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A systematic scoping review**

Lund, Lisbeth; Bast, Lotus Sofie; Rubæk, Mette; Andersen, Susan

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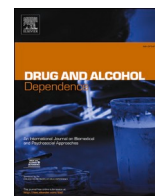
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Review

Exploring factors associated with smokeless tobacco use among young people: A systematic scoping review

Lisbeth Lund^{*}, Lotus Sofie Bast, Mette Rubæk, Susan Andersen

National Institute of Public Health, University of Southern Denmark, Studiestræde 6, 1455 Copenhagen, Denmark

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ABSTRACT

Purpose: While smoking is declining among young people, smokeless tobacco use is increasing. Identifying who is using smokeless tobacco and why is essential in preventing smokeless tobacco use. This study aimed to comprehensively explore the factors of young people's use of smokeless tobacco in western countries and identify research gaps.

Methods: We conducted a systematic scoping review of studies that examined factors associated with smokeless tobacco use among young people (ages 13–29) from western countries published between January 2011 and September 2021. Searches were conducted in CINAHL, Medline, and Scopus. Studies on adults, total tobacco use (i.e., did not differentiate between tobacco product types), dual and multiple uses of tobacco, and studies on smokeless tobacco cessation programs were excluded.

Results: A total of 160 studies were included in this scoping review. The studies were primarily undertaken in the US and the Scandinavian countries, and the majority explored smokeless tobacco use without distinguishing between the specific types. Smokeless tobacco users were more likely to be male, non-Hispanic white, engaging in physical activity, and using other substances, including cigarettes and alcohol. The role of friends and family were identified as critical factors that were related to the use of smokeless tobacco.

Conclusions: This scoping review suggests that preventative measures against smokeless tobacco use should focus on peer and family members' roles and that these measures may benefit from targeting males. Additional research, including systematic reviews on this area to validate the identified associated factors, would improve the understanding of smokeless tobacco use.

1. Introduction

The tobacco market has changed markedly over the past decades (Staal et al., 2018). Cigarette smoking is declining while alternative tobacco products (ATP) such as e-cigarettes and smokeless tobacco (SLT) are increasing (World Health Organization, 2021; East et al., 2021b). Especially SLT use has escalated globally (Kendrick et al., 2021; Siddiqi et al., 2020; East et al., 2021b). SLT is particularly popular among young people (Lipari and Van Horn, 2017; Anon, 2018) and is commonly used in Scandinavian countries. In 2020, 25 % of Norwegian males and 14 % of Norwegian females between 16 and 24 years used snus daily (Anon, 2018). Among US high school students, 6.4 % were current SLT users (Arrazola et al., 2014). Although much less prevalently used in the US, the consumption of newer SLT products such as Swedish snus and moist snuff has been growing in recent years (Federal Trade Commission,

2018; Bhattacharyya, 2012). Between 2001 and 2010, regular moist snuff users among younger adults increased to 2.8 % - equivalent to a 55 % increase in the US (Bhattacharyya, 2012).

The increased popularity among young people raises concerns. First, SLT contains nicotine and is highly addictive. Studies have found that young people's brains are more vulnerable to nicotine than adults, impacting brain development and disturbances in emotion and attention regulation (Yuan et al., 2015). Second, although research indicates that SLT is less harmful than cigarettes (Fisher et al., 2019; Rostron et al., 2018), they are not harmless and, like cigarettes, contain harmful substances such as carcinogens (Hatsukami et al., 2004; Folkhelseinstituttet, 2019). SLT has been associated with an increased risk of cancer, oral diseases, and cardiovascular diseases (Gupta et al., 2004; Critchley and Unal, 2003; Lee and Hamling, 2009). The global burden of disease attributable to SLT in terms of disability-adjusted life years

Abbreviations: SLT, Smokeless tobacco; ATP, Alternative tobacco products; SES, Socioeconomic status.

^{*} Corresponding author.

E-mail addresses: Lilu@sdu.dk (L. Lund), Loni@sdu.dk (L.S. Bast), Merub@sdu.dk (M. Rubæk), Suan@sdu.dk (S. Andersen).

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(DALYs) lost and deaths are substantial. In 2019, 2.5 million DALYs and 90,791 lives were lost globally due to oral, pharyngeal, and oesophageal cancers attributed to SLT (Siddiqi et al., 2020). Third, a growing concern is that using SLT will lead to uptake or escalation in cigarette use (Tam et al., 2015). A recent longitudinal study among Finnish young men found that snus experimentation during late adolescence predicted becoming a daily smoker in early adulthood (Araneda et al., 2020).

The growth in popularity may be ascribed to several factors, e.g., an increase in SLT marketing and the promotion of SLT as a safer alternative to cigarettes (Federal Trade Commission, 2018, National Cancer Institute and Centers for Disease Control Prevention, 2014), as well as comprehensive tobacco policies and regulation strategies such as taxation and smoke-free laws, mainly targeting cigarette smoking (National Cancer Institute and Centers for Disease Control Prevention, 2014). This may have created a demand for alternative products that can be used discreetly (Mejia and Ling, 2010).

Given the evolving character of SLT use, preventative initiatives are essential. However, most countries have not implemented initiatives to reduce SLT use (Mehrotra et al., 2019), and knowledge about prevention and whether targeted efforts are required is still lacking (Levy et al., 2017). Unique features of SLT use, e.g., social and cultural factors, need to be addressed to inform preventative strategies. With this knowledge, it can be possible to design interventions for specific high-risk groups and identify key factors that interventions must focus on influencing. However, in contrast to the vast number of reviews on factors of cigarette use (East et al., 2021a; Ahun et al., 2020) and e-cigarettes (Short and Cole, 2021; Fadus et al., 2019), to date, only one review has been conducted on factors of SLT use (Solhi et al., 2021). This review was not systematic, and the included studies were predominantly from non-western countries (Solhi et al., 2021). No studies have systematically reviewed the literature on the factors of young people's SLT use in the western world.

