Next to best health decisions

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NEXT TO BEST HEALTH DECISIONS

Exploring two cases: smoking behavior and
childhood vaccination.

Kim Romijnders

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NEXT TO BEST HEALTH DECISIONS

Exploring two cases: smoking behavior and
childhood vaccination.

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*'For a choice is always a choice among possible alternatives;
and it is a rare agent for whom everything is possible.*

Nussbaum MC. *The fragility of goodness: Luck and ethics in Greek tragedy and philosophy.* Cambridge University Press; 2001.

Contents

Chapter 1	General Introduction	9
Part 1		
Chapter 2	Perceptions and Reasons Regarding E-Cigarette Use among Users and Never-users: A Narrative Literature Review	35
Chapter 3	A Deliberate Choice? Exploring the Decision to Switch from Cigarettes to E-Cigarettes	61
Chapter 4	E-liquid flavor preferences and individual factors related to vaping: a survey among Dutch never-users, smokers, dual users, and exclusive vapers	77
Chapter 5	A Combination of Factors Related to Smoking Behavior, Attractive Product Characteristics, and Socio-Cognitive Factors are Important to Distinguish a Dual User from an Exclusive E-Cigarette User	99
Part 2		
Chapter 6	A deliberate choice? Exploring factors related to informed decision-making about childhood vaccination among acceptors, refusers, and partial acceptors	121
Chapter 7	Deciding on childhood vaccination: differences in decisional conflict and determinants between parents who accepted, refused, and partially accepted childhood vaccination	141
part 3		
Chapter 8	Exploring differences in knowledge, attitude, and deliberation: an illustration of next to best health decisions in the cases of childhood vaccination and smoking behavior.	165
Chapter 9	General Discussion	193

Volarization	233
Summary	243
Samenvatting	249
Curriculum Vitae	257
Publication list	261
Publications in this thesis	
Additional publications	
Acknowledgements	265
Appendices	271

CHAPTER 1

General introduction

According to the World Health Organization (WHO), public health is a discipline that aims to prevent disease, prolong life, and promote health and general well-being by working with and in society.¹ Through organized preventive efforts, public health experts aim to foster their goal of a healthy population.² Public health experts aim to inform and empower society to make healthy decisions that prevent disease, prolong life, and promote health since informed and empowered individuals are more able to take responsibility over their health.²⁻⁴

In daily life, people make decisions about their health and the health of others, as is for instance the case in parental decision-making about childhood vaccination.⁵ When making health-related decisions, there can be different options to choose from. For instance, a parent can decide to accept, refuse, or partially accept childhood vaccinations; or a smoker can decide to quit smoking or switch from smoking regular cigarettes to electronic cigarettes (e-cigarettes). Public health professionals often inform individuals only about a *recommended option*, i.e. the option that is scientifically proven to be the healthiest. For example, they provide a brochure in order to inform parents about vaccinating their children according to the National Immunization Program (NIP) schedule.^{6,7} However, this recommended option might not be suitable for all individuals due to different personal values, priorities with regard to health, experiences, opinions, and the norms of their social environment. Consequently, in these cases people can choose options that match their individual values and goals but that are considered by public health professionals as, for example, '*next to best*'. Next to best health options are – from a public health and scientific point of view – less harmful or less healthy than the unrecommended health option, but not less harmful or less healthy compared to the recommended health option. Another option people may choose is the unrecommended option, which is considered as being unhealthy by public health experts and science.

Acknowledging that people may choose other options than the recommended health option as defined by public health experts, and wanting to support decision-making, raises an interesting question for public health: should public health experts communicate about all health options, or should they focus their efforts on the recommended health option? Communicating about all three options could result in those who preferred an unrecommended option to switch to the recommended or next to best option, resulting in public health gain. However, it could also result in those who preferred the recommended health option or next to best health option to switch to the unrecommended health option, which could potentially mean a public health loss. These potentially different outcomes result in a dilemma for public health experts regarding whether they should communicate about these options in order to support decision-making and improve public health. In order to provide insight into the consequences of either communicating about all health options or only the recommended health option, and to ultimately develop evidence-based health communication, it is first important to understand how people decide on these health options, an area that will be addressed in this thesis.

