months (ref: no use last six months)	0.65 (0.38–1.11)

Model: $df = 12$, $p < .001$, $\chi^2 = 209.942$, Cox & Snell = .109, Nagelkerke $R^2 = .229$.

Notes. Daily users of both snus and cigarettes ($n = 16$) are excluded from the analysis. OR = odds ratio; CI = confidence interval; Z based on z-scores; AUDIT = Alcohol Use Disorders Identification Test.

* $p < .05$. ** $p < .01$. *** $p < .001$.

between smokers and snus users in terms of characteristics will be given. Finally, the implications of the current findings for the understanding of the relationship between smoking and snus use will be discussed.

Personality traits and snus use

All rates of snus use were associated with higher extroversion scores compared to non-snus use. Daily snus use was further associated with higher agreeableness scores and lower

conscientiousness scores, while occasional and daily snus use was associated with lower scores on openness. To our knowledge, associations between personality traits and snus use have not been investigated by previous studies, hence the current findings are novel. Smokers have previously been found to have higher scores on extroversion (Raynor & Levine, 2009; Vollrath & Torgersen, 2008), although no association between smoking and extroversion was found in the current study. Given the low prevalence of smoking in the current sample, and that smokers in Norway typically have to go to designated areas to smoke, the sociable, extroverted students in our sample who used nicotine may prefer snus over smoking so as to avoid having to remove themselves from social settings in order to smoke. The association between extroversion and snus use may further relate to extroverts' tendency to use substances in general, due to their stronger need for stimulation (McCrae & John, 1992; Munafo et al., 2007). The observed association between extroversion and snus use is in line with the findings of a study by Sæbø (2013) where snus users were found to be socially active (e.g., more likely to eat at restaurants) compared to daily smokers and non-tobacco users.

The positive association between daily snus use and agreeableness may be considered somewhat surprising, as agreeableness tends to be inversely associated with substance use (e.g., alcohol use, cannabis use) (Allen & Holder, 2014; Malouff et al., 2007). Compassion is a hallmark of agreeable individuals (McCrae & John, 1992), thus agreeable individuals may avoid substance use in order to refrain from causing others concern, harm or inconvenience. Snus has not been associated with appreciable harm for the user or those around them (Gakidou et al., 2017); hence, individuals with high agreeableness scores and a vulnerability for substance use may prefer snus to other more damaging substances.

When compared to non-snus use, there was an inverse association between conscientiousness and daily snus use, which may relate to

findings suggesting conscientiousness to be inversely associated with substance use in general (Allen & Holder, 2014; Malouff et al., 2007). Conscientious individuals may avoid snus due to their increased capabilities for delaying gratification and adhering to long-term goals (e.g., good health or good financial situation) (Bogg & Roberts, 2004). Occasional and daily snus use was also inversely associated with openness. This finding may also relate to the association between openness and conventionality, where those with lower scores are more conventional (McCrae & John, 1992). The conventionality of students with lower openness scores may explain their tendency toward snus use as snus use was rather common in the current sample.

Similarities and differences between smokers and snus users

Smokers and snus users were similar on some characteristics. Compared to non-users, both smokers and snus users were less likely to be single (ex-smokers, ex-snus users and daily snus users), had lower scores on conscientiousness (ever smokers and daily snus users), consumed more alcohol (ever smokers and ever snus users) and were more likely to report cannabis use during the last six months (ever smokers and ever snus users).

When smokers and snus users were compared to each other some relative differences on common traits were identified. Compared to daily smokers, daily snus users were more likely to have a high level of alcohol consumption and less likely to report cannabis use. Compared to current dual users, current snus users had higher scores on conscientiousness, lower levels of alcohol consumption and were less likely to report cannabis use. Current smokers had a lower consumption of alcohol compared to dual users.

Several differences between smokers and snus users were also identified. Snus users were consistently younger while smokers were consistently older, both compared to non-users, daily smokers/snus users, respectively, and dual

users. Further, there was a clear tendency of smokers being more likely to be women and less likely to have been born in Norway and snus users being more likely to be men and more likely to have been born in Norway when compared to the other groups (i.e., non-users, daily smokers/snus users, respectively, and dual users), although the associations did not remain in all the individual analyses. Similarly, smokers and snus users tended to differ on the trait of openness; smokers had higher scores and snus users had lower scores compared to non-users, each other and compared to dual current users in the case of snus use. Finally, some traits, namely extroversion, agreeableness, neuroticism and use of illegal substances other than cannabis, were solely associated with smoking or snus use while unrelated to the other. Snus users had higher scores on extroversion and agreeableness both compared to non-users and daily smokers. Lastly, compared to non-smokers, smoking was associated with higher scores on neuroticism and an increased likelihood of reporting use of illegal substances other than cannabis.

In sum, the students who smoked and used snus appeared to share lower scores on conscientiousness and a general tendency to use substances. In accordance with previous studies, smokers and dual users seemed more maladjusted compared to snus users, as snus users had relatively higher conscientiousness scores (only compared to dual users), lower alcohol consumption levels (only compared to dual users) and were less likely to report cannabis use (compared to daily smokers and dual users) (Engström et al., 2010; Grøtvedt et al., 2008; Kvaavik et al., 2015; E. Larsen et al., 2013; Pedersen & von Soest, 2014). Further, smokers and snus users differed on most of the included demographic characteristics (i.e., age, sex, and country of birth) and personality traits (i.e., extroversion, agreeableness, neuroticism and openness). The differences in terms of personality traits further support the notion of smokers as maladjusted compared to snus users, as smokers had lower scores on extroversion and

agreeableness compared to snus users, and higher scores on neuroticism compared to non-smokers. Lower extroversion and agreeableness scores and higher neuroticism scores have further been associated with lower levels of well-being (Grant et al., 2009).

