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## **Perceptions of Relative Risk of Disease and Addiction From Cigarettes and Snus.**

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# Perceptions of relative risk of disease and addiction from cigarettes and snus

Running head: Perceptions of relative risk

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# Perceptions of relative risk of disease and addiction from cigarettes and snus

## Abstract

The public is largely unaware of the lower global risk associated with snus compared to that of cigarettes, but little is known of perceptions of relative risks for specific diseases. Inveterate, daily and non-daily smokers' perceptions of the relative snus/cigarette risk of cardiovascular disease, and of cancer of the lung, stomach, and oral cavity, and perceptions among smokers, snus users and dual users of the relative risk of nicotine addiction, was studied in a pooled sample from annual national surveys (2008-2011) performed by Statistics Norway. The total sample included 2661 ever smokers and snus users aged 15-79 years old. 53 per cent were men, and the average age was 46.1 years. Compared to medical consensus, all smoker groups overestimated the relative risks of diseases from snus use, and inveterate smokers overestimated them significantly more than other groups. For all diseases except lung cancer, the majority of smokers thought snus users were running a higher or equal risk. For lung cancer, 22 per cent believed that snus use gave a higher or equal risk. Smokers, snus users and dual users tended to think that snus and cigarettes were equally addictive products, while a somewhat higher proportion of those who had quit both products thought that cigarettes were more addictive. Increased knowledge of the relative health risks might give smokers an incitement to switch to snus, and prompt current dual users to stop smoking completely. Awareness could be improved by tailoring information at targeted groups, for example via the health care system.

Keywords: smoking, snus, relative risks, diseases, addiction.

## Perceptions of relative risk of disease and addiction from cigarettes and snus

Since the first Surgeon General's report on smoking and health in 1964, the risks to health from smoking have been upgraded several times, and for many years now, the assumption is that approximately 50 per cent of smokers will die from a tobacco-related disease (Doll et al., 1994). Moreover, a general, but not absolute positive correlation between consumption intensity and level of mortality has been established, although significant increases in total and cardiovascular mortality have been found at consumption levels as low as 1-4 cigarettes daily (Bjartveit & Tverdal, 2005), and for less-than-daily smoking (Luoto, Uutela & Puska, 2000).

The findings from studies of health risks associated with the use of the smokeless tobacco Swedish moist snuff (snus) have followed a different trajectory. Starting from the assumption that snus might substantially increase the risk for several health problems (Cullen et al., 1986), mounting evidence and a refinement of research results differentiating snus from other forms of smokeless tobacco (ST) have led to a gradual downgrading of these risks. The development of products with lower nitrosamine (Osterdahl, Jansson & Paccou, 2004) and polycyclic aromatic hydrocarbon (PAH) levels (Stepanov et al., 2010) also means that the factual risks are likely to be lower today than with the snus types used 20-30 years ago (Lee & Hamling, 2009). A group of EU-appointed experts performed a review of studies of the risk of harm to health from combustible and non-combustible tobacco, and concluded that snus was 70-90 per cent less harmful to users' health than smoking (The Scientific Committee on Emerging and Newly-Identified Health Risks (SCENIHR), 2008). This evaluation was also in agreement with an estimate from the Royal College of Physicians (RCP, 2007).

Integrated in a development where harm reduction ideas have gained importance within the field of tobacco control, increasing evidence of the favourable risk profile of snus compared to combustible tobacco have led to a debate regarding the role of snus in relation to public and individual health-improving efforts (Hatsukami, Lemmonds & Tomar, 2004; Rodu, 2011; Rodu &

Godshall, 2006; Tomar, 2002). At the core of the debate lies a disparity in the outlook on the fundamental and uttermost goals of anti-tobacco policies and anti-tobacco work (Arnott, 2012). Where the traditional approach is almost exclusively focused on total abstinence, the line of tobacco harm reduction (THR) argues the merits of encouraging smokers to switch to less harmful tobacco products, including snus (Rodu & Godshall, 2006).

In terms of specific health risks, SCENIHR (2008) maintained that there is no evidence of any major health hazard from snus that does not also arise from smoking, and that the risks can be divided into three groups: respiratory disease, cardiovascular disease, and cancer.

While 46 per cent of the deaths caused by smoking are due to some respiratory disease, including lung cancer, there is no evidence that snus causes this type of health problem (SCENIHR, 2008). Substituting snus for cigarettes would give a 100 per cent reduction in risk (SCENIHR, 2008).