Two cases, namely, smoking behavior and childhood vaccination, will be the focus in this thesis. We have chosen these two exemplary cases since an increase in next to best health options – partially accepting childhood vaccinations and e-cigarette use – was observed for both cases in recent years.⁷⁻¹⁸ In the case of smoking behavior, a next to best option for quitting or refraining from smoking could be deciding to use e-cigarettes, as these are in general considered less harmful than tobacco cigarettes (i.e. the unrecommended option), although certainly not harmless.^{10,16,18-22} In the case of childhood vaccination, accepting all childhood vaccinations according to the NIP can be considered the recommended health option, partially accepting childhood vaccinations can be considered a next to best option, and refusing all vaccinations is regarded as the unrecommended option from a public health perspective. This chapter provides the context of decision-making in public health, introduces the two cases, and presents the outline of this thesis. We start by describing two prevailing narratives, stereotypes as it were, to explain a societal shift from law-abiding citizens to decision empowerment.

History of informed health-related decisions

Prior to 1950, the public could be characterized as law-abiding citizens who followed the government, religious leaders, a monarch, or a physician. These relationships were based on trust. Physicians – who were perceived as all-knowing beings at the center of the health care system – have long determined which course of action best fitted healthy behavior and served the common good.²³⁻²⁶ The main responsibility of the physician was to bestow trust in the course of action determined. It was believed that informing patients about risks, consequences, and alternatives of treatment would destroy the trusting relationship between the physician and the patient.²³⁻²⁶ Since physicians had this knowledge, they knew the best option for the patient's well-being.^{23,26} The information and knowledge asymmetry between the patient and the health care provider changed in the US and several other countries after 1950.²⁷ From then on, physicians were obligated by law to offer information about the risks, consequences, nature, and alternatives to the treatment and explain it,²⁶ and individuals have since had the right to be informed and the right for self-determination.²³ The right to be informed and the right for self-determination were defined as the right to make an informed choice in the form of an informed consent.^{23,27} In the Netherlands, this right was established in 1994.²⁸ In the informed decision approach to health care²⁵, patients had to be informed about the risks, consequences, nature, and alternatives to the treatment in order to make a decision that reflects scientific evidence, and the decision-maker's values and preferences.^{23,25,29} At the same time that the informed decision approach in health care progressively developed, disease prevention decisions, such as exercising and not smoking, were more and more regarded as individual decisions rather than a public responsibility.³⁰

Informed decisions in public health

In the 19th century, health and lifestyle were seen by hygienists (i.e. public health experts) as a collective responsibility to prevent disease and improve health on a local level via such means as effective sewage systems and clean drinking water.³⁰ The success of public health in the 19th century was the result of a very strong moral responsibility for prevention of disease and the efforts of public health experts which, although organized on a local level, were enforced by the government.³⁰ The (implicit) underlying assumption was that by disseminating knowledge from the “all-knowing” experts to the public, the public would be motivated to make healthy decisions and change their unhealthy behavior.^{4,25,31-35} However, and as demonstrated by previous research,^{4,32,36-43} knowledge dissemination alone often does not change people’s unhealthy behavior. In the Netherlands, a change could be observed in the 1970s resulting in fewer obedient citizens who did not question authority.^{4,30,31,44} From then on, public health experts increasingly aimed to empower and inform the public to make healthy, autonomous, informed decisions by working with and in society.^{1,2,29,45-48} Public health experts were the main source providing (scientific) information to present information the general public needed.^{4,49,50} With the rapid growth of the internet in the 1990s, information became easily available for the public, allowing the general public to pro-actively look for and verify information, which also resulted in the objectivity of scientific evidence being offered by public health experts no longer being taken for granted by everyone.^{30,51,52} Due to large-scale information sharing and statements that science could be regarded as just another opinion,⁴⁴ the veracity and objectivity of scientific evidence and health professionals^{51,52} are no longer taken for granted. People can look for information from different sources, including information provided by parties with a vested interest,⁵³ which can sometimes be categorized as untrustworthy information.⁵⁴⁻⁵⁸