We conducted a systematic scoping review to explore the available literature on factors of SLT use among young people from western countries. A scoping review is relevant to exploring a large body of literature, generating an overview of factors examined, and identifying research gaps (Munn et al., 2018). More explicitly, we want to examine the risk factors for SLT use.

2. Methods

We followed the guidelines by the Joanna Briggs Institute (JBI) for conducting a scoping review (Peters et al., 2020) and the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) checklist (Tricco et al., 2018) guided the reporting. A priori protocol with objectives, inclusion criteria and methods were specified and published in advance on the Open Science Framework (10.17605/OSF.IO/BF6PK).

2.1. Search strategy

A three-step search strategy was undertaken (Peters et al., 2020). First, an initial search was performed using the databases PubMed and Medline, where keywords and index terms were identified by analyzing the wording of the title and abstracts of the literature obtained. In the second step, the search strategy was developed based on the keywords and index terms identified in the first step, and a search was undertaken in the databases Medline, CINAHL, and Scopus. In the final step, references of all the included studies were hand-searched. In addition, grey literature was searched for in GreyLit.org, ProQuest Dissertations & Theses, and Google Scholar to identify reports not published in the electronic databases. The search strategy was performed in consultation with a research librarian from the University of Southern Denmark (SDU) and reviewed with a research team at SDU. The search terms and strategy can be found in supplementary file 1.

2.2. Study selection criteria

The framework Population, Concept, and Context recommended by JBI (Peters et al., 2020) was used to establish inclusion and exclusion criteria.

2.2.1. Inclusion criteria

Studies on factors associated with SLT use among young people aged 13–29 years with no physical or psychological disabilities, published between 2011 and September 2021, were included. SLT was defined as tobacco and nicotine products that are not smoked or burned, such as chewing tobacco, moist snuff, and Swedish snus. Factors were broadly defined and included sociodemographic, individual, social, school, and societal factors. Only studies in English, Danish, Swedish and Norwegian from western countries were included. All types of original research, including quantitative studies such as RCT studies, observational studies (cohort studies, case-control studies, and cross-sectional studies), and qualitative studies, were included. Systematic reviews and meta-analyses were used for searching references.

2.2.2. Exclusion criteria

Studies on adults, where the majority of the study population was older than 29 years or expanded the specified age range for inclusion with more than ten years, e.g., 18–40 years, were excluded. The study's first author was contacted by email if age was missing. If there was no reply, the study was excluded. Studies were excluded if the study focused on specific groups, e.g., indigenous youth. Studies on cigarettes or ATPs and SLT use combined with other tobacco products (i.e., dual and multiple uses) were excluded. Studies on the health consequences of SLT use were excluded. Furthermore, studies on SLT cessation were excluded.

2.3. Source of evidence screening and selection

Identified studies were retrieved and stored in Endnote20, where duplicates were removed. The software Covidence was used to screen the identified studies (Babineau, 2014) by two independent reviewers. Disagreements between the reviewers were resolved at discussion meetings, and if necessary, a third member of the research team was present. A pilot test of the titles and abstracts of 25 randomly selected articles was screened for assessment against the inclusion criteria to ensure consistency. Further, a pilot test of 25 studies was performed to screen on the full-text level. According to the scoping review methodology, quality assessment was not performed (Peters et al., 2020).

2.4. Data extraction

Data from the included studies were extracted using a data extraction table consisting of information on 1) Author, year, and country, 2) Population and sample size, 3) Study design, 4) SLT product, 5) Factors, and 6) Key findings (supplementary file 2). The data extraction table was piloted on ten of the included studies by two reviewers to ensure that it contained the most relevant information. Next, data were extracted by one reviewer, and a second reviewer did sample controls. The studies were discussed with two other reviewers if there were any doubts. The study's first author was contacted by email if the information was missing. If the author did not reply, the information is missing in the table.

2.5. Charting and analyzing the data

Data were analyzed via narrative synthesis, and factors of SLT use were categorized into five broad themes after reviewing the included studies (defined post facto): sociodemographic factors, individual factors, social and community factors, living conditions, and structural and policy factors. Due to presumed demographic differences between the

US and the European countries as well as Canada, the sociodemographic factors' results are stratified by studies conducted in the US and elsewhere (European countries and Canada).

3. Results

The systematic literature searched in the three databases yielded 27,388 articles. After duplicates were removed, 13,862 unique articles were identified for screening and were subject to title and abstract screening. This resulted in 900 articles that were full text screened, after which 153 articles were identified as eligible for inclusion. The most common reasons for exclusion were: 1) wrong objectives, 2) did not include SLT products or explored total tobacco use/ATP, and 3) wrong age group. One author was contacted because of missing key information on results. This study was excluded as the author did not reply. The grey literature search yielded seven additional reports. In total, 160 studies were included in the scoping review. The results of the search and screening process are presented in the PRISMA flow chart (Fig. 1).

3.1. Characteristics of the included studies

The majority of the studies were conducted in the US (76 %, n = 121), followed by Scandinavian countries such as Norway (8 %, n = 13), Finland (5 %, n = 8), and Sweden (4 %, n = 7), and after that Canada (3 %, n = 4) and Switzerland (3 %, n = 4). Most of the studies were published in 2019 (15 %, n = 24) and fewest in 2011 (6 %, n = 9). The largest part were cross-sectional studies (72 %, n = 115), 19% were cohort studies (n = 31) and the remaining were qualitative studies (9 %, n = 14). Sixty-eight percent (n = 108) included adolescents (<19 years), 27 % (n = 43) included young adults (18 +), and 6 % (n = 9) included both adolescents and young adults. In most studies (71 %, n = 114), SLT was examined as a broad measure, including snus,

chewing tobacco, and dipping, without differentiating between product types. Forty-four percent of the studies examined specific SLT products (n = 71), such as snus and chewing tobacco. As several studies examined more than one product type, percentages do not add up to 100 %. Furthermore, the majority of the studies examined ever and/or current use of SLT. In this review, the measure of SLT use is merged under the umbrella term "use", including ever use and/or current use. Study characteristics and key findings are presented in supplementary file 2.