Cardiovascular disease (CVD) is a major health risk from smoking, and accounts for 28 per cent of smoking-related deaths (SCENIHR, 2008). The relative risk of myocardial infarction for current smokers (vs. non-smokers) has been estimated to be 2.60-2.80 (Hergens et al., 2005; Wennberg et al., 2007), while for fatal myocardial infarction smokers have an OR over non-smokers of 3.6 (Hergens et al., 2005). With regard to snus use, no significant association with stroke has been found, but some Swedish studies have found significant but moderate effects for fatal, although not for non-fatal, myocardial infarction (OR=1.26; 1.27)(Boffetta & Straif, 2009). However, in a recent analysis, pooling data from eight Swedish prospective observational studies, no association between use of snus and the development of myocardial infarction was found, after controlling for confounding by socio-economic or lifestyle factors on a moderate effect on case fatality (OR=1.28) (Hansson et al., 2012). These recent results have made it probable that substitution of smoking with snus use would reduce cardiovascular mortality even more than SCENIHR's (2008) conservative estimate of 50 per cent.

A wide range of cancers have at some time been associated with the use of snus (IARC, 2012), and much insecurity has been attached to the possible risk of cancer in general, and to pancreatic cancer in particular. However, a number of recent review studies have contributed to a more solid base of knowledge in this area. Lee and Hamling (2009) conducted a meta-analysis with the input from eighty-nine studies from the USA and Scandinavia. Their results indicated that Scandinavian snus had no effect on the risk of cancer of the oropharynx, oesophagus, pancreas, larynx, kidney, stomach, oral cavity or lung. No association for oral cancer was also the conclusion in a study by Rosenquist (2005) and in a review article by Rodu and Jansson (2004). Sponsiello-Wang, Weitkunat and Lee (2008) looked specifically at the association between ST and pancreatic cancer, as earlier studies had identified this as a particular health hazard for snus users (Boffetta et al., 2008). Based on seven studies from the USA and Scandinavia, they concluded that if there was any risk for pancreatic cancer for ST users, it was highly likely to be less than that from smoking. More recently, the Boffetta-team published a pooled analysis study, where they found no significant association between ST use and pancreatic cancer (Bertuccio et al., 2011). Seen together, these research summaries support an overall conclusion of a low relative risk of any cancer from snus use (Rodu, 2011; Lee, 2011).

Meanwhile, little doubt exists about the effect of smoking on the risks for these cancers. For oral cancer, Rosenquist et al. (2005) found that Swedish smokers had an odds ratio over non-smokers of 2.4, while Luo et al. (2007) found an OR of 2.0 for Swedish ever-smokers. Regarding pancreatic cancer, findings suggest OR sizes of 2.5 (Fuchs et al., 1996) and 2.8 (Swedish ever smokers, Luo et al., 2007). A meta-analysis conducted by Gandini et al. (2008) found that current smokers had significantly higher relative risk (compared to non-smokers) for cancer in the oral cavity (3.43), pancreatic cancer (1.70), stomach cancer (1.65) and lung cancer (8.96). Furthermore they found that the risk of lung cancer increased by 7% for each additional cigarette smoked per day. SCENIHR (2008) estimated that the risk of oral and gastro-intestinal cancer would be reduced by 50 per cent if smokers switched to snus.

Nicotine is an addictive substance, and habituated smokers and snus users will suffer withdrawal symptoms during quitting and quitting attempts. Snus is illegal in the EU except in Sweden, and consequently the only two mature snus markets in Europe, where data on patterns of use and transitions between tobacco products have been available have been Sweden and non-EU Norway. Recent studies have shown that individuals who have used snus as an aid in smoking cessation tend to continue the snus habit even after they have stopped smoking (Lund, Scheffels & McNeill, 2011; Scheffels, Lund & McNeill 2012), indicating continued nicotine addiction in this group. Snus use gives a prolonged period of high nicotine levels in the brain, but the high initial concentration and rapid delivery of nicotine to the brain with combustible tobacco has led to the proposition that cigarettes have the highest addiction potential (Foulds et al., 2003; SCENIHR, 2008). However, the question of relative addictiveness has not been settled conclusively, and there are examples of studies that find snus and cigarettes to be equally addictive (DiFranza et al., 2012; Post, et al., 2010). Considering the relative scarcity of studies on this subject, it is reasonable to say that there is no objective standard on this question at present.

It may also be difficult to measure a general degree of addictiveness, due to differences in nicotine levels between cigarette types, and large variability in nicotine absorption from snus products with different PH-values. In addition there will be individual differences between users, such that some snus users and smokers are more addicted and others less addicted to nicotine.

