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A discrete choice experiment on price and flavour effects on the appeal of nicotine products: a pilot study among young adults in Switzerland

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Summary

AIMS: To explore the effects of prices and flavour availability on the appeal of different tobacco and nicotine products, including conventional cigarettes, Electronic Nicotine Delivery Systems (ENDS) and Heated Tobacco Systems (HTS) among an adult population in Switzerland.

METHODS: We performed a Discrete Choice Experiment among a group of Swiss aged ≥18 years via the online recruiting platform Prolific in a convenience sample. Our sample included both non-smokers and smokers. We used a within-subject, alternative-specific block design in a series of choice sets including different smoking products. We fixed the attributes of nicotine content (high or medium) and harmfulness (in years of life lost) for each product. Attributes of interest included price (ranging from CHF 5 to 25 in increments of 5) and flavour (fruity/menthol vs none/tobacco flavour). We performed a conditional logistic regression on the attributes' influence on the appeal of cigarettes, ENDS and HTS.

RESULTS: A total of 108 out of 153 participants (n = 25 smokers and n = 83 non-smokers, completion rate = 71%) successfully completed our pilot survey experiment. We found that, in general, increasing the price of combustible cigarettes, ENDS and HTS by one standard deviation (around CHF 7) reduced their appeal by approximately 66% (relative risk [RR]: 0.34; 95% CI: 0.28–0.42). Unflavoured alternative nicotine products were found to be less appealing than flavoured products, especially for non-smokers, with a 86% decrease in appeal (RR: 0.14; 95% CI: 0.13–0.16). For non-smokers, an increase in price by one standard deviation was associated with a decrease in the appeal of any product by approximately 19% (RR: 0.81; 95% CI: 0.72–0.92). For smokers, the effect sizes were smaller, but overall, the appeal of all products decreased with increasing prices and reduced flavours.

CONCLUSIONS: Our Discrete Choice Experiment suggests that, for the Swiss context, limiting the availability of flavours for alternative smoking products has the potential to reduce their appeal to non-smokers by 86% and that a small but significant increase in prices to CHF 15 for cigarettes, ENDS and HTS could lead to a major (around 66%) decrease in their appeal.

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Introduction

Tobacco and alternative nicotine products

Over the last decade, new alternative tobacco products such as Electronic Nicotine Delivery Systems (ENDS) and Heated Tobacco Systems (HTS) have gained popularity worldwide, especially among young adults. While preliminary research suggests that alternative tobacco products confer lower health risks than combustible cigarettes, independent long-term studies are still lacking [1, 2]. The tobacco industry claims that HTS are less harmful due to their lack of combustion processes [3]. HTS are relatively new to the Swiss market. They first appeared in 2015. By using lower temperatures, they heat disposable tobacco sticks with an electric blade at around 350 °C instead of burning them. However, they still release cancer-causing chemicals [2]. On the other hand, the use of ENDS, also called "vaping", produces an aerosol that is inhaled through a mouthpiece. The wide availability of sweet flavours appeals to young consumers [4–6]. ENDS are available in various designs, such as pod- or liquid-based devices. Their variable appearance makes it difficult to track evolving products through targeted legislation. Although research suggests that ENDS are less harmful than conventional smoking, there is insufficient data on the long-term health effects of exposure to solvents such as propylene glycol and glycerin used in the e-liquid [4].

Epidemiological data from Switzerland and the US

While cigarette smoking has declined in Switzerland, the consumption of electronic cigarettes has risen sharply. In 2022, about 11% of 15-year-olds used at least one nicotine product frequently (≥ 10 days in the past 30 days) [7]. ENDS use among adolescents aged 15 to 24 was almost twice as common as among adults; with 5.5% having used them at least once a month [8]. Half of boys and around a third of girls had tried ENDS in 2018. After alcohol, ENDS are the second most often consumed psychoactive substance among school-aged children [7]. Daily and weekly vaping among respondents older than 15 was reported at under 1% [9, 10]. A survey by the Federal Office of Public Health (FOPH) reported that 1.7% of all tobacco products consumed in 2017 were HTS, around 6% ENDS (with or without nicotine) and 89% cigarettes.

In the US, according to the 2020 National Youth Tobacco Survey (NYTS), nearly a quarter of high school students were currently using any tobacco product. The number of young people using ENDS has increased drastically since 2011, with 3.6 million young vapers. Among high school students, 38.9% indicated having used ENDS on 20 or more days in the past 30 days, and nearly 1 out of 4 indicated using ENDS daily, with 8 out of 10 using flavoured ENDS [11].

Tobacco product prices and tobacco taxation in Switzerland

Currently, a pack of tobacco sticks of a commonly known brand of HTS is priced at approximately the same range (CHF 8–9) as a 20-pack of combustible cigarettes. In contrast, the excise tax levied on HTS is only 12% compared to 53% for cigarettes [12]. Other than Value-Added Tax (VAT), ENDS remain untaxed due to not meeting the legal definition of a tobacco product [13]. Switzerland is currently discussing the tobacco product draft law in the Swiss Parliament. Currently prices of Swiss cigarettes are only marginally different to those in neighbouring countries like Germany and France, despite a much higher purchasing power [14–17].