Conceptualization of informed decision-making

To support informed decision-making among the public, it is important to investigate what constitutes informed decision-making and what the consequences of not making an informed decision could be. Originating from a Rational Decision model,^{59,60} there are multiple definitions of what makes a decision informed. Several definitions suggest that individuals need to be informed about the risks, consequences, nature, and alternatives about the decision subject with correct scientific evidence, and a decision should reflect decision-makers’ values and preferences.^{45,61-70} In this thesis we use the definition of informed decision-making of van den Berg et al.⁷¹ This definition states that a choice can be classified as informed if the decision-maker has made the decision based on relevant evidence-based knowledge about the subject, made a choice that reflects their attitude (i.e. they are value-consistent), and has deliberated the different choice options.^{64,65,67,68,71,72} For our studies, although we used this definition to conceptualize the criteria of informed decision-making,

no classification of informed or uninformed decisions were made based on this definition because this dichotomization is a crude distinction that does not reflect the variety of levels of informed and uninformed decisions.^{31,71,73}

This latter criterion, the process of deliberation, is an important step in informed decision-making, in which the decision-maker weighs the pros and cons of each available option, and deliberates alternatives to determine the expected utility of an outcome.⁵⁹ For example, the decisional balance of considering the perceived susceptibility to lung cancer later in life if a smoker were to quit smoking, or considering the pros and cons of smoking cessation before making a decision, is a deliberation process.^{42,74-80} This deliberation of available information has been identified in several decision-making theories as key to an informed decision-making process.³⁶⁻⁴⁰ In addition, socio-cognitive theories, such as the health belief model,⁷⁴⁻⁷⁶ the protection motivation theory,^{77,78} and the Integrated Behavioral Model^{42,79,80} also recognize the importance of deliberation in health decisions.

In addition, supporting informed decision-making may reduce decisional conflict, and reducing decisional conflict may support decision-making.^{45,81,82} With regard to childhood vaccination, increasing informed decision-making and decreasing decisional conflict may reduce vaccine hesitancy⁸³⁻⁸⁵ and may positively affect intention to accept childhood vaccinations, and thus also positively affect the vaccination coverage.⁴⁷ With regard to smoking behavior, increasing informed decision-making about smoking cessation and lowering decisional conflict regarding smoking cessation may support smokers in their efforts to quit smoking.⁸⁶ According to the Elaboration Likelihood Model⁸⁷, people can make a decision through two types of routes: the central route or the peripheral route.⁸⁷ To make an informed decision, it is important that people use the central route of processing since this could lead to decisions that are less vulnerable to unobjective information^{51,52} or decisional regret⁴⁵, and to more maintenance of sticking to a healthy choice.⁸⁷

For both smoking behavior and childhood vaccination, the Dutch National Institute for Public Health and the Environment (RIVM) offers information to the public. Research is needed to provide insight into how people decide on the recommended, unrecommended, or next to best health option, and how decision-making could be supported. These insights may also shed light on whether public health experts should communicate about various health options in addition to the recommended option, and how to communicate about next to best options. We will now present the next to best options in smoking behavior and childhood vaccination.

Next to best health decisions

E-cigarette use

Electronic Nicotine Delivery Systems (ENDS) are devices that vaporize a solution of additives, glycerin, and propylene glycol that is inhaled by the user.^{13-15,88}

The solution may, or may not, contain nicotine.^{13-15,88} Electronic cigarettes are the most common type of ENDS. The variety of electronic cigarette (e-cigarette) devices available on the market is rapidly increasing. While early models mimic conventional cigarettes (in shape and size), newer models vary in product specifications (shape, size, battery, and tanks)^{14,15,88-90}.