3.2. Factors associated with SLT use among young people

Table 1 provides information on factors associated with SLT use among young people identified in the 160 included studies.

3.2.1. Sociodemographic factors

Ninety of the included studies (56 %) examined sociodemographic factors of SLT use, involving sex, age/grade, race/ethnicity, and socio-economic status (SES).

The 66 studies addressing sex mainly showed that males are more likely to use SLT than females (91 %, n = 60). No cross-country differences emerged when stratified by the US and the rest of the western countries (Canada and European countries).

Age/grade was assessed in 46 studies. In total, more than half of the studies (55 %) showed associations with SLT use. All studies from Canada and European countries found an association with age/grade (n = 8), whereas this was the case for less than half of the studies conducted in the US (46 %, n = 18). Increasing age or higher grades were predominantly associated with the use of SLT.

Of 54 studies on race/ethnicity, the majority were conducted in the US (n = 51). Most US studies found differences in SLT use by race/ethnicity (84 %, n = 43). SLT use was most prevalent among non-Hispanic whites and lowest among non-Hispanic blacks. For example,

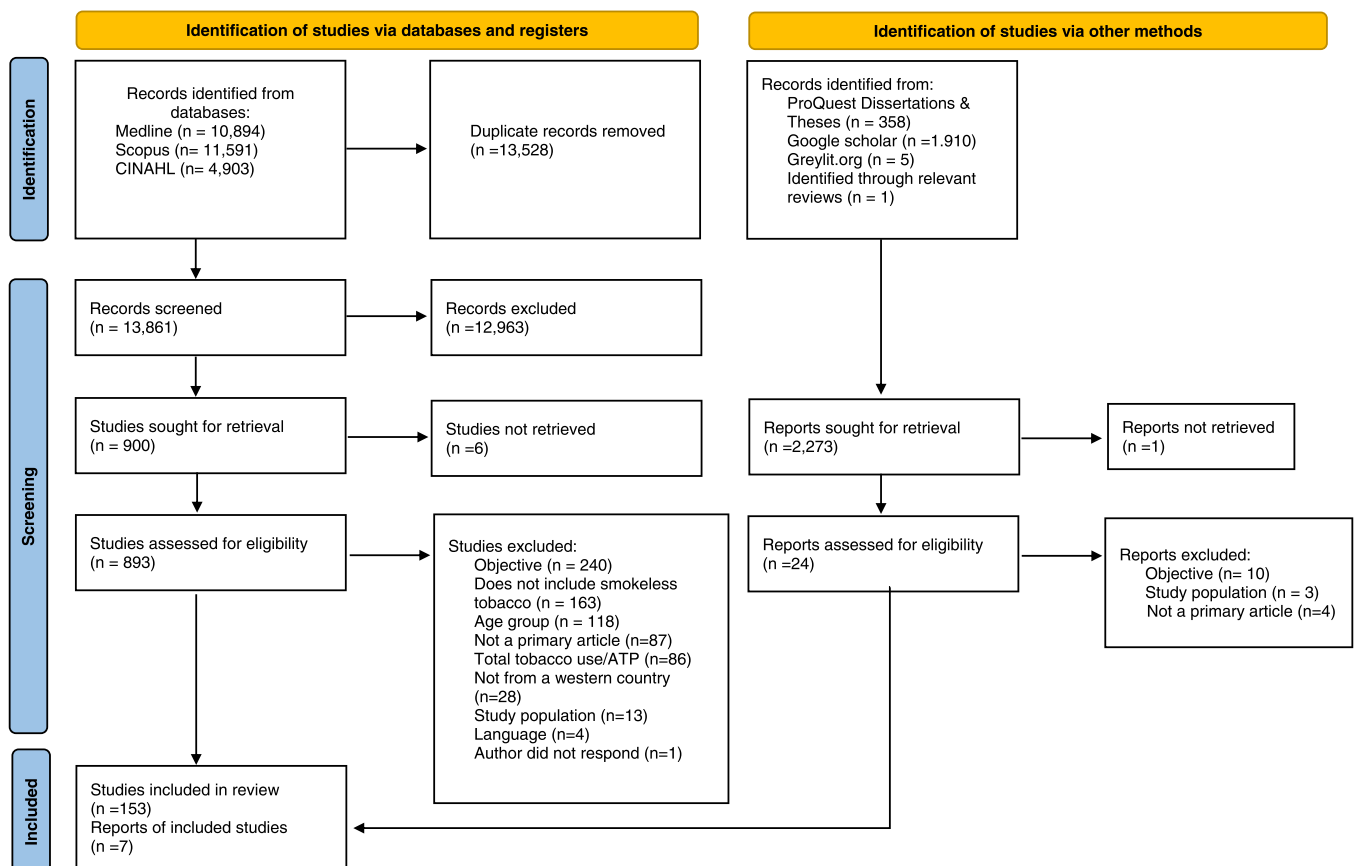


Fig. 1. Flowchart of the review process.

Table 1
Factors of SLT use among young people from 160 included studies.