Price is an attribute that policymakers can influence through excise taxation to reduce overall consumption and to make smokers internalise the externalities of tobacco [18], but the final sales price is not under regulatory control. This results in currently similar sales prices for different alternative nicotine products, which do not reflect estimated risks nor any risk-associated excise taxation. Rising prices for combustible cigarettes could facilitate risk-associated taxation, assuming substitution among different tobacco products. Additionally, policies aimed at new smoking products must legislate beyond price, such as minimum sales age, advertising and smoke-free policies.

Study aim

Earlier research showed that price increases influence smoking behaviour, especially among price-sensitive consumer groups such as the youth or low-income people [18–21]. Data on product price-related preferences for cigarettes and alternative tobacco products is necessary to inform tobacco control policies among current users, dual users and those susceptible to trying.

Some proposals have suggested reduced tax levels for products with reduced risks [22]. They argue that the increasing availability of substitutes should make cigarette demand more price-elastic. A remaining central question is to what degree cigarettes and alternative products are substitutes or complements [23]. The substitution of combustible cigarettes with less harmful products could have public health benefits, reducing the overall tobacco-associated disease burden. This approach could encourage the substitution of alternative nicotine products among current smokers [22, 24] or their usage as a cessation aid [25]. Still, uptake by youth can lead to lifelong nicotine addiction and a later switch to smoking [1, 26]. Also, dual use is a frequent pattern of consumption [10]. Some studies suggest that increasing cigarette prices are associated with increases in ENDS sales, suggesting a substitution pattern among these products [27–29].

This study aimed to investigate the impact of pricing and flavour options on the appeal of tobacco and alternative nicotine products to smoking and non-smoking young adults in Switzerland with a Discrete Choice Experiment. Specifically, the study examined the appeal of ENDS, HTS and combustible cigarettes and explored how pricing and flavour options influence consumer preferences within an experimental framework.

Methods

Method and experimental design

The Discrete Choice Experiment (DCE) represents an experimental approach to elicit stated preferences. The technique is based on the random utility theory. Individuals are asked to make several choices among products or services. Answers to the DCE survey are used to determine perceived utility, either positive or negative, and to determine consumers' trade-offs between attributes [30, 31]. DCEs allow us to estimate the independent effects of systematically manipulated characteristics on decision-making [32]. DCEs use different methodologies to construct designs of sets of alternatives; participants choose the most appealing option in each set and are assumed to be making decisions that maximise utility [31].

We used a fractional factorial design with a within-subject, alternative-specific block design in a series of choice sets including different nicotine products (i.e. cigarettes, HTS, ENDS and "none" as an opt-out option). We performed a labelled choice experiment, where participants were presented with sets of choices, each containing four options to choose from ("*Please choose the option that you would most likely buy. Pay attention to the features of the products. If you would not buy any of the products, select 'None'*"). While the most efficient design had eight choice sets based on uninformative priors, participants were randomly assigned to evaluate one out of five mutually exclusive blocks, each including four choice sets (see Appendix as an example of choice sets) to prevent respondent fatigue. To reduce ordering effects, choice sets were ordered randomly within blocks.

DCE development

We presented subjects with various combinations of price and flavour attributes. Participants were asked to make consecutive choices between (1) ENDS, (2) HTS, (3) combustible cigarettes and (4) none (as an opt-out option). Two fixed attributes were predefined: harmfulness (in number of years lost when using the product as an average user) and nicotine content (high or medium). Our two attributes of interest that varied were prices and flavours of each product, with five continuous price levels and two discrete flavour levels (see table 1 for experimental design). Participants were informed about product types and attributes in an introduction prior to the survey. We made the simplifying assumption that cigarettes are the most harmful (consumers die 10 years earlier compared to non-smokers), HTS are less hazardous (consumers die 5 years earlier compared to non-smokers) and ENDS are the least harmful (consumers die 1 year earlier). We predefined the nicotine

level as high for cigarettes and HTS and as medium for ENDS. The five hypothetical price levels ranged from CHF 5 to CHF 25 (in increments of CHF 5) and were chosen based on an earlier published study on taxation options for nicotine products in Switzerland, where it was found that current prices needed to be increased substantially to achieve a risk-associated taxation between different products. A hypothetical upper limit of CHF 20 corresponds to current cigarette prices in the United Kingdom. However, we chose to set the upper limit even higher, at CHF 25, in consideration of Switzerland's significantly greater purchasing power [14, 33]. We set the lower limit of CHF 5 below current sales prices of a pack of cigarettes. Participants were informed to make the simplifying assumption that package sizes of ENDS and HTS correspond to a 20-pack of cigarettes.

Sample

A convenience sample of Swiss adult residents was recruited via Prolific (www.prolific.com), an online crowdsourcing platform for recruiting study participants for behavioural experiments from diverse pools. Participants were paid for completing a self-administered online survey in November 2022. Demographic data was obtained from participants' profiles on Prolific. As this survey aimed to give a first preliminary insight into the topic, there were no exclusion criteria in the form of an upper age limit or smoking behaviour. Since our sample mostly consisted of young adults completing their studies, it is relatively homogeneous in terms of age and educational background and not representative of the entire Swiss population.