As studies from several countries have shown, the public is largely unaware of the size of the differences in risks between combustible tobacco and snus. Health risks from snus are commonly overrated both in the USA (Heavner, Rosenberg & Phillips, 2009; O'Connor, et al., 2007; Peiper, et al., 2010), and in the two Scandinavian countries with long-standing snus traditions and widespread snus use: Norway and Sweden. Two Norwegian studies showed such overrated snus risk perceptions among adolescents (Overland, Hetland & Aaroe, 2008) and adult men (Lund, 2012), while a third study showed overrated snus risk perceptions among Norwegian general practitioners (Lund &

Scheffels, 2012). Widespread high risk perceptions were also found in an earlier survey conducted on behalf of the Norwegian Medical Association, where 70 per cent of adult respondents thought snus use was an important cause of cancer, and 43 per cent thought it was an important cause of heart disease (Opinion, 2002). A Swedish study showed that a majority of daily smokers had exaggerated ideas of the harmfulness of both snus and NRT (nicotine replacement therapy) (Wikmans & Ramström, 2010).

The majority of these studies applied a global concept of harm, asking respondents to rate the overall harmfulness of snus – either comparatively or absolutely. This design has some inherent limitations, as it makes it impossible to know exactly which factors respondents have included in their relative harm considerations. As suggested in a previous study, (Lund & Scheffels 2012) factors such as risk of addiction, risk of dual use, and risk of recruiting new users could be read into people’s understanding of the complex concepts of risk and harm. An additional possibility that has been discussed in the literature is that risk, by some respondents, is understood more in terms of the severity of the possible consequences, and less in terms of the probability of occurrence (Teigen, 2001). On a more general level therefore, the addictiveness of both products, and the fact that both smoking and snus use increase the probability of contracting severe diseases (although smoking increases it substantially more), might affect people’s perceptions of the global relative risk in ways that we have yet to fully understand.

The knowledge about appraisals of the relative risk of specific diseases and addiction is as yet relatively limited. Also there is a need for increased insights into which factors that may influence these appraisals. An interesting question in that regard is to what extent perceptions of health risks and addiction potential are associated with an individual’s smoking status. It has been argued that snus might be particularly suited as an alternative to traditional cessation aids for heavy or inveterate smokers who are more addicted to nicotine and less motivated for quitting (Rodu & Godshall, 2006). Inveterate smokers are understood as heavy smokers with a strong commitment to smoking and a

strong smoker identity. An important background for this claim is that snus maintains greater nicotine plasma levels relative to nicotine replacement therapies (NRT) (Lunell & Lunell, 2005), making withdrawal less of a problem. This might serve to explain why smokers who are less motivated to quit might still be willing to try snus, as indicated by results from Biener et al. (2011), and why smokers seem to prefer snus to nicotine gum (Caldwell, Burgess & Crane, 2010) Studies have also indicated that the likelihood of achieving cigarette abstinence is greater with snus than with NRT, but not greater with snus than with varenicline (Lund, McNeill & Scheffels, 2010).

However, whether or not these smokers would be interested in switching to snus might in part be determined by their views on the relative risk involved in using the two products. It has been shown that male adult smokers who regard snus to be less harmful will be more inclined to use it for smoking cessation purposes (Lund, 2012), and that US smokers might not switch to ST due to erroneous beliefs about the risks involved (Heavner, Rosenberg & Phillips, 2009) Also, following the introduction of snus into the US market, smokers who believed that snus was less harmful than cigarettes were more than three times as likely to report trying it (Biener & Bogen, 2009). It is possible that perceptions of addiction can influence switching in a similar way, such that smokers might be more reluctant to switch to snus if they believe that snus is more addictive than cigarettes. No studies have explored such associations. The public's perceptions of the relative risk of addiction from snus use and smoking have also not been investigated before, and it is therefore not known how the scientific position compares to popular beliefs and experiences on this subject.

This study had two aims. First to investigate if less-than-daily, daily and inveterate smokers differ in their perceptions of the relative risk of cancer of the oral cavity, stomach cancer, lung cancer, and cardiovascular disease from cigarette smoking and snus use. Second to survey how smokers, snus users, dual users, and quitters perceive the relative risk of nicotine addiction from snus use and smoking, and to uncover potential differences in this perception between the groups.

## Methods

### Participants & procedure

Data were collected annually by telephone by Statistics Norway, a government body responsible for official statistics. Our study period included four annual cross-sectional surveys (2008-2011), and comprised information from a sample representative of the adult Norwegian population (15+ years) regarding age, gender and geography on tobacco behaviour, demographic background variables and perceptions of the relative risk for specific diseases and nicotine addiction from regular snus use or smoking. The legal age for purchase of tobacco in Norway is 18 years, but the age limit is not strictly enforced. Samples were drawn from Statistics Norway's own database, which is updated every month with the National Population Register. Approximately 1100-1200 individuals participated each year, giving a total sample of 4572 people. The average age was 44.6 years, and 50.4 per cent were women. The original gross samples for each survey year were approximately N=2 000, and annual response rates for these surveys were 59 per cent (2008), 60 per cent (2009), 57 per cent (2010), and 58 per cent (2011).