Factor	Qualitative studies (n)	Quantitative studies (n)	Statistically significant associations of the quantitative studies (n, %)	Main findings
Sociodemographic factors	0	90		
Sex	0	66	60 (90.9 %)	Males are more likely than females to use SLT
Age/grade	0	47	26 (55.3 %)	Older are more likely than younger to use SLT
Race/ethnicity	0	54	43 (79.6 %)	White, non-Hispanics are more likely to use SLT than other races/ethnicities
SES	0	36	20 (55.6 %)	Inconsistent directions. Some studies found that high SES increased the likelihood of SLT, whereas some studies found that low SES increased the likelihood of use
Individual factors	13	82		
Genetics		1	1 (100 %)	Specific genes are associated with SLT use
Identity				
Sexual orientation	0	12	9 (75.0 %)	Inconsistent directions. Some studies found that heterosexuals were more likely to use SLT and some studies found that non-heterosexuals were the most likely
Masculinity	5	2	2 (100 %)	Masculine males are more likely to use SLT
Personality traits	0	8	6 (75.0 %)	High extroversion, rebelliousness, thrill-seeking, novelty-seeking, and lower conscientiousness
Beliefs about SLT				
Harm-perception beliefs	0	16	14 (87.5 %)	Believing SLT as less harmful was associated with SLT use
Motives for use	7	6	6 (83.3 %)	Mood regulation, smoking control, feeling confident and relaxed were identified as motives
Lifestyle factors				
Combustible tobacco products	1	25	24 (96.0 %)	Smoking combustible tobacco products was associated with SLT use
Other substance use	0	21	20 (95.2 %)	Using other substances was associated with SLT use
SLT behavior	0	2	2 (100 %)	Age of initiation and susceptibility was associated with SLT use
Physical activity	0	26	23 (88.5 %)	Being physically active or participating in sports was associated with SLT use
Other health behaviors	0	5	4 (80.0 %)	Inconsistent results regarding sleep, eating habits, and consumption of soft drinks
Other risk behaviors	0	4	2 (50.0 %)	Sexual experience was associated with SLT use
Physical and mental health factors				
Disability and self-perceived health	0	3	3 (100 %)	Inconsistent direction. Having a disability was in some studies found to increase the likelihood of SLT use, whereas other studies found that having no disability increased the likelihood of using SLT
BMI	0	7	7 (100 %)	Overweight/high BMI was associated with SLT use
Mental health	0	11	5 (45.5 %)	No clear association. Some studies found that mental health problems were associated with SLT use, whereas others did not find an association
Social and community factors	7	37		
Family factors				
Family substance use	5	14	9 (64.2 %)	Family substance use were associated with SLT use
Parental attitudes towards SLT use	3	1	1 (100 %)	Positive parental attitudes towards SLT use were associated with SLT use
Parental relationship and monitoring	0	4	2 (50.0 %)	Living in homes with smoke-free policies decreased the likelihood of using SLT
Peer factors				
Peer substance use	6	11	9 (81.8 %)	Peer substance use was associated with SLT use
Peer crowds	0	3	3 (100 %)	No clear pattern emerged from the studies
Peer attitudes towards substance use	0	3	3 (100 %)	Peers' attitudes towards substance use were associated with SLT use
Social skills	0	3	3 (100 %)	No clear pattern emerged from the studies
School factors				
School type and size	0	6	4 (66.7 %)	Attending a public school compared to a private school increased the likelihood of SLT use
Senior student tobacco use rate	0	1	1 (100 %)	Senior student tobacco use rate was associated with junior students SLT use
School-level tobacco interventions/policies	0	4	2 (50.0 %)	Students had lower prevalences of SLT use after participating in school-based tobacco prevention programs
Low school performance and motivation	0	3	2 (66.6 %)	Low school performance and motivation were associated with SLT use
Truancy	0	3	3 (100 %)	Truancy was associated with SLT use
School connectedness	0	2	2 (100 %)	School connectedness was associated with a lower likelihood of SLT use
Living conditions	6	20		
Family composition and marital status	0	11	5 (45.5 %)	Inconsistent directions. Some studies found that living independently without parents or being single was associated with an increased likelihood of using SLT, whereas others found the opposite
Rural residency	6	6	6 (100 %)	Rural residency increased the likelihood of SLT use
Region/state	0	3	3 (100 %)	Use of SLT differed by place of residency
Language spoken	0	3	2 (66.7 %)	Use of SLT differed by language spoken
	6	31		

(continued on next page)

Table 1 (continued)

Factor	Qualitative studies (n)	Quantitative studies (n)	Statistically significant associations of the quantitative studies (n, %)	Main findings
Structural and policy factors				
Tobacco advertisement/marketing exposure and receptivity	1	18	12 (66.7 %)	Exposure and receptivity to tobacco advertisement or marketing were associated with an increased likelihood of SLT use
SLT product characteristics	3	1	1 (100 %)	Flavored SLT used as the first product used was associated with an increased likelihood of SLT use
Anti-tobacco campaigns/advertisements	0	2	2 (100 %)	Anti-tobacco campaigns/advertisements decreased the likelihood of SLT use
State-level legislation	0	7	2 (28.6 %)	No clear association appeared from the studies.
Tobacco taxes	0	6	5 (83.3 %)	Inconsistent directions. Some studies found that tobacco taxes decreased the likelihood of SLT use, whereas other studies found that tobacco taxes increased SLT use
Access	3	1	1 (100 %)	Access to SLT products was associated with SLT use
Health warning labels	0	4	3 (75.0 %)	Health warning labels were associated with a decrease in SLT use

a study found that being a non-Hispanic Caucasian increased the odds of current SLT use by 4.4 times (OR 4.36, 95 % CI: 6.45–14.88) compared to other races/ethnicities (Redner et al., 2014). The three studies conducted outside the US (two from Norway and one from Hungary) found that Norwegian students were more likely to use SLT than students of other nationalities (Balogh et al., 2021; Sæther et al., 2021; Skogen et al., 2018).

Overall, SES was explored in 36 studies with different proxies such as parental education, income level, and the young people's educational level. Of these, 56 % found an association between SES and SLT use, with inconsistent directions. Some studies showed that participants with higher SES were more likely to use SLT (Bierhoff et al., 2019; Fischer et al., 2014; Grotvedt et al., 2013; Kennedy et al., 2011; Powell, 2013). In contrast, others found that SLT users were more likely to have low SES (Welte et al., 2011; Tjora et al., 2020; Simon et al., 2017; Larsen et al., 2013; Hamari et al., 2012). Cross-country differences appeared. Among studies that found an association, over half of the studies conducted outside the US found that high SES increased the use of SLT (58 %, $n = 7$), whereas this was the case for only two (25 %) of the US studies.