The analysis was stratified into smokers and non-smokers (smokers were defined as positive respondents to the question: "How many cigarettes have you smoked in your life?"; "I smoke daily" or "I smoke several cigarettes a week"). Participants were asked to self-report their use, ever-use or susceptibility to ever-use and last-30-day use of combustible cigarettes, HTS and ENDS. Before proceeding to predefined questions (see table 2), participants were briefly introduced to the different types of nicotine and tobacco products and their attributes such as nicotine content, harms associated with their use, and information on prices and flavours.

Data analysis

We used the random utility framework, where participants made sequential choices among the hypothetical scenarios among the four alternatives (j=1, 2, 3, 4), and assumed them to be maximising their utility. We used a similar approach to Marti et al. 2019 [34]. Because this utility function is unobservable, we modelled it as an indirect function for participant i for product j within the set c with a linear combination of prices and flavours and an error term:

(1) $V_{ijc}=X'_{ijc}\beta + \varepsilon_{ijc}$

Where V_{ijc} is the utility of choice, $X'_{ijc}\beta$ is part of the utility explained by the price and flavour of the alternatives and ε_{ijc} is the random component of utility. The matrix $X'_{ijc}\beta$ will be specified as a set of product attributes:

(2) $X'_{ijc}\beta_j = \beta_{pj}Price_{ijc} + \beta_{fj}Flavour_{ijc} + ASC_2 + ASC_3 + ASC_4$

The two experimental attributes $Price_{ijc}$ and $Flavour_{ijc}$ have their associated marginal utilities expressed as β_p and β_f. With respect to the outside option, not smoking. ASCs represent the alternative-specific constant utility, which in our case, contains health hazards, nicotine content and other unobservable characteristics. We used conditional logit models with three modelling approaches to estimate the marginal utilities: a) a simple conditional logit model, b) a conditional logit model with a set of varying control variables (educational level, geographic area, monthly income, smoking status, first age tried smoking, social circle smoking status and interest in trying), and c) a conditional logit model with sample splitting based on their current use. We empirically tested these assumptions for the simple conditional logit, which assumes the independence of irrelevant alternatives and the homogeneity of individual preferences. For approach b), we also tested for the underlying assumptions of independence of irrelevant alternatives and no heterogeneity within groups, and categorical covariates with missing values were encoded as an additional category to prevent loss of observations. The software R version 4.1.1 was used to organise and analyse the data.

Ethics

Ethical approval for this study was waived by the Cantonal Ethics Committee of Zurich, Req. 2022-00489.

Results

Participant characteristics

A total of 153 individuals participated in the survey. After exclusion of those who did not complete the entire survey, the final analysis sample consisted of 108 participants (n = 25 smokers and n = 83 non-smokers; table 2). More males participated (58.3%) and the majority of participants were from the German-speaking part of Switzerland (71.8%). The survey was conducted in German. Most participants indicated that they were currently studying or had an academic background (77.6%) and reported a monthly income above CHF 1000 (54.4%). The median self-reported age of the respondents was 29.5 years. The interquartile range (IQR) was 24.75–39.25 years. Our study population approximates the demographics of age, sex and reported income of the average Swiss student, who is, according to data from the Federal Office of Statistics, 25.9 years old, with a weekly workload of ten hours [35]. Nearly half of

Table 1:
Experimental design, attributes and levels for different nicotine products varying throughout the choice sets.

Product	Electronic Nicotine Delivery Systems	Heated Tobacco Systems	Cigarettes
Flavour	Fruity/menthol, none		None
Price in CHF	5, 10, 15, 20, 25		
Harmfulness (in life years lost)	1	5	10
Nicotine level	Medium	High	High

CHF: Swiss Francs.

the participants have tried cigarettes, ENDS or HTS before (46.6%). A small percentage (5%) was susceptible to trying ENDS but had never used them. The majority of participants were not current users of any tobacco product (67.0%), while a small proportion reported using cigarettes (12.6%), ENDS (4.9%), HTS (3.9%) or a combination of several products. DCE respondents took a median of 6.85 minutes (IQR: 4.55–9.72) to complete the survey.

Main results

Our estimates reveal that increases in price decrease the utility to participants with respect to all alternatives. Additionally, unflavoured alternatives also reduce utility to participants). In terms of relative effect sizes, our preferred specification reveals the scaled price coefficient to be 59% higher than that of flavour. Table 3 shows our main results of the conditional logit with various factors influencing the

Table 2:
Descriptive statistics. Continuous variables are expressed as median [interquartile range].

