

Summary and main findings

Main findings

- ▶ Experimentation with snus or e-cigarettes may be a predictor for subsequent initiation of cigarette smoking. The certainty of evidence was higher for e-cigarette data than for snus.
- ▶ Due to scarce material for snus, and very heterogeneous results in studies of e-cigarettes, we could not find quality evidence for associations between either use of snus or use of e-cigarettes, and a change in smoking behaviour among individuals using smoking tobacco.

Background

According to a report from The Swedish Council for Information on Alcohol and Other Drugs (CAN) on tobacco habits in Sweden 2003–2018, about a quarter of the Swedish population use tobacco, either daily or occasionally [1]. Snus is more commonly used by men, where 25% reported having used snus in the previous month. The corresponding figure for women is 6%. E-cigarettes (electronic cigarettes) are used by 1 to 2% of the adult population, and among second year high school students, 6% state that they have used e-cigarettes in the past month [2,3]. Like snus, e-cigarettes are more commonly used by men.

This systematic review investigates possible associations between using snus or e-cigarettes, and smoking tobacco. Subgroups of men, women, children <18 yrs., and adults were analysed. This field of research is rapidly expanding, when it comes to e-cigarettes, while the number of studies about snus is scarce. This systematic review provides a current review of the research.

Aim

The aim of this systematic review is to assess possible associations between snus or e-cigarette use, and subsequent change in cigarette smoking behaviour (initiation of smoking/quit smoking/increased smoking/decreased smoking) at follow up.

The two main review questions:

1. Is ever use of snus or e-cigarettes a predictor for later initiation of cigarette smoking, among individuals that do not smoke at the beginning of the study period.
2. Is there evidence for associations between use of snus or use of e-cigarettes, and a change in smoking behaviour, measured as increase, decrease or quitting, among people smoking tobacco at the beginning of the study period.

Method

The literature was evaluated using a priori established protocols, and reported according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses. The certainty of evidence was assessed with GRADE [4,5,6,7], as very low (⊕○○○) low (⊕⊕○○), moderate (⊕⊕⊕○) or high (⊕⊕⊕⊕).

Inclusion criteria

The study question formulated according to the PICO format:

Population¹

- Research question 1: General population samples of non-smokers, any age.
- Research question 2: General population samples of smokers, any age.

Intervention/Exposure

Self-reported current or ever use of snus or e-cigarettes, with or without nicotine

Comparison

Self-reported non-use of snus or e-cigarettes, with or without nicotine, all through the study period.

¹ For research questions about snus, only studies investigating individuals living in the Nordic countries were included.

Outcome

- Research question 1: Self-reported ever or current use of combustible tobacco products at follow up.
- Research question 2: Self-reported non-use, non-use for at least 30 days, increased use or decreased use of combustible tobacco products at follow up.

Study design

Studies reporting empirical results, with either longitudinal observational design with a minimum of 3 months of follow-up, or Randomised Control Studies (RCT); including general population samples; allowing for the comparison between users and non-users of snus or e-cigarettes.

Language

English, Swedish, Norwegian, Danish.

Search period

From 1998 to 2019. Final search November 11, 2019.

Databases searched

PubMed incl. Medline, EMBASE, Cochrane Library, Scopus, PubMed Health, NICE evidence search, PROSPERO, CRD, and PsycInfo