3.2.2. Individual factors

Ninety-five of the identified studies (59 %) explored individual factors in terms of genetics, identity, beliefs about SLT use, lifestyle, and physical and mental health.

3.2.2.1. Genetics. Only one study explored genetics as a risk factor associated with SLT use. This study found that carrying specific genes increased the odds of SLT use (Wilkinson et al., 2015).

3.2.2.2. Identity. Nine of twelve studies on sexual orientation found contradictory associations with SLT use (75 %). Some studies found that gay or bisexuals had lower odds of SLT use than their heterosexual peers (Dai, 2017; Goldbach et al., 2017; Jordan et al., 2014; Larson and Pearlman, 2016). In contrast, others found that a sexual orientation other than heterosexual was associated with a greater likelihood of use (Hinds et al., 2017; Johnson et al., 2014; Thrul et al., 2016; Gentzke et al., 2020).

Five studies on masculinity in relation to SLT use were qualitative, and two were quantitative. The latter found that masculinity, both in terms of feelings of masculinity and the acceptance of dominant masculine ideals, was associated with SLT use (Helme et al., 2019; Roberts et al., 2014). The qualitative studies revealed that SLT use was considered a masculine act and often introduced during male-centered activities or was used to bond with other males (Helme et al., 2021; Helme et al., 2012; Walker et al., 2018; Edvardsson et al., 2012b).

The majority of the studies on personality traits (75 %, $n = 6$) found that traits such as high extroversion, rebelliousness, and thrill-seeking

(Wilkinson et al., 2015; Sæther et al., 2021; Holman et al., 2013; Berg et al., 2017), and lower conscientiousness (Berg et al., 2017; Wilkinson et al., 2015) were associated with SLT use.

3.2.2.3. Beliefs about SLT use. Twenty-five studies examined harm-perception beliefs, e.g., the perception of the health consequences of using SLT or the harm compared to other tobacco products, of which nine were qualitative studies. Fourteen of the 16 quantitative studies found an association between harm-perception beliefs and SLT use (88 %). Participants who perceived SLT as less harmful were more likely to use SLT, as illustrated in a cohort study that showed youth who thought SLT posed no or little harm at baseline were almost three times as likely to have tried SLT at follow-up (RR 2.8, 95 % CI: 1.7–4.5) (Parker et al., 2018). Six studies found that perceiving SLT as less harmful than cigarettes was associated with an increased likelihood of SLT use (Choi and Forster, 2013; Linde et al., 2017; Monson and Beaulieu, 2011; Parker et al., 2018; Persoskie et al., 2017; Wackowski and Delnevo, 2016). The qualitative studies supported these findings; the participants generally believed that their use was much less risky since they were not smoking cigarettes or using other forms of tobacco (Wray et al., 2012; Walker et al., 2018; Liu et al., 2021; Helme et al., 2021; Couch et al., 2017a).

Of the thirteen studies on motives for using SLT, seven were qualitative, and six were quantitative. Mood regulation, smoking control, weight control, and feeling confident and relaxed were identified as motives that were associated with SLT use (Wiiium and Aaro, 2011; Adkison et al., 2016; Chaffee and Cheng, 2018; Choi and Forster, 2013; Wong et al., 2017). These motives were in line with the results of the qualitative studies (Rothwell and Lamarque, 2011; Vu et al., 2018; Zobena, 2021; Wray et al., 2012; Edvardsson et al., 2012b; Couch et al., 2017a; Liu et al., 2021). Another motive that emerged was that SLT was odorless and could be used in places where smoking was prohibited (Zobena, 2021; Wray et al., 2012; Couch et al., 2017a). One qualitative study identified that the habit of having something under the lip made young people use snus even if they did not feel a craving (Edvardsson et al., 2012b).

3.2.2.4. Lifestyle factors. The use of combustible tobacco products, e.g., cigarettes, was examined as a risk factor in 26 studies, of which one was a qualitative study. Combustible tobacco products increased the likelihood of SLT use ($n = 24$, 96 %). For example, a cohort study found that using other tobacco products at baseline more than doubled the odds of initiating SLT use at follow-up (OR 2.33, 95 % CI: 1.74–3.13) (Mantey et al., 2019). A qualitative study showed that nearly all respondents who used tobacco-free nicotine pouches had gained their first nicotine experience from smoking (Zobena, 2021). Other substance use, e.g., e-cigarettes, marijuana, and alcohol, were addressed in 21 studies. As seen for combustible tobacco products, nearly all the studies found that

the use of other substances such as e-cigarettes and alcohol were associated with SLT use ($n = 20$, 5 %). A Swedish study showed that drinking less alcohol was associated with being snus-free among men (OR 6.19, 95 % CI: 3.65–10.49) and females (OR 5.28, 95 % CI: 1.55–17.96) (Edvardsson et al., 2012a).

Two studies examining SLT behavior, i.e., the age of initiation and susceptibility, showed that these factors were related to the use of SLT (Sharapova et al., 2020; Mantey et al., 2019). For example, early age of initiation (13 years or younger) increased the odds of using SLT daily in the past 30 days (OR 4.87, 95 % CI: 3.62–6.55) compared with older age of initiation (older than 13 years) (Sharapova et al., 2020).

Twenty-three of 26 studies (89 %) showed an association between participating in sports or being physically active and an increased likelihood of SLT use. Country differences were observed, whereby studies conducted in the US or Canada were more likely to find team sport participation was a risk factor for SLT use (Holman et al., 2013; Parent et al., 2016; Boyes et al., 2017) than studies from Scandinavia, where team sport participation or being a member of a sports association was protective against SLT use (Edvardsson et al., 2012a, Pedersen and von Soest, 2014).

No clear pattern appeared among the studies exploring other health behaviors such as sleep, eating habits, oral health, and consumption of soft drinks.

Other risk behaviors such as sexual experience and driving with a drunk friend were explored in four studies, of which two found an association between sexual experience and the use of SLT (Wiener, 2013; Edvardsson et al., 2012a). For example, a Swedish study found that having few sex partners was associated with being snus-free for girls (OR 2.36, 95 % CI: 1.27–4.38) and boys (OR 1.90, 95 % CI: 1.35–2.66) (Edvardsson et al., 2012a).