		Overall (n = 108)
DCE duration, in seconds — median [IQR]		411.50 [273.75–583.50]
Self-reported age, in years — median [IQR]		29.50 [24.75–39.25]
Sex — n (%)	Male	63 (58.3%)
	Female	45 (41.7%)
Region — n (%)	German-speaking Switzerland	74 (71.8%)
	French-speaking Switzerland	23 (22.3%)
	Italian-speaking Switzerland	6 (5.8%)
Educational level — n (%)	Apprenticeship	12 (12.2%)
	Compulsory schooling	10 (10.2%)
	Studying	76 (77.6%)
Monthly income — n (%)	>CHF 1000	56 (54.4%)
	CHF 701–1000	13 (12.6%)
	CHF 401–700	11 (10.7%)
	CHF 201–400	14 (13.6%)
	≤CHF 200	9 (8.7%)
How many cigarettes have you smoked in your life? — n (%)	10 cigarettes or fewer	32 (31.1%)
	I stopped smoking	19 (18.4%)
	I smoke daily	11 (10.7%)
	I smoke several cigarettes a week	14 (13.6%)
	None	27 (26.2%)
How old were you when you first tried smoking? — n (%)	10 years old or younger	1 (1.0%)
	11 or 12 years old	4 (3.9%)
	13 or 14 years old	14 (13.6%)
	15 or 16 years old	25 (24.3%)
	17 or 18 years old	17 (16.5%)
	19 years old	18 (17.5%)
	I have never tried	24 (23.3%)
Does a member of your immediate circle regularly smoke normal cigarettes? — n (%)	Yes, a parent	19 (18.6%)
	Yes, a parent, good friends or siblings	10 (9.8%)
	Yes, some friends	45 (44.1%)
	No, nobody	28 (27.5%)
Does a member of your immediate circle regularly smoke e-cigarettes or heated tobacco products? — n (%)	Yes, a parent	8 (7.8%)
	Yes, a parent, good friends or siblings	3 (2.9%)
	Yes, some friends	44 (42.7%)
	No, nobody	48 (46.6%)
Have you ever tried e-cigarettes or heated tobacco products? — n (%)	Yes	48 (46.6%)
	No, but I would like to	5 (4.9%)
	No, I have no interest	50 (48.5%)
Current use of any of the following products at least once a week: tobacco cigarettes, e-cigarettes, heated tobacco products. — n (%)	Yes, e-cigarettes (ENDS)	5 (4.9%)
	Yes, heat no burn (HTS)	4 (3.9%)
	Yes, various	3 (2.9%)
	Yes, cigarettes	13 (12.6%)
	Yes, cigarettes and e-cigarettes (ENDS)	3 (2.9%)
	Yes, all of the above	1 (1.0%)
	Yes, cigarettes and heat no burn (HTS)	1 (1.0%)
	No, but I would like to	4 (3.9%)
	No, I'm not interested	69 (67.0%)

IQR: interquartile range.

appeal of cigarettes, ENDS and HTS. With an increase in price of one standard deviation (SD) of CHF 7 for all products, the appeal of the products decreases by around 43% (relative risk [RR]: 0.57; 95% CI: 0.51–0.62) for the unadjusted model a and by 56% (RR: 0.44; 95% CI: 0.43–0.45) for models b and c considering the price and flavour and alternative intercepts. Effect sizes were similar when further covariates were included in models d and e (such as educational level, geographic area, monthly income, smoking status, first age tried smoking, social circle smoking status and interest in trying). Our preferred specification e shows that by increasing the price by one SD of CHF 7, the appeal of these products decreases by 66% (RR: 0.34; 95% CI: 0.28–0.42). The coefficients suggest that more expensive products are less appealing and that flavoured alternative tobacco products are more likely to be chosen than unflavoured products. The McFadden R^2 values in table 3 suggest that the model fits the data well, with increasing values for models with different control variables a to e. The Log-Likelihood decreases by including more alternative-specific intercepts, which suggests that the models with more control variables provide a better fit with the data by capturing the heterogeneity in preferences across individuals.

Figures 1A to 1C represent the data concerning prices and flavours for the different products, with the price of alternatives fixed at CHF 10 and flavoured, when possible. In general, our results show that increases in product prices decrease their appeal. Figure 1A shows that by increasing the price of combustible cigarettes, the appeal of ENDS and HTS increases, while the probability of quitting or choosing "None" does not change substantially. By increasing the price of a 20-pack of cigarettes to CHF 15, the likelihood of choosing cigarettes declines from roughly 0.3 to 0.1. Figure 1B shows that by increasing the price of HTS, the appeal of cigarettes and ENDS increases only slightly. Figure 1C shows that by increasing the price of ENDS, the appeal of choosing "None" or quitting increases, but does not lead to an increased appeal of HTS or cigarettes. Regarding prices, we further explored the non-linearity of price effects, and table S3 in the Appendix presents the estimates per CHF 5 increase. It can be observed that the CHF 25 level presents a non-linear relationship, almost doubling the effect from previous increases. Table S4 in the Appendix also shows that price effects interacted with educational level. Higher educational levels such as university studies or vocational school are more price-sensitive than for those with only compulsory schooling.