For the purpose of this study, all lifetime non -tobacco users were removed, leaving us with a working sample of 2661 people, 15-79 years old. 53 per cent of the working sample was male, and the average age was 46.1 years. Further descriptive details are given in Table 1.

### Measures

*Relative risk of specific diseases:* The respondents were asked to rate the relative risk of specific diseases from snus and smoking given relatively strict stipulations. The wording of the informational text was: "Compare the health risks for a group of daily smokers with a group of daily users of snus. The smokers and snus users belong to the same age group, and have used tobacco for the same length of time." The diseases included were: cancer of the oral cavity, lung cancer, stomach cancer and cardiovascular disease. Provided categories were: the risk is...: "far higher for snus users", "somewhat higher for snus users", "more or less equal for snus users and smokers", "somewhat

higher for smokers” and “far higher for smokers”. There was also a “don’t know” category. For analytical purposes, two versions of the relative risk variables were calculated. For bivariate comparisons (Table 2) the answers were trichotomized such that the two extreme categories were kept unchanged, while the three non-extreme answers were merged into a single category, giving the categories: “The risk is far higher for smokers”, “The risk is fairly similar”, and “The risk is far higher for snus users”. Partly this was done to reduce the complexity of the results (analyses done on the original variables gave similar results as those presented in Table 2), but partly also because those who held the extreme views were of particular interest. It is within this group one would expect perceptions of relative risk to have the most profound effect on behavior, eg. as a reluctance to substitute snus for cigarettes. This was also the background for dichotomizing these variables into: “The risk is far higher for smokers” vs. all other answers for the purpose of estimating adjusted ORs (Table 3). *Relative risk of addiction:* Similar to the relative risk of diseases, the respondents were asked to rate the relative risk of nicotine addiction from snus use and smoking. The same stipulations were also given for this question (daily use, same age, equal length of tobacco habit). The answers were trichotomized into: “The risk is far higher for smokers”, “The risk is far higher for snus users” and “The risk is fairly similar”.

*Smoking and snus use status:* Current smokers were divided into inveterate smokers, daily smokers and less-than-daily smokers. Inveterate smokers were defined as daily smokers who did not have plans for quitting smoking, and who believed that they would still be smokers in five years. Furthermore, the sample was split into exclusive ever smokers, exclusive ever snus users, former and current dual users. Finally, former dual users were broken down into former smokers (still using snus), former snus users (still smoking), and former both (i.e. total quitters).

There were significant group differences both among current smokers and among ever users of tobacco (Tab. 1). Inveterate and daily smokers tended to be older and to have a lower education than less-than-daily smokers. Ever snus users tended to be younger and to have more education than

ever smokers. There were also significantly fewer women among snus and dual users than among smokers.

### **Statistical analysis**

The distribution of perceptions of relative risks and associations between perceptions and tobacco-user groups were analyzed bivariately, using Chi square testing with critical level  $p < 0.05$ , to check for significant group differences. Possible confounding by demographic and socioeconomic factors was controlled for in logistic regressions with binary risk perception as the explained variable, and smoker group as the explanatory variable, adjusting for gender, age and education. Due to item non-response, total Ns varied slightly between analyses.

## **Results**

### **Perceptions of relative health risks**

Bivariate analysis revealed that, with the exception of lung cancer, the majority of smokers believed that smokers were not much more at risk of the diseases they were asked about (Tab. 2). However, there was some variation in the distribution of perceptions between diseases.

Almost no-one believed that the risk for lung cancer or cardiovascular disease was far higher for snus users. However, 22 % of the respondents believed that the risk of lung cancer was fairly similar for smokers and snus users, while 51% perceived the risk for cardiovascular disease to be the same for smokers and snus users. Overall therefore approximately one in five smokers did not believe that smoking gave a far higher risk for lung cancer, while one in two did not believe that smoking gave a far higher risk for cardiovascular disease.

The perceptions of the risks for cancer of the oral cavity and stomach cancer differed dramatically from the perceptions concerning the other two diseases, particularly with regard to the risk for snus users. More than 18 per cent of all the smokers thought that snus use gave a far higher

risk of stomach cancer, while 34 per cent thought the risk of cancer of the mouth was far higher for snus users. At the other end of the scale, only 6.5 and 14.4 per cent believed that the risk of oral and stomach cancer was far higher for smokers.

Risk perceptions differed significantly between smoker groups for lung cancer and cardiovascular disease, with the tendency being a shift from “far higher risk for smokers” towards “fairly similar risk” as we progress from less-than-daily, to daily, to inveterate smokers. While 40 per cent of inveterate smokers thought smokers were much more at risk for cardiovascular disease, the corresponding proportion among less-than-daily smokers was 56 per cent. Similarly, 3.3 per cent of inveterate smokers believed that smoking gave a far higher risk of cancer of the mouth than snus use, while 8.5 per cent of less-than-daily smokers thought so.