3.2.2.5. Physical and mental health factors. Three studies examined disability and self-perceived health, with conflicting results (Larson and Pearlman, 2016; Casseus et al., 2020; Edvardsson et al., 2012a). For example, one study found that SLT was more frequently used by students with no disabilities (Larson and Pearlman, 2016), whereas another study found the opposite (Casseus et al., 2020).

The identified studies addressing weight/BMI all documented that being overweight or obese was associated with SLT use ($n = 7$). For example, a Finnish study showed that a BMI between 25 and 30 was associated with snuff use (OR 1.33, 95 % CI: 1.01–1.76), and the odds increased with higher BMI values (Päkkilä et al., 2017).

Under half of the studies exploring mental health and mental health problems (45 %, $n = 5$) found that positive future orientation (Szoko et al., 2021), internalizing problems such as depression and anxiety (Pedersen and von Soest, 2014, Wilkinson et al., 2015, Lienemann et al., 2019), and externalizing problems such as ADHD (Bierhoff et al., 2019; Lienemann et al., 2019) were related to SLT use.

3.2.3. Social and community factors

In 44 of the 160 included studies (28 %), social and community factors were assessed, including family, peer, and school factors.

3.2.3.1. Family factors. Nineteen studies explored family substance use; five were qualitative studies, and 14 were quantitative. The latter studies yielded different results, with nine studies (64 %) showing an association with family use of alcohol (Grotvedt et al., 2019), SLT (Agaku et al., 2013a; Rolandsson et al., 2014; Auf et al., 2019; Helme et al., 2019), and other forms of tobacco such as cigarettes (Agaku and Ayo-Yusuf, 2014; Ruokolainen et al., 2019). The qualitative studies supported these findings (Nemeth et al., 2012; Walker et al., 2018; Edvardsson et al., 2012b; Helme et al., 2021; Couch et al., 2017b), highlighting that especially male family members using SLT influenced the use of these products among young males.

Parental attitudes toward tobacco use were explored in four studies,

of which three of them were qualitative studies. A cross-sectional study found that youth who lived in homes with no smoke-free policies were 2.6 times more likely to use SLT than youth who lived in homes with smoke-free policies (OR 2.6, 95 % CI: 1.6–4.2) (Valentine et al., 2019). The qualitative studies emphasized that parents' approval or failure to react influenced the young people's use, and some reported that parents encouraged them to use SLT as it was seen as a healthier alternative to cigarettes (Edvardsson et al., 2012b; Helme et al., 2021; Helme et al., 2012).

Two of four studies on parental relationships and monitoring found an association with SLT use (Haugland et al., 2019; Szoko et al., 2021). A Norwegian study found that low parental monitoring and emotional support and a high level of conflict with parents increased the odds of SLT use (Haugland et al., 2019).

3.2.3.2. Peer factors. Nine of 11 quantitative studies (82 %) showed that having friends or knowing peers that smoked cigarettes or used SLT increased the likelihood of using SLT. Six qualitative studies underpinned these findings, showing that friends and peers - primarily male friends - contributed to the use of SLT for the reasons of social acceptance, passive peer pressure, or because they were actively encouraged (Vu et al., 2018; Couch et al., 2017b; Nemeth et al., 2012; Edvardsson et al., 2012b; Helme et al., 2021; Helme et al., 2012). Another study showed that role models also played a role, as baseball players who believed that their favorite major league baseball player used SLT were more likely to use SLT themselves (Chaffee et al., 2018).

The construct "peer crowds" was examined in three studies (Lisha et al., 2016; Jordan et al., 2019; Moran et al., 2019). Peer crowds are described as "macro-level subcultures with distinct beliefs, values, and norms" (Moran et al., 2017). No clear pattern emerged from the studies.

All studies examining other peer factors, such as social skills and peer attitudes towards risky behavior, found that these factors impacted the use of SLT ($n = 6$). For example, if the participants perceived their peers would approve of them engaging in risky behaviors, it increased the likelihood of using SLT (Smith et al., 2015; Géczy et al., 2020; Macy et al., 2016).

3.2.3.3. School factors. Four of six studies on school type and size (67 %) found an association with school type but not school size. For example, attending a public school compared to a private school was associated with an increased likelihood of SLT use (Smith et al., 2015; Bierhoff et al., 2019). A study found that a one percent increase in the number of senior students using SLT was associated with an increased likelihood that a junior student at that school used SLT (OR 1.14, 95 % CI: 1.06–1.24) (Cole and Leatherdale, 2014).

Two of four studies on school-level tobacco interventions or policies found that students had lower prevalences of SLT use after participating in school-based tobacco prevention programs (Hedman et al., 2015; Meier et al., 2013).

Two of three studies (67 %) on school performance and motivation found that snus users were more likely to get lower grades than non-users (Pedersen and von Soest, 2014, Loukas et al., 2012). The same pattern was identified among the studies exploring truancy; students that used snus were more likely to have higher truancy (Larsen et al., 2013; Edvardsson et al., 2012a, Pedersen and von Soest, 2014).

School connectedness was associated with a lower likelihood of SLT use in both studies exploring this factor (Géczy et al., 2020; Szoko et al., 2021).

3.2.4. Living conditions

Living conditions were addressed in 26 of the identified studies (16 %), including family composition or marital status, rural residency, and other factors such as region and spoken language.

3.2.4.1. Family composition and marital status. Five of 11 studies (46 %)

on family composition or marital status reported an association with SLT use, but with contradictory directions (Sæther et al., 2021; Welte et al., 2011; Cavazos-Rehg et al., 2016; Larsen et al., 2013; Grotvedt et al., 2019). For example, two studies identified that living independently without parents or being single was associated with an increased likelihood of using SLT (Sæther et al., 2021; Welte et al., 2011), whereas one study found that living alone was inversely associated with SLT use (Larsen et al., 2013).