The current findings' implications for the understanding of the relationship between smoking and snus use

As discussed above, several pathways through which smoking and snus use may relate to each other have been suggested (i.e., smoking causing snus use, snus use causing smoking, smoking and snus use as caused by the same underlying factors, or smoking and snus use as unrelated behaviours). The findings from the present study can shed some light on these different notions, although it is important to note that the current study has limitations that preclude conclusions regarding causality (e.g., cross-sectional design, low response rate). Further, some of the suggested links between smoking and snus use (e.g., the gateway hypothesis and the diversion hypothesis) cannot be proved or disproved with certainty, as they build on assumed counterfactual outcomes (e.g., the diversion hypothesis positing that some snus users would have smoked if snus was not available) (Lund et al., 2020) which, due to methodological and ethical constraints, are not possible to investigate with sufficient scientific rigor.

First, we found strong positive associations between smoking and snus use, while daily smoking was inversely associated with daily snus use and vice versa. In total, 16.5% of daily snus users considered themselves to be ex-smokers while only 6.6% of daily smokers considered themselves to be ex-snus users. This may suggest that it is more common to go from smoking to snus use than the other way around, at least in terms of daily use. This supports the notion of snus as a substitute rather than supporting the gateway hypothesis, and is consistent with previous studies (Kvaavik et al., 2015;

Lund et al., 2010). In our sample, though, snus use did not seem to primarily have replaced smoking directly, as 67.9% of ever snus users were non-smokers (past and current). In total, 44.7% of ever smokers were non-snus users, which suggests that a small majority of the ever smokers had also used snus. This finding may also relate to snus replacing smoking as the combination ex-smoker and daily snus user and the combination occasional smoker and daily snus user were the largest groups among the ever smokers who had used snus. The large proportion of students who had only used snus or only smoked, suggests that smoking may not be the most important determinant of snus use, nor may snus use be the most important determinant of smoking.

In line with the assumptions of the common liability theory, smokers and snus users in the current study were similar on certain characteristics (i.e., lower scores on conscientiousness, higher alcohol consumption and cannabis use), indicating that they might to some degree be part of the same segment. Still, smokers and snus users differed significantly in terms of age, sex and country of birth, as well as on personality traits, suggesting that snus may also recruit a new segment to nicotine use that may otherwise not have smoked if snus was not available.

The relationship between smoking and snus use can best be understood using prospective studies. Still, our findings indicate that snus might work as a replacement for smoking for some students. Most snus users had, however, never smoked. In line with the diversion hypothesis, some of these students may have smoked if snus was not available, but the demographic and personality differences observed between smokers and snus users might suggest that snus is also recruiting a new segment to nicotine use. The gateway hypothesis was not supported by the current findings.

Strengths and limitations

The main limitation of the current study is the cross-sectional design, precluding causal

inferences. Further, the response rate might be considered as low (39.4%). However, over the last decades, participation in population-based studies has declined (Krokstad et al., 2013; Tolonen et al., 2006), and the response rate is higher than that obtained in a similar student survey in Norway (Nedregård & Olsen, 2014), and higher than the response rates found when reviewing email survey response rates (Sheehan, 2001). Further, a large proportion of respondents (16%) had missing data. In general, individuals who participate in studies are healthier than non-participants (Knudsen et al., 2010). The rather low response rate, the large proportion of missing data and the potential selection bias in terms of healthier participants involve a high risk of bias and selective data. The risk of biased results may, however, be larger for prevalence estimates than for exposure–outcome associations and the generalisability of associations is therefore likely to be sufficient even when the distribution of the exposure/outcome variables in the study population is different from the general population (Manolio & Collins, 2010; Nilsen et al., 2009). Thus, there is more uncertainty regarding the prevalence estimates for smoking and snus use found in the present study, than for the associations found between smoking and snus use and other variables. Additionally, the item assessing snus use also included “chewing tobacco and similar products”, further increasing the uncertainty regarding the precise prevalence of snus use.

Despite these abovementioned limitations, the current study had a large sample size enabling detailed investigations of smoking and snus use in relation to each other, and in relation to demographic characteristics, personality traits and use of other substances. An improved understanding of student use of tobacco products, as well as factors associated with use, are of great importance, as they may aid prevention initiatives. To the best of our knowledge, snus use and smoking have to a limited extent been investigated in Scandinavian student populations, and the current study provides novel

findings regarding the associations between smoking, snus use and individual characteristics. Furthermore, the current sample displayed similar characteristics to other Norwegian student samples (e.g., in terms of sex, age and relationship status) (Nedregård & Olsen, 2014; Sivertsen et al., 2019). Hence, the results from the present study are likely to be generalisable to the Norwegian student population.

Conclusions

The current study identified characteristics associated with smoking and snus use, some of which have not previously been investigated. In total, 67.9% of ever snus users identified themselves as non-smokers (past and current) while 44.7% of ever smokers identified themselves as non-snus users (past and current). Hence, being solely a smoker or solely a snus user appears to be rather common. Though limited by a cross-sectional design, it seems plausible that the group of students using snus may consist of a combination of previous smokers, students who would have smoked if snus was not available and a new segment of students who may not have used nicotine if snus was not available.

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