Client/patient involvement

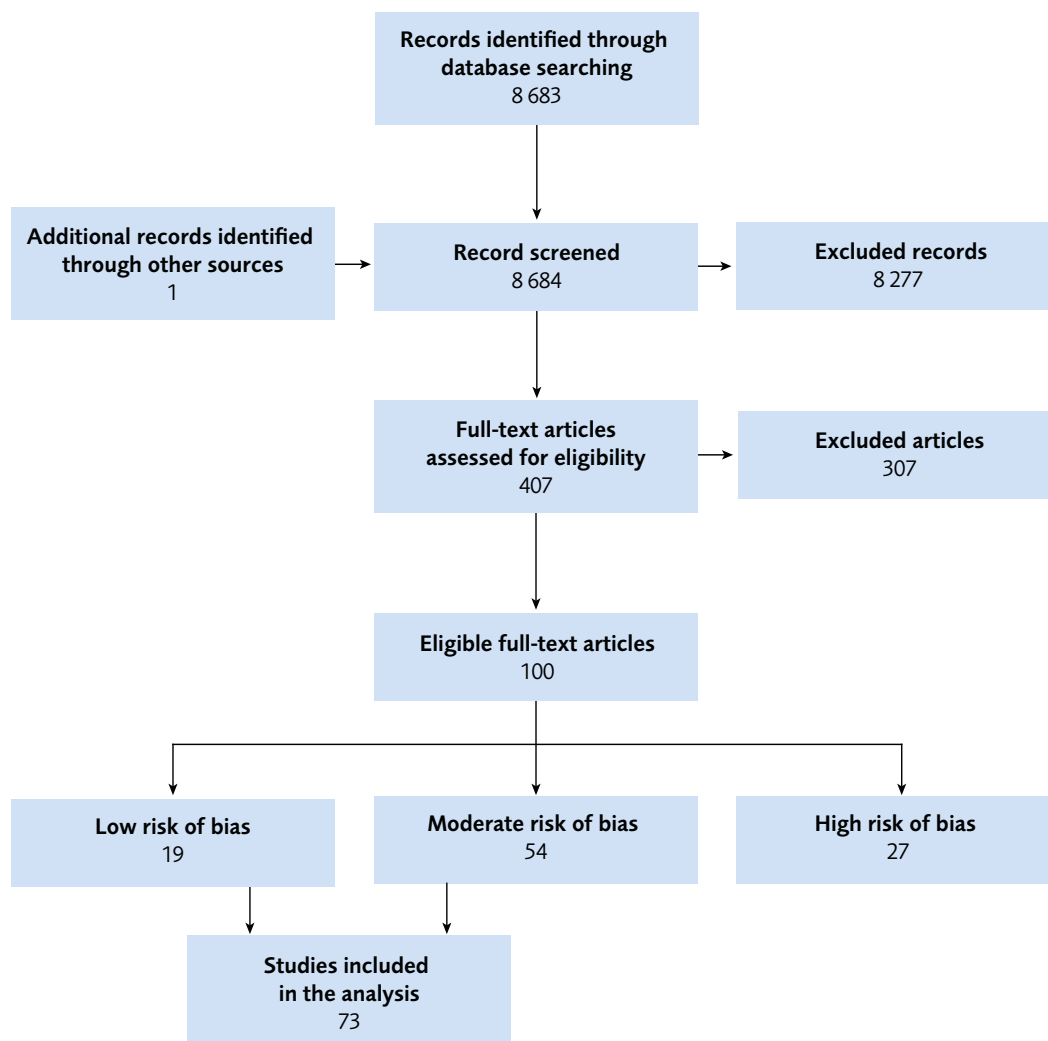
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Results

Literature search

There are 73 primary research articles included in the different analyses of this systematic review (Figure 1). Most of them are investigating research questions about e-cigarettes. Eight are investigating snus.

Figure 1 Flow chart.



Summary of results

An overview and summary of the main results is presented in Table 2 and 3.

Snus

It is possible that experimentation with snus may be a predictor for later initiation of cigarette smoking (certainty of evidence: ⊕⊕○○). However, association between experimentation with snus and current use of cigarettes was not found (certainty of evidence: ⊕○○○).

Due to scarce material it was not possible to draw any conclusions about associations between use of snus, and quitting smoking (certainty of evidence: ⊕○○○), or between use of snus and increased smoking (certainty of evidence: ⊕○○○). With the present inclusion criteria, no studies investigating associations between use of snus and quitting smoking for at least 30 days, or between use of snus and decreased smoking, were found.

E-cigarettes

It is probable that experimentation with e-cigarettes may be a predictor for later initiation of cigarette smoking (certainty of evidence: ⊕⊕⊕○). The certainty of evidence was higher among young individuals (<18 years) (certainty of evidence: ⊕⊕⊕○) but could also be found among adults (certainty of evidence: ⊕⊕○○). Association between experimentation with e-cigarettes and current use of cigarettes was also found (certainty of evidence: ⊕⊕⊕○).

Due to very variable results in the included studies that investigated e-cigarettes and changes in smoking behaviour, it was not possible to draw any conclusions about possible associations between e-cigarettes and quit smoking, quit smoking for at least 30 days, decreased smoking or increased smoking (certainty of evidence for all four outcomes: ⊕○○○).

Table 1 Overview of main findings. The direction of association is shown if the certainty of evidence according to GRADE was (⊕⊕○○) or higher. Arrow pointing upwards: association between snus or e-cigarettes and a higher incidence of the outcome. Arrow pointing downwards: association between snus or e-cigarettes and a lower incidence of the outcome.