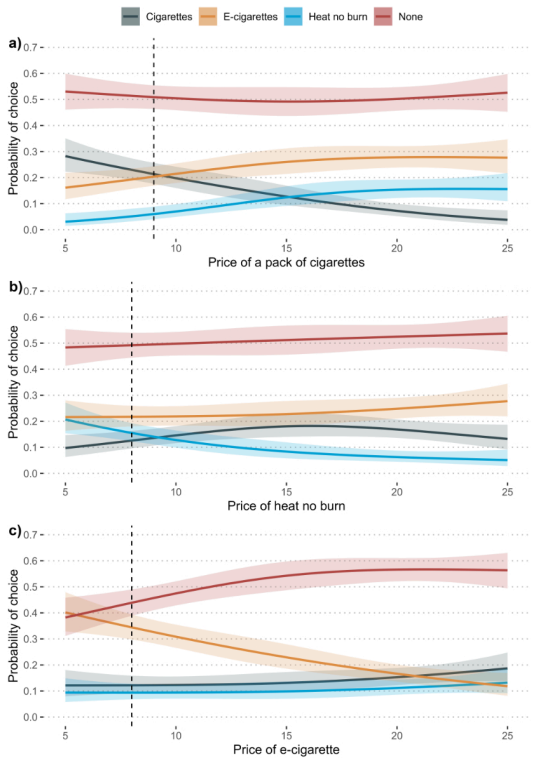

Figure 1: Price effects for cigarettes (A), ENDS (e-cigarettes) (B) and HTS (heat no burn) (C). Lines and 95% confidence intervals were estimated with respect to the price of each alternative of interest while fixing the other prices at CHF 10, and flavour attributes were fixed to flavoured for those products that had the option. The functional form of the estimates was a natural spline with two degrees of freedom.

Table 3:

Conditional Logistic regression estimates. Frequency of alternatives (ENDS = 0.26599, HTS = 0.12500, cigarettes = 0.15262, none = 0.45640).

		Model				
		a	b	c	d	e
		Coefficients				
Price (increase in 1 SD ~ 7CHF)		–0.732	–0.827	–0.830	–1.016	–1.191
	(SE)	0.0422	0.0781	0.079	0.096	0.110
Flavour (unflavoured vs flavoured)				–0.955	–0.813	–0.748
	(SE)			0.329	0.284	0.184
Alternative intercepts			x	x	x	x
Alternative-specific intercepts						
	Educational level				x	x
	Geographic area				x	x
	Monthly income				x	x
	Smoking status				x	x
	First age tried smoking					x
	Social circle smoking status					x
	Interest in trying					x
Log–Likelihood		–934.59	–908.17	–834.15	–618.54	–514.66
McFadden R^2			0.074	0.133	0.285	0.405

CHF: Swiss Francs; SD: standard deviation; SE: standard error.

We carried out quality checks to assess the quality of our DCE data, as outlined in table S5 in the Appendix [36].

For flavours (figures 2A and 2B), according to our estimates, we found that by not offering flavours, the appeal of ENDS decreases significantly among non-smokers from 0.18 to 0.07 (panel A). For current smokers, we found that the flavour effect reduces the appeal of ENDS strongly, and also slightly for HTS (panel B). The flavour effects seem to depend heavily on the product evaluated and smoking status.

Results by subgroups: non-smokers vs smokers

Table 4 represents regression coefficients for the subgroups of smokers (defined as positive respondents to the question: How many cigarettes have you smoked in your life?; I smoke daily resp. I smoke several cigarettes a week) and non-smokers from five different models a to e predicting the appeal of cigarettes and alternative nicotine products based on price and flavour, as well as several individual-level and contextual factors.

For non-smokers, our results indicate that increasing the price of all products by 1 SD is associated with a decrease in their appeal of around 83% (RR: 0.17; 95% CI: 0.13–0.23) for the unadjusted model a; when accounting for more variables, the reduction in appeal was around 54% (RR: 0.46; 95% CI: 0.27–0.76) in models b and c, 74% (RR: 0.26; 95% CI: 0.12–0.57) in model d and 81% (RR: 0.19; 95% CI: 0.17–0.21) in model e. This means that for non-smokers, an increase in price by 1 SD (CHF 7) is associated with an overall decrease in the appeal of any

Figure 2: Flavour effects for cigarettes, ENDS (e-cigarettes) and HTS (heat no burn) on (A) non-smokers and (B) current smokers. Lines and 95% confidence intervals were estimated with respect to the flavour of each alternative of interest while fixing the price at CHF 10.