In addition to product specifications, such as wattage and resistance, design and flavor characteristics are increasingly elaborate and appealing.⁹¹⁻⁹³ Research in recent years has demonstrated that since their introduction in 2003 on the market, the appeal of e-cigarettes has increased rapidly.^{14,15,88-90,94,95} The prevalence of e-cigarette use is increasing in the United States, mostly among cigarette smokers, but recent research suggests that e-cigarette use is also increasing among non-smokers, and may even be a gateway to smoking.^{14,88,93,96-107} The majority of the e-cigarette users are currently former cigarette smokers that either switched completely to e-cigarettes or use e-cigarettes in addition to tobacco cigarettes.¹⁰⁻¹⁵ Concerns exist that e-cigarette use may attract (adolescent) never-users and thus affect public health adversely, and even lead to dual use and a nicotine addiction.¹⁶⁻¹⁸ Indeed, a recent study in the US showed that e-cigarette use is very popular among youth.¹⁰⁸

E-cigarette use in the Netherlands

The number of people who smoke in the Netherlands is decreasing.^{109,110} In 2017, 23% of the adult Dutch population smoked cigarettes.¹¹⁰ Of these 23%, 75% smoke daily. Of all smokers, higher educated people smoke less often (17%) compared to middle (27%) or lower (26%) educated people; more men smoke (27%) than women (19%).¹¹⁰ Of the Dutch population, young adults, 20 – 24 years old, smoke more often than older adults. Sixteen percent of the Dutch adult smoking population are considered heavy smokers (i.e. smoking more than 20 cigarettes a day).¹¹⁰ Three percent of Dutch adults use an e-cigarette. Of Dutch adults, higher educated people use e-cigarettes less often (2.5%), compared to middle (3.7%) and low (3.0%) educated people.¹¹⁰ Ten percent of the current smokers sometimes use an e-cigarette, and daily smokers (12%) compared to non-daily smokers (4%) use an e-cigarette more often. Of the 3% of e-cigarette users, seventy-five percent of the e-cigarette users also smoke.¹¹⁰

Types of users and frequency of use

Definitions of types of users and frequency of use differ. For the purpose of this thesis, four groups were defined. *Never-users* are individuals who reported to have never smoked or used e-cigarettes. *Smokers* are participants who reported to currently exclusively use cigarettes on a daily or weekly basis. *Dual users* are individuals who reported concurrently using cigarettes and e-cigarettes on a daily or weekly basis.¹¹¹ *E-cigarette users* are individuals who reported to be currently exclusively using e-cigarettes on a daily or weekly basis.¹¹¹

In the Netherlands, the RIVM investigates the harmfulness of cigarettes and e-cigarettes for public health in order to inform the public.¹¹² Although not using tobacco or nicotine products would be most beneficial for all types of users, exclusive e-cigarette use¹¹¹ – and not dual use of both cigarettes and e-cigarettes, which has an adverse public health effect^{14,16,111} – has potential health benefits for smokers compared to cigarette smoking.^{22,113-116} However, exclusive e-cigarette use is not without risks itself. Consequently, from a public health point of view it is recommended to prevent e-cigarette use among non-smokers.¹⁶ Motives for e-cigarette use among smokers have been investigated.^{90,117-127} In addition, other research on e-cigarette use focused on e-cigarettes as a tool for smoking cessation or changing smoking behavior with behavior change techniques.¹²⁸⁻¹³¹ Since decision-making about e-cigarette use is largely uninvestigated, it is unclear how people make a decision about refraining from cigarette or e-cigarette use, smoking, or e-cigarette use. This thesis investigates decisions about never-use, smoking, and e-cigarette use among never-users and users about these specific decisions in order to develop health communication aimed to support these decisions.

Partially accepting childhood vaccinations

Childhood vaccinations are very successful interventions to protect against vaccine-preventable diseases (VPDs).^{33,132-134} In the Netherlands, the National Immunization Program (NIP) offers vaccinations free of charge and on a voluntary basis since 1957.⁷ Currently, within the NIP, vaccinations are offered against 12 childhood diseases (polio (IPV), diphtheria (D), tetanus (T), pertussis (aP), rubella (R), measles (M), mumps (M), disease caused by *Haemophilus influenzae* type b (Hib), meningococcal ACWY disease (MenACWY), hepatitis B (HBV), pneumococcal disease (PCV) and cervical cancer caused by human papillomavirus (HPV), see Figure 1.1.⁷ The RIVM is responsible for organizing the NIP and for offering information about the NIP in the Netherlands. The vaccines itself are administered in primary care facilities (Child Welfare Centers i.e. CWCs) specialized in child health care⁶. These centers provide children from zero to four years old with health check-ups and administer vaccines according to the vaccination schedule. When the child is four to six weeks old, the parents receive an invitation for the first consult at the CWC with information on vaccination including the NIP schedule, VPDs, and side-effects and practical information. The vaccination status of children is recorded in a national register at the RIVM, called Praeventis.