Risk perceptions and awareness are likely to vary between demographic groups. Multiple binary logistic regressions (Tab. 3) showed that even when demographic variables were controlled for, inveterate smokers were significantly less likely to believe that smokers were much more at risk of lung cancer (OR=0.55), cardiovascular disease (OR=0.57) and cancer of the oral cavity (OR=0.41) than less-than-daily smokers. The perceptions of daily smokers did not differ significantly from the perceptions of less-than-daily smokers. With regard to the risk of stomach cancer, the regressions showed no significant effect of either demographic variables or smoker group.

### **Perceptions of relative risk of addiction**

The majority of current or former smokers and snus users believed that snus-users and smokers were running more or less the same risk of becoming addicted to nicotine, but there was still a statistically significant difference between the groups regarding the distribution of perceptions of addiction risks (Tab. 4). Pair-wise comparisons of the groups showed that it was the perceptions of exclusive ever smokers that differed significantly from all other groups (chi square,  $p < 0.001$ ;  $p < 0.001$ ;  $p < 0.01$ , respectively), while there were no significant differences between exclusive snus users, former dual users and current dual users.

There was a tendency for exclusive smokers to be more inclined to think that smoking was more addictive than snus, but even among snus users, a majority thought that smokers were more at risk of addiction. Those who had current or former experience with both products were more inclined to believe that snus gave the higher risk for nicotine addiction than those who had used snus exclusively. This tendency was particularly strong for current dual users.

We found the largest proportion who believed that smokers were much more at risk for addiction (20.7%) in the group that had quit both products. At the same time, this was also the group with the smallest proportion who thought that snus users were much more at risk (7.6%) (Figure 2). However, the difference between sub-groups of former dual users was not statistically significant, possibly due to small group sizes.

## Discussion

Consistent with earlier findings (Lund, 2012; Overland, Hetland & Aaroe, 2008), this study has shown that Norwegian smokers are far from fully informed about the favourable risk profile of snus compared to cigarettes. When asked about the relative risk of specific diseases, a majority of respondents grossly over-estimated the risks from regular snus use compared to the risks from regular smoking. With regard to the risk of nicotine addiction, the majority of respondents believed snus and cigarettes to be equally addictive products.

There were significant differences in how user groups perceived the potential harm to health and the relative risk of nicotine addiction. Inveterate smokers more often believed that the risk of oral cancer, lung cancer and cardiovascular disease was fairly similar irrespective of which of the two products one used. Regarding oral cancer, inveterate smokers also had a more distinct tendency to believe that the risk was far higher for snus users. Pertaining to addiction, exclusive ever smokers were significantly more prone to believe that smokers had a far higher risk of addiction, while current dual users more than other groups believed that snus users ran the highest risk. According to

previous research, Norwegian current dual users are characterized by a tendency to plan to quit smoking within the next five years or earlier, and by combining the daily use of one product with the occasional use of the other, making for a lower cigarette intake per week than among exclusive smokers (Lund & McNeill, 2012). Consequently, the group current dual users included very few inveterate smokers, and quite many daily snus users who occasionally smoke, both characteristics that might have contributed to bring the perceived cigarette-addictiveness down, while increasing the perceived snus-addictiveness.

As many tobacco users have developed addiction to nicotine, the ideas they express about addiction risks can possibly be understood as partly built on personal experiences. In terms of withdrawal symptoms, the most comprehensive personal experiences are presumably found among former dual users who have quit tobacco altogether. Moreover, one might assume that ideas about addiction in this group are less likely to be biased by personal success or failure in (ongoing) quitting attempts. It is particularly interesting therefore, that respondents from this sub-group more than others held the view that smoking was the more addictive behavior. However, even among “dual quitters”, the majority maintained that snus and cigarettes were equal products in terms of addictive potential. While nicotine addiction in itself is a negligible problem to health (RCP, 2007), it is likely to be experienced both as a practical, economic, and emotional problem by many smokers. It is also conceivable that people incorporate ideas about addiction in their perceptions of global health risks of tobacco products, making further knowledge in this field important to our understanding of the constitution of global risk assessments.

The interpretation of these results is subject to some limitations. Smoking has in later years increasingly come to be considered an objectionable behavior. Some respondents might therefore have underreported their smoking frequency, or over-reported their quitting plans, and as a result been defined into a different category of smoker than they should have been according to their factual smoking behavior. However, the likelihood is that this would have contributed to reduce the

observed differences in risk perception between groups, in which case one might assume that these differences were in fact even more pronounced than implied by our results. Respondents may also, in an attempt to appear responsible and well-informed, have exaggerated their perceptions of the risks involved in both smoking and snus use. It is difficult to judge what effect this might have for questions on relative risks, but if such effects were similar across smoker groups, the validity of our results are less affected by them.