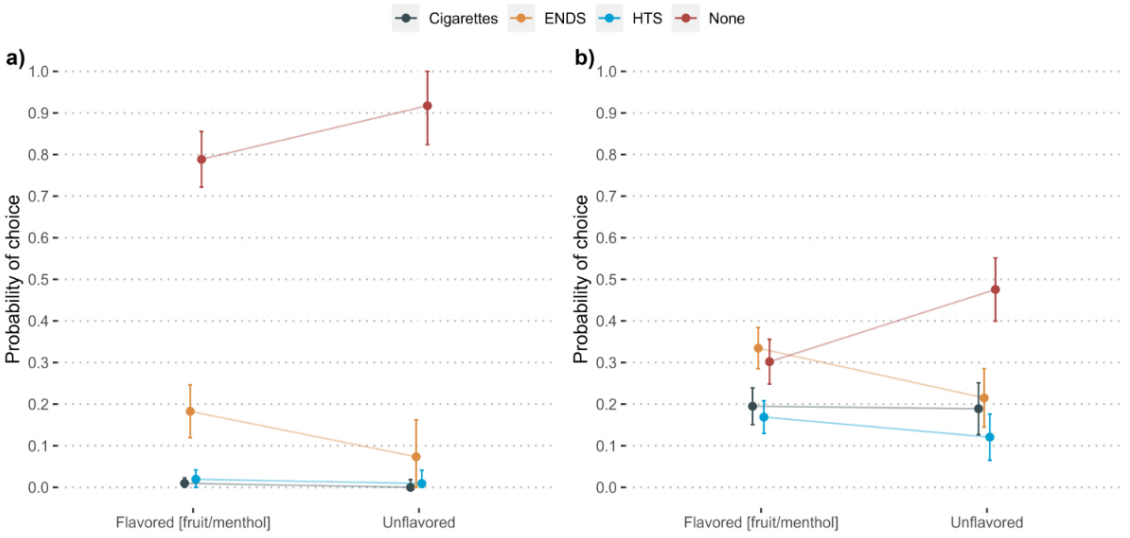

Table 4:
Results by smoking status. Frequency of alternatives (among non-smokers) (ENDS = 0.12676, HTS = 0.01408, cigarettes = 0.00469, None = 0.85446), (among smokers) (ENDS = 0.28403, HTS = 0.14286, cigarettes = 0.19832, None = 0.37479).

		Coefficients				
Non–smokers		**a**	**b**	**c**	**d**	**e**
Price (increase in 1 SD ~CHF 7)		–1.861	–0.845	–0.807	–1.412	–1.741
	(SE)	0.156	0.275	0.276	0.405	0.455
Flavour (unflavoured vs flavoured)				–1.044	–1.917	–2.050
	(SE)			0.484	0.749	0.829
Smokers		**a**	**b**	**c**	**d**	**e**
Price (increase in 1 SD ~CHF 7)		–0.509	–0.854	–0.868	–0.919	–0.971
	(SE)	0.046	0.084	0.085	0.092	0.097
Flavour (unflavoured vs flavoured)				–0.860	–1.094	–1.226
	(SE)			0.208	0.236	0.256
Alternative intercepts			x	x	x	x
Alternative–specific intercepts						
	Educational level				x	x
	Geographic area				x	x
	Monthly income				x	x
	Smoking status				x	x
	Age first tried smoking					x
	Social circle smoking status					x
	Interest in trying					x

CHF: Swiss Francs; SD: standard deviation; SE: standard error.

product of around 80%. An increasing number of individual-level and contextual factors included in the models comes with an increased, relatively sizeable standard error (SE), while effect sizes remain similar across the models. The inclusion of more alternative-specific intercepts in the models reveals a significant 86% decrease in the likelihood of non-smokers trying flavoured products (RR: 0.14; 95% CI: 0.13–0.16).

For smokers, the estimates from our preferred specification suggest that an increase in price of 1 SD for all products comes with a reduced appeal of approximately 54% in model e (RR: 0.46; 95% CI: 0.39–0.54). Price effect sizes are smaller than those for non-smokers. Flavoured products are more likely to be chosen than unflavoured products (RR: 0.37; 95% CI: 0.23–0.57).

Discussion

Our findings show that if prices for combustible cigarettes increase, smokers are likely to switch to lower-cost nicotine products such as ENDS and HTS. Conversely, an increase in price for ENDS does not lead to higher appeal of cigarettes to non-smokers. These results suggest that ENDS and HTS are likely substitutes for combustible cigarettes. Similar results were found in earlier studies [37, 38]. Our data suggests that the demand for quitting nicotine entirely is relatively inelastic, meaning that fewer users seem willing to quit nicotine entirely. Participants revealed that switching to alternative nicotine products was a more desirable alternative, likely due to factors such as addiction and behavioural patterns associated with the use of these products. Nevertheless, decreased appeal does not necessarily influence product usage or sales similarly. We used an experimental setting and stated choices may differ from real-world purchasing behaviour, especially among non-smoking individuals.

Policymakers should consider different consumption patterns when implementing excise taxes and subsequent price hikes on nicotine products. More-harmful products, such as combustible cigarettes, could be taxed at higher levels to significantly increase retail prices and discourage their use and especially their initiation. We found that increased cigarette prices decrease their appeal to smokers and non-smokers. When cigarette prices are raised to CHF 15, they become less attractive to both smokers and non-smokers, leading smokers to be more likely to switch to other, possibly less harmful options. Most of our respondents had their first cigarette at the age of 15 or 16. A current study revealed that around 11% of 15-year-olds in Switzerland indicated using at least one of our analysed products regularly [7]. If ENDS and HTS are substitutes for cigarette smokers, as confirmed by our study, they should be taxed at a lower rate to incentivise substitution but not dual use. They should further be taxed high enough to discourage initiation among non-smokers such as young adults. Further research on tobacco control should target the group of potential adolescent consumers.

To reduce the appeal of ENDS to youth, reducing the availability of youth-appealing flavours in Switzerland could have a positive impact. In the US, the sales of flavoured ENDS (other than tobacco or menthol) have been strongly restricted since 2020 as a response to an increased initiation among youth by a policy "prioritizing enforcement against the manufacture, distribution, and sale of certain unauthorized flavoured prefilled pod or cartridge-based e-cigarettes (excluding tobacco or menthol)" [11]. On top of restrictions on the availability of flavours, the federal minimum age has been raised to 21. Many US states also levy excise taxes [39].

Monzon et al. [32] found that menthol, while more appealing than tobacco flavour, is still less appealing than other flavour options. Our results suggest that flavoured products particularly increase appeal to non-smokers, with a more pronounced effect for ENDS than for HTS. Therefore, minimising available flavours could have a positive public health impact [40].