Outcomes that are non-relevant to a specific research question are denoted by NA.

Exposure	Baseline non-smokers		Baseline smokers				
	Outcome at follow-up	Initiation of tobacco smoking	Current tobacco smoking	Quit smoking	Quit smoking at least 30 days	Decreased smoking	Increased smoking
Snus	Research question 1	⊕⊕○○ ↑	⊕○○○	NA	NA	NA	NA
	Research question 2	NA	NA	⊕○○○ Scarce material	No studies	No studies	⊕○○○ Scarce material
E-cigarettes	Research question 1	⊕⊕⊕○ ↑	⊕⊕⊕○ ↑	NA	NA	NA	NA
	Research question 2	NA	NA	⊕○○○ Inconsistent results	⊕○○○ Inconsistent results	⊕○○○ Inconsistent results	⊕○○○ Inconsistent results

Table 2 Summary of main findings.

Outcome	Study design Number of studies (with unadjusted + adjusted data) Number of participants	Results, Odds ratio (95% CI)	GRADE	Comment
Snus and initiation of tobacco smoking	Longitudinal observational design 5 (5+3) 23 472	Unadjusted: 2.09 (1.57 to 2.79) Adjusted: 2.48 (1.79 to 3.44)	⊕⊕○○ ^{a b c d}	It is possible that Swedish snuff may be a risk factor for later initiation of cigarette smoking
Snus and current tobacco smoking	Longitudinal observational design 3 (3+3) 3443	Unadjusted: 2.16 (1.08 to 4.31) Adjusted: 2.48 (1.79 to 3.44)	⊕○○○ ^{a b c d f}	Not enough data to draw conclusions about associations
Snus and quitting smoking	Longitudinal observational design 2 (2+0) 6350	Unadjusted: 1.98 (1.72 to 2.28) Adjusted: No data	⊕○○○ ^{a c d f h}	Not enough data to draw conclusions about associations
Snus and increased tobacco smoking	Longitudinal observational design 1 (0+1) No information	Unadjusted: No data Adjusted: 6.21 (3.20 to 12.05)	⊕○○○ ^{a c d h}	Not enough data to draw conclusions about associations
E-cigarettes and initiation of tobacco smoking	Longitudinal observational design 22 (17+20) 89 076	Unadjusted: 4.68 (3.64 to 6.02) Adjusted: 3.37 (2.68 to 4.24)	⊕⊕⊕○ ^a	It is probable that e-cigarettes may be a risk factor for later initiation of cigarette smoking
E-cigarettes and current tobacco smoking	Longitudinal observational design 10 (7+9) 39 086	Unadjusted: 3.51 (2.87 till 4.29) Adjusted: 3.89 (2.16 till 7.00)	⊕⊕⊕○ ^a	It is probable that e-cigarettes may be a risk factor for later current cigarette smoking
E-cigarettes and quitting smoking*	Longitudinal observational design 28 (18+14) 39 147 RCT 8 3202	Unadjusted: 0.99 (0.78 till 1.33) Adjusted: 0.95 (0.70 till 1.28) RCT: 1.78 (1.41 till 2.25) Data not included in the meta-analyses ¹	⊕○○○ ^{a b e g i}	Data to diverse to draw conclusions about associations
E-cigarettes and quitting smoking at least 30 days*	Longitudinal observational design 17 (9+9) 13 588 RCT 4 2368	Unadjusted: 0.96 (0.77 till 1.19) Adjusted: 0.86 (0.59 till 1.25) RCT: 2.04 (1.51 till 2.77) Data not included in the meta-analyses ¹	⊕○○○ ^{a b c e g i k}	Data to diverse to draw conclusions about associations
E-cigarettes and decreased tobacco smoking*	Longitudinal observational design 13 (7+12) 14817 RCT 7 2851	Unadjusted: 1.22 (0.89 till 1.66) Adjusted: 1.46 (1.03 till 2.08) RCT: OR:1.79 (1.26 till 2.55) Mean Difference: 1.08 (-0.38 till 2.54) Data not included in the meta-analyses ^{2,3}	⊕○○○ ^{a b e g i j}	Data to diverse to draw conclusions about associations

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Table 2 continued

Outcome	Study design Number of studies (with unadjusted + adjusted data) Number of participants	Results, Odds ratio (95% CI)	GRADE	Comment
E-cigarettes and increased tobacco smoking*	Longitudinal observational design 11 (6+9) 13 286 RCT 3 891	Unadjusted: 1.79 (1.40 till 2.29) Adjusted: 1.91 (1.36 till 2.69) RCT: OR: No data Mean Difference: 1.08 (-0.38 till 2.54) Data not included in the meta-analyses: ^{2,3}	⊕○○○ ^{abcegi}	Data too diverse to draw conclusions about associations

^a Material with several deficits and limitations.