On the topic of perceived relative risks of diseases, the most surprising result of this study might be that 20-30 per cent of smokers believed that cigarettes did not increase the risk for lung cancer much more than snus. As reported by earlier research (SCENIHR, 2008), snus use does not increase the risk for lung cancer, while smoking on the other hand is the primary cause of this disease (Hecht, 1999). The close link between lung cancer and smoking has been known for decades, and is presumably widely recognized by the general public. Therefore one would perhaps have expected the respondents to be more aware of the difference between smoking and snus use regarding this particular risk. However, relating to personal health risks from continued smoking, the common misconception that snus users are more or equally at risk for cardiovascular disease, ideas expressed by approximately half of the smokers, is possibly just as important. While oral, stomach and lung cancer are relatively rare even among smokers, cardiovascular disease occurs quite frequently, and is responsible for 28 per cent of smoking-related deaths (SCENIHR, 2008). Moreover, for CVD the highest ratio of mortality of smokers compared to non-smokers is found for people under the age of 65 (Doll et al., 1994). Consequently, a 50 per cent or higher reduction in the risk of cardiovascular disease from smokers switching to snus (SCENIHR, 2008) could make a dramatic impact both on the number of fatalities and on the number of life-years saved.

The observed variations in perceptions indicate that the information about risks from tobacco use is construed differently depending on the receiver's smoking status. To use a product that is very dangerous to health may be a serious threat to self-image in a society where rationality

and self-improvement are important values, and rejecting that smoking is more damaging to health than other tobacco products might be a strategy to reduce cognitive dissonance. After all, if smoking is not much more dangerous than other behaviors, there is less reason to quit. Similarly, if smoking is very addictive, continued smoking might be more socially acceptable, and easier to explain, to oneself as well as to others. Through such mechanisms, self-protective denials of health consequences might result, and one might speculate that this affects inveterate smokers more than others, as some of them may not want to – or find that they are not able to – give up smoking.

A correct appreciation of the relative risk of snus compared to cigarettes could potentially promote health-improving behavioral changes in both exclusive smokers and dual users. If improved knowledge of the substantial differences in health risks should motivate inveterate and other smokers to switch to snus, a considerable health benefit would be realized even if, regrettably, they were not able to subsequently quit the snus habit. For dual users, who tend to consume fewer cigarettes per day than other regular smokers (Lund & McNeill, 2012), the fact that just a few cigarettes per day, or even less than daily, might increase the risk for cardiovascular disease substantially is particularly relevant (Bjartveit & Tverdal, 2005; Luoto, Uutela & Puska, 2000; Pope III et al., 2011). Dual users would reap health benefits quite simply by stopping the cigarette habit, while continuing to use snus. Correct relative risk assessments might of course also discourage snus users from switching over to cigarettes or dual users to quit snus use while continuing to smoke.

Addiction to tobacco has often been conceptualized narrowly as a physical dependence on nicotine, but studies exploring smokers' understanding of addiction have argued for a more complex concept, including social aspects, habit, and pleasure (Johnson et al., 2003, O'Loughlin et al., 2002). Such psychosocial and behavioral elements can perhaps serve to impede a transition from cigarettes to snus, as the rituals of use differ between the two products. However, to the extent that these elements are influenced by beliefs, impediments to transitions can also be belief-sensitive. By way of example, it has been shown that the belief that smoking is very addictive can hinder cessation

attempts (Gillies, 1999), while on the other hand cessation attempts might be encouraged among inveterate smokers by influencing and altering deterministic ideas about how difficult it is to quit (Parry, Fowkes & Thomson, 2001). Potential fears of a stronger nicotine addiction following a switch from cigarettes to snus might be reduced with enhanced information about the relative addictiveness of snus. In this sense, perceived addictiveness is interesting both from a harm reduction perspective and from a prevention perspective.

To eliminate misunderstandings about relative risk, and to enhance smokers' and dual users' chances to reduce the health consequences of their tobacco use, improved structures to ensure proper information of the harm profiles of different tobacco products within the health care system might prove constructive. Brief intervention procedures have been shown to have effect on smoking cessation (Stead, Bergson & Lancaster, 2008), and such procedures could also be used to inform smokers and dual users about differences in risk between cigarettes and snus (and other tobacco/nicotine products). Obviously, this should not imply any risk-free messages, but rather that, in addition to informing about absolute risks, the reduction in risk that would follow a switch from cigarettes to snus should also be pointed out. Moreover, continued informational efforts towards health personnel might prove beneficial to keep advisors updated on the risk profiles of different tobacco products, and to develop the health care system's ability to guide tobacco users in questions of relative tobacco risks further.