3.2.4.2. Rural residency and other residency factors. Rural residency was addressed in six qualitative studies and six quantitative. Rural residency was found to increase the likelihood of SLT use in five studies from the US- and Canada (Pesko and Robarts, 2017; Wagner et al., 2019; Géczy et al., 2020; Berg et al., 2017; Wiggins et al., 2020). A study from Finland found the opposite; the odds of snus use increased with urbanization level; young people living in the capital area had 2.6 times increased odds of using snus than young people living in rural municipalities (OR 2.6, 95 % CI: 1.8–3.6), while young people from small towns had 1.6 times increased odds (OR 1.6, 95 % CI: 1.1–2.4) (Mattila et al., 2012). Results from the qualitative studies (all from the US) revealed that SLT use often had cultural implications, involving rural identity, values, and norms (Helme et al., 2012; Helme et al., 2021; Nemeth et al., 2012; Couch et al., 2017a).

Six studies explored other residency indicators, such as living in different regions or states and language spoken (French or German), and apart from one study, the use of SLT was found to differ by place of residency and language spoken (Welte et al., 2011; Powell, 2013; Kennedy et al., 2011; Henninger et al., 2015; Fischer et al., 2014).

3.2.5. Structural and policy factors

In 37 of the 160 included studies (23 %), structural and policy factors, including tobacco advertisement and marketing, SLT product characteristics, anti-tobacco campaigns, state-level legislation, tobacco taxes, access, and health warning labels, were addressed.

3.2.5.1. Tobacco advertisement and marketing. Nineteen studies, all from the US, explored tobacco advertisement, marketing exposure, and receptivity, of which 18 were quantitative studies. The majority (67 %) identified that both exposure and receptivity were associated with the use of SLT (Pesko and Robarts, 2017; Agaku et al., 2013a; Ganz et al., 2020; Linde et al., 2017; Thrul et al., 2016; Mantey et al., 2019; Soneji et al., 2017; Choi et al., 2020). For example, a study found that advertising receptivity at baseline predicted the use of SLT at follow-up (Timberlake, 2016).

3.2.5.2. SLT product characteristics. SLT product characteristics were explored in one cohort study (Villanti et al., 2019) and four qualitative studies (Scheffels and Lund, 2017; Vu et al., 2018; Zobena, 2021; Couch et al., 2017b). Flavored SLT was identified as an associating factor for the use of SLT and perceived as particularly appealing to youth and new users (Scheffels and Lund, 2017; Vu et al., 2018). A cohort study supported this, showing that young adults with the first SLT product being flavored at baseline were more likely to use SLT at follow-up (Villanti et al., 2019). Package design, e.g., colors and fonts, and the variety of different brands also emerged as a theme from the qualitative studies and were connected with distinct user identities (Scheffels and Lund, 2017; Zobena, 2021).

3.2.5.3. Anti-tobacco campaigns. Two studies examined anti-tobacco campaigns and advertisements (Cavazos-Rehg et al., 2016; Wagner et al., 2019). One found that greater exposure to anti-smoking advertising was associated with decreased odds of SLT use, but only among the youngest (Cavazos-Rehg et al., 2016). The other study found lower odds after exposure to an anti-tobacco campaign, but only among teens identifying themselves as being “country” (Wagner et al., 2019).

3.2.5.4. State-level legislation. Only two of seven studies (29 %) found that state-level legislation impacted the use of SLT, with conflicting results (Grube et al., 2021; Hawkins et al., 2018). A study found that raising the minimum tobacco sales age to 21 was associated with a slight reduction in past month SLT use (OR 0.93, 95 % CI 0.91–0.96) (Grube et al., 2021). On the other hand, a study showed that legislation on smoke-free restaurants was associated with an increase in SLT use among males by 1.1 % point ($p = 0.002$) (Hawkins et al., 2018).

3.2.5.5. Tobacco taxes. Five of six studies showed that tobacco taxes were associated with using SLT (83 %). However, these findings were inconsistent; two showed that rising cigarette taxes were associated with an increase in the use of SLT (Courtemanche et al., 2017; Hawkins et al., 2018), and three that an increase in tobacco taxes decreased the odds of SLT use (Huang and Chaloupka, 2012; Cavazos-Rehg et al., 2016; Pesko and Robarts, 2017).

3.2.5.6. Health warnings. Three of four studies (75 %) on health warning labels found an association between SLT use and attitudes (Agaku et al., 2013a; Helme et al., 2019; Johnson et al., 2014). For example, a study found that students thinking that health warnings are effective had reduced odds of lifetime SLT use (OR 0.59, 95 % CI: 0.49–0.70) and past month use (OR 0.37, 95 % CI: 0.26–0.51) (Helme et al., 2019).

3.2.5.7. Access. Three of four studies examining access to SLT products were qualitative studies. These studies highlighted that young people generally found it easy to purchase SLT products (Vu et al., 2018; Nemeth et al., 2012; Helme et al., 2021). In addition, a cross-sectional study showed that participants that found it easy to access SLT products had 2.2 times higher odds of using SLT (OR 2.22, 95 % CI: 1.35–3.63) (Agaku et al., 2013b).

4. Discussion

To our knowledge, this is the first scoping review on factors associated with SLT use among western young people. Our review found that a wide range of factors was examined in the literature. Most studies examined sociodemographic factors such as sex, age/grade, ethnicity, and individual factors, including harm-perception beliefs, identity, and lifestyle factors. The review further revealed that studies on SLT interventions are missing. For example, only four studies were identified examining how school-based interventions were associated with the use of SLT, and seven studies on state-level policies. In addition, the majority of the included studies were cross-sectional, and the causal associations were, in most cases, not possible to direct.