To our knowledge, this is the first DCE varying prices for three nicotine products within a survey. Further research should focus on price-sensitive consumer groups such as youth and young adolescents living in Switzerland, who are also the main target of sweet flavours [32]. By setting sales prices high enough, for instance CHF 15, with corresponding excise taxation, policymakers could mitigate the risk of increased initiation among young adults by approximately 66%. Even higher effects could be expected with an additional ban on flavoured products [40].

If future research provides evidence that long-term use of ENDS and HTS has lower health risks than conventional cigarettes, promoting the adoption of reduced-risk products through corresponding policies could have a beneficial impact on public health. However, earlier research has shown that prices for combustible cigarettes and HTS must be increased to enable risk-based taxation as a public health goal [33].

Limitations

Our study should be interpreted as a first pilot attempt to investigate the appeal of different tobacco products with respect to price and flavour within a DCE. Our findings have limitations. First, our sample was drawn within a self-administered online platform with a convenience sample, which poses a risk of limited external validity by attracting a non-representative group of respondents. Most of our respondents were relatively young, and were higher education students, which limits the generalisability of our findings, especially to people of lower socioeconomic status. Second, a DCE is a stated preference method that may not cover real-world behaviour or capture the full range of factors influencing consumer behaviour. Third, there is a risk of hypothetical bias [41], as respondents do not make real-life decisions. Fourth, given our sampling quota, the sample is not representative of Swiss adults smoking or susceptible to trying different nicotine products. Also, not all combinations of products and attributes are represented in this survey, as we used a fractional factorial design to reduce the set of scenarios. Finally, despite obtaining relatively precise estimates, our study was not adequately powered due to funding constraints.

Future studies should further explore the flavour attribute by looking into sweet or fruity flavours versus menthol and no taste. In the US, buying ENDS with menthol flavour is possible, while the sale of sweet flavours is strongly restricted. Therefore, separating these could give further insight into the influence of different flavours in different

subgroups. Further research should target young non-smoking adolescents, as this is the group mainly targeted by sweet flavours and highly susceptible to trying ENDS and HTS and becoming addicted to the contained nicotine.

Conclusion

We presented evidence on the impact of prices and flavour on the appeal of combustible cigarettes, ENDS and HTS to Swiss adults. Our results indicate that increasing the cost of tobacco and nicotine products to CHF 15 is associated with a substantial decrease in their appeal by approximately 66%, particularly for non-smokers. Our findings provide important insights on how flavours and prices influence the appeal of cigarettes and alternative nicotine products; insights that could be implemented in future tobacco control policies. However, the effectiveness of pricing and flavour regulations may differ among subgroups, and additional research is needed to determine the most effective strategies for reducing overall tobacco use and encouraging smoking cessation.

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Potential competing interests

All authors have completed and submitted the International Committee of Medical Journal Editors form for disclosure of potential conflicts of interest. No potential conflict of interest related to the content of this manuscript was disclosed.

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Appendix

List of R packages used:

1. *readxl*: Wickham H and Bryan J (2019). readxl: Read Excel Files. R package version 1.3.1. https://CRAN.R-project.org/package=readxl
2. *esc*: Lüdecke D (2019). Effect Size Computation for Meta Analysis (Version 0.5.1). doi: 10.5281/zenodo.1249218 (URL: https://doi.org/10.5281/zenodo.1249218), https://CRAN.R-project.org/package=esc
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Example of choice set (Qualtrics survey)

Experimental design

Design #1.

- Full factorial design (5^1 x 2^1) 10 profiles, (10 x 9 x 8)/3 = 240 different choice sets.
- Within-subject.
- Alternative-specific block design.
- Three alternatives.
- Outside option: none.
- Choice sets: 8.

Figure S1: Choice set.