Vaccination coverage in the Netherlands

Every year, the RIVM publishes a report on the vaccination coverage in the Netherlands. The latest figures showed that the vaccination coverage seemed to be stabilizing compared to a decline in previous years. At age two, born in 2014, 91.2% of all Dutch two-year-olds received all vaccines according to the NIP, 3.6% did not receive any vaccines according to the NIP and 5.2% received or delayed some vaccines (i.e. the next to best option).¹³⁵ At age two, born in 2015, 92.4% of the children received the DTaP vaccine and 92.9% of the children received the MMR vaccine.¹³⁵ In addition, 90.2% of all Dutch two-year-olds, born in 2015,

received all vaccines according to the NIP, 4.6% did not receive any vaccines according to NIP and 5.2% received or delayed some vaccines (i.e. the next to best option).¹³⁵ These figures seem to be stabilizing, since of all Dutch two-year-olds born in 2016 90.2% received all vaccines according to the NIP, 4.6% did not receive any vaccines according to the NIP and 5.2% received or delayed some vaccines (i.e. the next to best option).¹³⁵

However, the vaccination coverage alone does not provide insight into whether parents have questions or doubts regarding their decision. For example, parents who accept all childhood vaccinations, may still have doubts about their decision or even experience regret.^{83,85,136} This is why it is important to investigate decision-making regarding childhood vaccination.

Parents' decision regarding childhood vaccination

For the purpose of this study we chose to include parents of children born between 2013-2015 to be able to classify parents in three groups based on their decision about the five vaccination moments in the first two years of life (see figure 1.1): acceptors, refusers, and partial acceptors. **Acceptors** are parents of children who received all vaccinations according to the Dutch NIP schedule. Refusers are parents of children who did not receive any vaccinations according to the Dutch NIP schedule. Partial acceptors are parents who refuse or delay some vaccines for their child. For example, some of these children did not receive any vaccine against PCV, but they did receive all four doses of the DTaP-IPV-Hib-HBV vaccine, or their first DTaP-IPV-Hib-HBV vaccine was delayed.

In the Netherlands, the RIVM monitors the NIP, and informs the public about childhood vaccinations.¹¹² The RIVM is responsible for presenting the public with information about childhood vaccination, for example through an information brochure and a website.^{6,7} Although accepting childhood vaccinations would be most beneficial for public health,¹³⁷ partially accepting childhood vaccination – and not refusing all vaccines of the NIP, which has an adverse public health and possible adverse individual effect – has potential individual and public health benefits compared to refusing all vaccines.¹³⁷⁻¹³⁹ However, partially accepting childhood vaccinations leads to lower herd immunity and may not be without risks for the individual.^{140,141} Consequently, it is not recommended from a public health point of view. The motives for accepting or refusing childhood vaccinations have been investigated from a behavioral perspective with socio-cognitive models,^{33,138,142-148} and to a lesser extent also the motives for partially accepting childhood vaccination. In addition, while some research looked into decision-making about accepting childhood vaccinations,^{143,149-152} decision-making about refusing and partially accepting childhood vaccinations among those who accept, partly accept or refuse vaccination has not been studied. This thesis focusses on decision-making regarding accepting, refusing, and partially accepting childhood vaccination by asking all parents questions concerning accepting, refusing, and partially accepting childhood vaccination. By focusing

on these decisions, we increase our understanding of these decisions so that we can develop health communication aimed to support decision-making.

Figure 1.1 Schedule of the Dutch National Immunization Program.

Picture copyright 2018 © RIVM. Centre for infectious disease control ⁷

Note, the schedule of the Dutch NIP changed due to the introduction of maternal pertussis vaccine in 2019.