It is possible that an increased utilization of this avenue could also be helpful in overcoming rejection or self-protective reactions in smokers in general and inveterate smokers in particular. Far from advertising snus, this might actually make peoples' ideas of the health hazards of smoking more accurate. By introducing a new scale to measure them by, smoking hazards may become more tangible and easier to comprehend. Furthermore, for inveterate smokers, the message might be less offensive when another tobacco product is viewed in a more favourable light.

## Conclusion

First and foremost, the results from this study tell us that erroneous ideas about the relative risk of specific diseases from snus and cigarettes are rampant. Consequently, when Norwegian tobacco users are asked about the global relative risk of snus and cigarettes, erroneous ideas about actual risks of specific diseases could be important contributors to the misperceptions they express. To the extent that risk of addiction is included in people's overall risk assessment, it will most likely promote a leveling of the risk scores of the two products.

To reduce the occurrence of misconceptions in this area, a possible strategy could be to make more active use of the health care system to offer individual advice about actual health risks from different tobacco and nicotine products directly to smokers and other tobacco users.

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**Table 1: Distribution of age, gender and education level within current smoker and ever user groups (%)**

	Current smoker groups				Ever user groups			
	Inveterate	Daily	Less-than-daily	Total	Ever snus	Ever smoke	Ever dual	Total
<b>Age group<sup>***/xx</sup></b>								
15-24 yrs	12.2	9.9	19.2	13.1	39.6	5.1	28.5	11.9
25-44 yrs	25.8	34.0	45.3	35.2	43.8	29.1	50.2	34.0
45-66 yrs	49.5	49.8	31.8	44.6	15.6	51.4	18.9	42.8
67-79 yrs	12.5	6.3	3.6	7.1	1.0	14.4	2.4	11.2
<i>N</i>	287	556	333	1176	192	1977	492	2661
<b>Gender<sup>ns/xxx</sup></b>								
Man	50.2	50.0	54.4	51.3	80.2	43.6	80.3	53.0
Woman	49.8	50.0	45.6	48.7	19.8	56.4	19.7	47.0
<i>N</i>	287	556	333	1176	192	1977	492	2661
<b>Education<sup>***/xx</sup></b>								
<11 yrs	42.7	33.9	24.8	33.5	28.2	24.5	32.0	26.1
11-14 yrs	45.5	47.9	38.7	44.7	35.0	46.9	42.8	45.4
>14 yrs	11.8	18.2	36.5	21.8	36.7	28.6	25.2	28.5
<i>N</i>	279	534	318	1131	177	1934	460	2571

Chi square testing. <sup>\*\*\*</sup>/<sub>xxx</sub>: p<0.001; <sub>xx</sub>: p<0.01. \*-sign refers to associations between current smoker groups and demographic group. X-sign refers to associations between ever user group and demographic group.

**Table 2: Perceptions of the relative health risks from use of snus vs. cigarettes among inveterate, daily and less-than-daily smokers (%)<sup>a</sup>**

	Risk is:	Inveterate	Daily	Less-than-daily	Total
Cancer of oral cavity	Far higher for snus users	35.9	34.2	33.3	34.4
	Fairly similar	60.7	58.8	58.2	59.1
	Far higher for smokers	3.3	7.0	8.5	6.5
	<i>N</i>	270	533	318	1121
Lung cancer***	Far higher for snus users	0.4	0.0	0.9	0.4
	Fairly similar	29.6	21.3	16.6	21.9
	Far higher for smokers	70.0	78.7	82.5	77.7
	<i>N</i>	270	545	326	1141
Stomach cancer	Far higher for snus users	15.7	18.7	20.6	18.6
	Fairly similar	73.1	65.1	65.4	67.0
	Far higher for smokers	11.2	16.2	14.1	14.4
	<i>N</i>	242	508	306	1056
Cardiovasc. disease**	Far higher for snus users	0.4	0.2	0.6	0.4
	Fairly similar	60.0	51.3	43.4	51.1
	Far higher for smokers	39.6	48.5	56.0	48.6
	<i>N</i>	260	529	318	1107

Chi square, \*\*\*:p<0.001, \*\*:p<0.01.

<sup>a</sup>: Bivariate analyses using the original 5-item risk perception variables (far/somewhat higher, more or less equal, somewhat/far lower) gave similar results, i.e. sign. difference for lung cancer(\*\*) and CVD (\*).