Our comprehensive scoping review highlight a broad spectrum of individual, social and structural factors associated with SLT use. Notable findings include that SLT is predominantly used among males and that family and friends play a role in SLT use, especially male family members and male friends. Moreover, the results indicate that masculinity plays a role in this relationship. Taken together, these findings show that the social acceptance and norms of SLT use increase the likelihood of young people adopting the behavior. This is in line with a review conducted mainly among non-western young people and adults that pointed out that young people were using SLT due to peer pressure and the role model of parents (Solhi et al., 2021). The findings of our review also complement existing research on smoking, stressing that friends and family significantly influence the initiation of smoking among young people (East et al., 2021a; Leonardi-Bee et al., 2011; Wellman et al., 2016). This highlights the relevance of focusing the strategies on reducing the exposure to SLT among young people in the home, at school, and among friends.

This review found that parental attitudes toward SLT use were more positive than cigarette use and that these attitudes were associated with SLT use among young people. Therefore, there is an urgent need to

promote awareness of the potential negative consequences of SLT use.

Another main finding was that substance use, including cigarettes, e-cigarettes, and alcohol, was associated with SLT use. This is in line with extensive research on tobacco and nicotine products and alcohol use (Falk et al., 2006; John et al., 2003; Adermark et al., 2021, O'Brien et al., 2021). The findings from our review suggest that prevention strategies could benefit from considering substance use behaviors together and addressing the co-use of different substances.

The results from our review align with what is seen for cigarette smoking, although differences between cigarette smokers and SLT users exist. For example, most of the included studies showed that physical activity increased the likelihood of SLT use. This finding contradicts research on smoking and physical activity, showing that smokers tend to be less physically active than their non-smoking peers (Mattila et al., 2012; Pokhrel et al., 2020; Irvine et al., 2021). Also, the significant sex differences in SLT use contradict what is known about smoking, where the sex differences are less marked (O'loughlin et al., 2017, Wellman et al., 2016). Differences between smokers and SLT users warrant further exploration to gain knowledge of which effective smoking prevention measures can be adopted and implemented targeting SLT use.

This review identified some research gaps. The lack of studies on the tobacco industry's role as a factor in SLT use is a significant research gap. The tobacco industry is continually changing the technology and content of its products and opposes tobacco control measures, making it possible to circumvent legislation, as was the case for the Danish advertising legislation (Organization, 2021, Zhu et al., 2014, British American Tobacco, Staal et al., 2018,). Furthermore, it is known from the tobacco literature that the tobacco industry target specific groups (Difranza et al., 1991). This is in line with our review showing that product characteristics, such as the brands and flavors of the SLT products and exposure and marketing strategies, can influence young people's use. These observations highlight the importance of regulating the tobacco market, e.g., a ban on point-of-sale displays and flavored products—on equal footing with cigarettes to prevent young people from simply replacing cigarettes with another tobacco product. Future research should consider if, how and to what extent the tobacco industry influence the use of SLT among young people.

Future research should consider cross-country differences in associations between SLT use and different factors, as our review identified that country differences are present. For example, North American studies found that participating in team sports was a risk factor for SLT use (Holman et al., 2013; Parent et al., 2016; Boyes et al., 2017), where Scandinavian studies found that participation in team sports was found to be protective against SLT use (Edvardsson et al., 2012a, Pedersen and von Soest, 2014). Furthermore, the findings suggest that rural participants are more likely to use SLT. However, this has primarily been examined in the US, and the only study conducted outside the US was from Finland, and it found that adolescents living in the capital area had almost three times higher odds of snus use than adolescents living in rural areas (Mattila et al., 2012). This indicates that different risk and protective factors may be country-specific.

4.1. Strengths and limitations

We used a stringent and systematic method throughout the review process, based on the methodology described by JBI (Peters et al., 2020). Another notable strength of this review is our search strategy, which was restrictive to a ten-year timeframe and limited to western countries, making it more comparable. Given the rapid changes in the SLT market, the newest available literature is wanted since the factors of the use may change over time. Our findings are likely to be generalizable for today. Furthermore, we assessed numerous factors, not limited to one aspect or level. In addition, the search strategy was not restricted to study design, and both quantitative and qualitative studies and grey literature were included, ensuring a broad scope of the review. Nonetheless, this review is also subject to some limitations. First, in line with the scoping review

methodology (Peters et al., 2020), the quality of the included studies was not assessed, and the findings may be subject to some methodological flaws. Second, the search strategy was restricted to studies written in English, Swedish, Norwegian, or Danish, which might have limited the scope of our findings. Lastly, our review did not differentiate between SLT types, such as chewing tobacco or snus, as most included studies used a combined measure of SLT use. Nor did we distinguish between the definitions of use (e.g., current use, regular use, or ever use). However, disparities in the associating factors may emerge when distinguishing between product types and the definition of the term use.

5. Conclusion

This systematic scoping review expands the literature on the various factors that are associated with young people's use of SLT and add essential knowledge to the preventative strategies. Social factors, including the role of friends and family's perception and use of SLT, and individual factors such as substance use in general and harm-perception beliefs, were identified as key factors, while studies also indicate that males and non-Hispanic whites were more likely to use SLT. These results can help establish preventative measures against the uptake and use of SLT among young people focusing on the identified key factors. Furthermore, preventative measures may benefit from targeting male adolescents. Although research addressing factors of SLT use has risen in the last decade, there are still knowledge gaps. The next step would be to conduct a systematic review and meta-analysis to validate the associations and clarify issues that were not addressed by this scoping review, such as differentiating between specific ages or considering cross-country differences.

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CRedit authorship contribution statement

Lisbeth Lund is the principal author and carried out the systematic search process and study selection, as well as the narrative analysis of the results, and drafted the initial manuscript. Lotus Sofie Bast and Susan Andersen contributed with writing, commenting, and critically reviewing the article and supervision of the systematic review process. Mette Rubæk contributed with supervision on the systematic review process, including piloting the data extraction table and critically reviewing the article. All authors have read and approved the final manuscript.

Conflict of Interest

No conflict declared.

Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at [doi:10.1016/j.drugalcdep.2022.109627](https://doi.org/10.1016/j.drugalcdep.2022.109627).

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