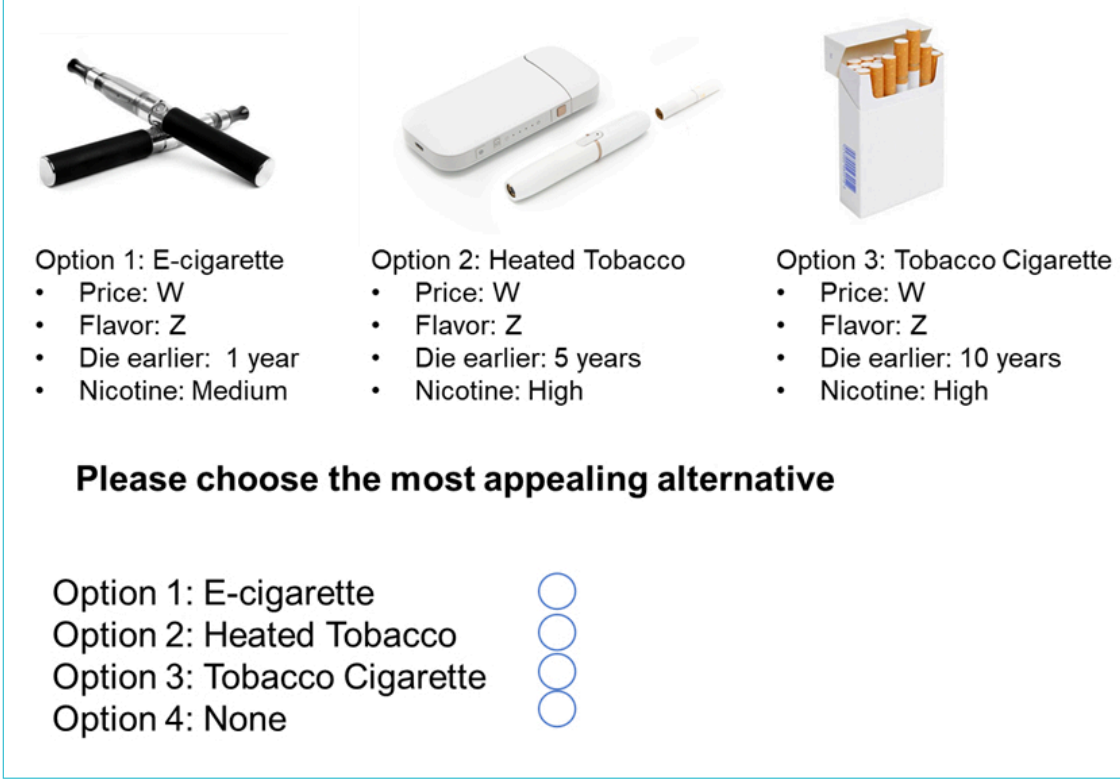

Table S1:
Attributes of choice set.

Attribute	Levels
Price	(0 = 5 CHF, 1 = 10 CHF, 2 = 15 CHF, 3 = 20 CHF, 4 = 25 CHF)
Flavour	(0 = fruit/menthol, 1 = tobacco)
Die earlier	Fixed
Nicotine	Fixed

Table S2.:
Choice tasks.

		Alternative		
Choice task #	**Attribute**	**e-cig**	**Heated tobacco**	**Cigarette**
1	Flavour	0	1	0
	Price	20	25	20
2	Flavour	1	1	0
	Price	5	5	5
3	Flavour	1	0	0
	Price	5	5	5
4	Flavour	0	1	0
	Price	5	5	5
5	Flavour	0	1	0
	Price	15	20	15
6	Flavour	1	0	0
	Price	10	20	20
7	Flavour	1	0	0
	Price	25	20	20
8	Flavour	1	0	0
	Price	10	15	15
9	Flavour	1	0	0
	Price	5	5	5
10	Flavour	0	1	0
	Price	5	5	5
11	Flavour	1	0	0
	Price	20	15	15
12	Flavour	0	1	0
	Price	15	20	15

Table S3:
Aonditional Logistic regression estimates with discrete price levels. Frequency of alternatives (ENDS = 0.26599, HTS = 0.12500, cigarettes = 0.15262, None = 0.45640).

		Model				
		a	**b**	**c**	**d**	**e**
Price (CHF 10 vs CHF 5)			–0.568	–0.568	–0.987	–0.899
	(SE)	0.274	0.185	0.194	0.047	0.213
Price (CHF 15 vs CHF 5)		–1.021	–0.949	–0.949	–1.576	–1.734
	(SE)	0.279	0.125	0.117	0.053	0.313
Price (CHF 20 vs CHF 5)		–1.511	–1.450	–1.450	–2.024	–2.332
	(SE)	0.326	0.276	0.275	0.410	0.392
Price (CHF 25 vs CHF 5)		–2.487	–2.478	–2.478	–3.190	–3.388
	(SE)	0.486	0.268	0.266	0.250	0.413
Alternative intercepts			x	x	x	x
Alternative-specific intercepts						
	Educational level				x	x
	Geographic area				x	x
	Monthly income				x	x
	Smoking status				x	x
	Age first tried smoking					x
	Social circle smoking status					x
	Interest in trying					x

CHF: Swiss Francs; SE: standard error.

Table S4:
Conditional Logistic regression estimates interacted with educational level. Frequency of alternatives (ENDS = 0.26599, HTS = 0.12500, cigarettes = 0.15262, None = 0.45640).

		Model				
		a	**b**	**c**	**d**	**e**
Price (SD): Vocational school		–0.648	–0.767	–0.796	–1.281	–1.365
	(SE)	0.121	0.139	0.145	0.217	0.243
Price (SD): Compulsory schooling		–0.353	–0.449	–0.561	–0.454	–0.606
	(SE)	0.122	0.138	0.148	0.168	0.186
Price (SD): Higher education		–0.797	–0.919	–0.968	–1.057	–1.200
	(SE)	0.050	0.086	0.089	0.102	0.113
Alternative intercepts			x	x	x	x
Alternative-specific intercepts						
	Educational level				x	x
	Geographic area				x	x
	Monthly income				x	x
	Smoking status				x	x
	Age first tried smoking					x
	Social circle smoking status					x
	Interest in trying					x

CHF: Swiss Francs; SD: standard deviation; SE: standard error.

Table S5:
Data quality tests.

	n	**Rate**
Total number of stability tests =	219	
Total number of failures =	73	33.33%
Total number of dominated-pair tests =	4081	
Total number of failures =	538	13.18%
Total number of across-set tests =	27,982	
Total number of failures =	646	2.31%
Total number of transitivity tests =	63	
Total number of failures =	6	9.52%