**Table 3: Adjusted odds ratios for believing that the risk is far higher for smokers**

	Risk of lung cancer <i>N=1099</i>		Risk of cardiovascular disease <i>N=1067</i>		Risk of cancer of oral cavity <i>N=1080</i>		Risk of stomach cancer <i>N=1016</i>	
	<b>AOR</b>	<i>95% C.I.</i>	<b>AOR</b>	<i>95% C.I.</i>	<b>AOR</b>	<i>95% C.I.</i>	<b>AOR</b>	<i>95% C.I.</i>
<i>Smoker group (ref: less-than-daily)</i>								
Inveterate	<b>0.55**</b>	<i>0.36-0.84</i>	<b>0.57**</b>	<i>0.40-0.82</i>	<b>0.41*</b>	<i>0.18-0.95</i>	<b>0.74</b>	<i>0.43-1.27</i>
Daily	<b>0.89</b>	<i>0.61-1.31</i>	<b>0.80</b>	<i>0.60-1.08</i>	<b>0.94</b>	<i>0.54-1.64</i>	<b>1.14</b>	<i>0.75-1.75</i>
<i>Gender (ref: women)</i>								
	<b>1.26</b>	<i>0.94-1.68</i>	<b>1.19</b>	<i>0.93-1.52</i>	<b>1.64</b>	<i>0.99-2.74</i>	<b>1.03</b>	<i>0.72-1.47</i>
<i>Age group (ref: 15-24 yrs)</i>								
25-44 yrs	<b>0.47**</b>	<i>0.25-0.87</i>	<b>0.53**</b>	<i>0.35-0.83</i>	<b>0.98</b>	<i>0.44-2.17</i>	<b>0.87</b>	<i>0.48-1.56</i>
45-66 yrs	<b>0.36***</b>	<i>0.20-0.66</i>	<b>0.57**</b>	<i>0.38-0.87</i>	<b>0.60</b>	<i>0.27-1.36</i>	<b>0.79</b>	<i>0.45-1.40</i>
67-79 yrs	<b>0.39**</b>	<i>0.18-0.84</i>	<b>0.45**</b>	<i>0.24-0.84</i>	<b>0.83</b>	<i>0.24-2.84</i>	<b>0.71</b>	<i>0.28-1.80</i>
<i>Educational level (ref: 10 yrs or less)</i>								
10-14 yrs	<b>1.19</b>	<i>0.85-1.65</i>	<b>0.92</b>	<i>0.69-1.23</i>	<b>0.70</b>	<i>0.38-1.29</i>	<b>0.82</b>	<i>0.54-1.23</i>
14+ yrs	<b>1.44</b>	<i>0.93-2.22</i>	<b>1.25</b>	<i>0.87-1.79</i>	<b>1.25</b>	<i>0.63-2.46</i>	<b>0.93</b>	<i>0.56-1.55</i>

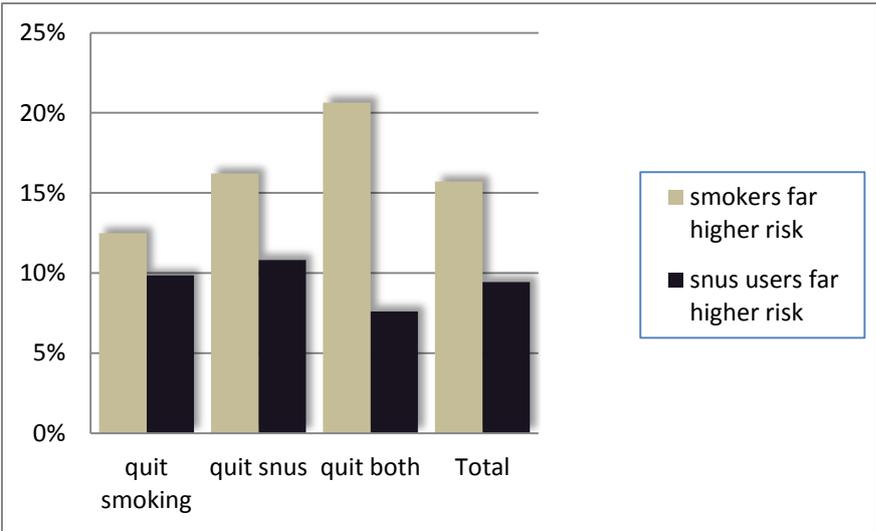
\*\*\*: p<0.001, \*\*: p<0.01, \*: p<0.05

**Table 4: Associations between smoking and snus use status and perceptions of relative risk of nicotine addiction from regular use (%)**

	Ever smokers	Ever snus users	Former dual users	Current dual users	Total
Snus users far higher risk	3.3	6.8	9.4	14.5	5.1
Fairly similar risk	76.2	77.9	74.8	70.9	75.8
Smokers far higher risk	20.5	15.3	15.7	14.5	19.1
<i>Total N</i>	<i>1872</i>	<i>190</i>	<i>318</i>	<i>165</i>	<i>2545</i>

Chi Square-test,  $p < 0.001$ .

Figure 1: Perceptions of relative risk for nicotine addiction in groups of former dual users (N=318)



Group sizes: quit smoking: n=152; quit snus: n=74; quit both; n=92