^b The confidence interval for one or several of the included studies include the value for no association.

^c The analysis is based on a limited amount of studies or participants

^d One or several of the included studies include only one subcategory of the general population e.g. only men or only individuals younger than 18 years.

^e Some of the included studies show a positive association, while others show a negative one.

^f The time to follow-up is long, or varies a lot between studies, which makes the association between exposure and outcome less clear.

^g The confidence interval of the meta-analysis (unadjusted/adjusted/ continuous/ dichotomous) include the value for no association.

^h Unadjusted data or data adjusted for confounders is lacking.

ⁱ Limitations in transferability for results from clinical study of smoking cessation to behaviour in the general population (refers to, among other things, differences in population, availability of intervention, comparison alternatives).

^j Variations in the way to define the outcome.

^k The adjusted and unadjusted analyses differ both regarding which studies that are included in the meta-analyses, and their results.

* Also studies with data presented in forms that could not be transformed to either odds ratios or mean differences, were considered during the grading of evidence. These studies were not included in the meta-analyses but were incorporated narratively when appropriate, as follows:

¹ Continuous abstinence rate measured between 9–24 weeks [8]. Smoking cessation was achieved by 28.0 percent of the participants in the group who were allocated to nicotine chewing gum and by 21.3 percent of the participants allocated to e-cigarettes. No statistically significant difference was seen between the groups.

² Unadjusted data: One study (persons 12–17 years) indicates an association between e-cigarette use and increased use of smoking tobacco (frequency), the association is not statistically significant [9]. One study (adults) indicates an association between e-cigarette use and reduced use of smoking tobacco (quantity), the connection is statistically significant [10]. Two studies (adults) indicate an association between e-cigarette use and reduced use of smoking tobacco (quantity), the associations are not statistically significant [11,12].

³ Adjusted data: Two studies show an association between e-cigarette use and reduced use of smoking tobacco (frequency and quantity) [13] or (quantity) [10], the associations are statistically significant. Three studies indicate a link between e-cigarette use and reduced use of smoking tobacco (quantity), the links are not statistically significant [11,12,14]. One study indicates an association between e-cigarette use and increased use of smoking tobacco (frequency and quantity), the link is statistically significant [15]. One study indicates a link between e-cigarette use and increased use of smoking tobacco (frequency) [16,17], the link is not statistically significant.

Discussion

This systematic review analyses possible associations between snus, e-cigarettes and the use of smoking tobacco in contexts transferable to Swedish conditions and to the population in general. For snus, only studies investigating use of snus in the Nordic countries are included. Studies on e-cigarettes have been included regardless of e-cigarette type or country of origin. No studies on e-cigarettes conducted in a Nordic context were found.

Our results show that there may be an association between using snus or e-cigarettes and later initiation of tobacco smoking. The certainty of evidence was higher for e-cigarette data than for snus.

It was however not possible to assess whether there is an association between use of snus or use of e-cigarettes and changed smoking habits among individuals using smoking tobacco. In the case of snus, this was due to the low number of primary studies investigating the possible association between snus and changes in smoking behaviour. In the case of e-cigarettes, it was due to very diverse results in the different primary studies included in the analyses. However, both the ongoing intensive research on e-cigarettes, and new studies about snus may change the current state of knowledge.

Based on the results of this systematic review, it is not possible to determine whether the associations found

in the material are causal, or mainly statistical relationships. In most of the included studies, it is possible that confounders affect the outcome. There may be underlying differences between the comparison groups that affect both the use of snus or e-cigarettes and the use of smoking tobacco. We have therefore not assessed the strength of the associations found, but only if there is an association or not. A non-significant result means that an association could not be statistically confirmed. It should not be interpreted as an evidence of no association. Based on the results of the systematic review, it is not possible to determine what the smoking habits of the population would have looked like if snus or e-cigarettes had not been on the market.

The purpose of this project has been to extract new knowledge. The report does not contain any proposals for changes in regulations or application of practice.

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