Thesis outline

To understand decision-making about smoking behavior and childhood vaccination, we present two objectives. First, we aimed to explore determinants of the decisions about smoking behavior and childhood vaccination, both qualitatively and quantitatively. Second, we aimed to provide insight into the extent to which decisions about smoking behavior and childhood vaccination adhere to the criteria of informed decision-making as defined in this thesis. With this aim in mind we investigated the level of knowledge, attitudes, and value-consistency toward a decision about the various choice options and levels of deliberation with regard to smoking behavior or childhood vaccination. These objectives are addressed in three parts through a series of studies (figure 1.2). The following section outlines the studies conducted.

Part 1 of this dissertation presents information on factors related to decisions

about never-use, smoking, and vaping. *Chapter 2* starts by offering an overview in the form of a systematic narrative review of reasons of use and perceptions among never-users, smokers, exclusive e-cigarette users, and dual users concerning e-cigarettes. The overview presented in chapter 2 and the conceptualization of informed decision-making based on a Rational Decision Model⁷¹ was used to develop the interview protocol used in a semi-structured focus group study among never-users, smokers, and e-cigarette users. *Chapter 3* describes the results of this qualitative study concerning decisions with regard to smoking behavior among never-users, smokers, and e-cigarette users. The results of the qualitative study presented in chapter 3 were used to develop a questionnaire about the recommended, unrecommended, and next to best health options with regard to smoking behavior to investigate socio-cognitive factors related to informed decision-making among never-users and users. In order to examine the role played by flavors in the decision regarding e-cigarette use, *chapter 4* presents the results of a quantitative analysis into the interplay of individual flavor choice and socio-cognitive factors related to e-cigarette use. *Chapter 5* provides insights into features that distinguish a dual user from an exclusive e-cigarette user, derived from a quantitative survey.

Chapter 1 General Introduction

Part 1	Exploring factors related to decision-making about smoking behavior. <i>Chapter 2:</i> Overview of reasons and perceptions regarding e-cigarettes. <i>Chapter 3:</i> Exploring factors mentioned by never-users, smokers and e-cigarette users regarding decision-making about never-use, smoking, and switching from cigarettes to e-cigarettes. <i>Chapter 4:</i> Exploring attractive aspects of e-cigarettes among never-smokers and never-users, smokers, and e-cigarette users. <i>Chapter 5:</i> Exploring features to distinguish a dual user from an exclusive e-cigarette user.
Part 2	Exploring factors related to decision-making about childhood vaccination. <i>Chapter 6:</i> Exploring factors mentioned by acceptors, refusers, and partial acceptors regarding decision-making about accepting, refusing, and partially accepting childhood vaccinations. <i>Chapter 7:</i> Exploring determinants and decisional conflict among acceptors, refusers, and partial acceptors regarding their decision about childhood vaccinations.
Part 3	Exploring whether the decisions about smoking behavior and childhood vaccinations adhere to informed decision-making criteria <i>Chapter 8:</i> Exploring knowledge, attitudes, and deliberation of those who opted for the recommended, unrecommended, and next to best health options

Chapter 9 General Discussion

Figure 1.2 Schematic outline of this thesis

Part 2 of this dissertation presents information on factors related to the decisions concerning childhood vaccination among parents who accept, refuse, or partially accept childhood vaccinations for their child with regard to these three health options. *Chapter 6* starts by providing insights into socio-cognitive factors related to the decisions regarding childhood vaccinations among vaccine acceptors, refusers, and partial acceptors gained by means of focus groups. The results of the qualitative study presented in chapter 6 were used to develop a questionnaire to investigate the identified factors related to decision-making about childhood vaccination among parents. In addition, to conceptualize the uncertainty about this decision, decisional conflict among parents was investigated. *Chapter 7* explores differences in determinants and decisional conflict experienced by parents who accepted, partially accepted, or refused childhood vaccinations, with regard to these three health options.

Part 3 of this dissertation discusses whether the decisions regarding smoking behavior and childhood vaccination adhere to the conceptualization of informed decision-making. For this study, we used the quantitative survey results from parts 1 and 2. *Chapter 8* describes whether the decisions about the recommended, unrecommended, and next to best health options in the case of smoking behavior and childhood vaccinations adhered to the criteria of informed decision-making: knowledge, attitudes, and deliberation.

Finally, *chapter 9* summarizes and discusses the major findings of the studies presented in this thesis. Practical recommendations and suggestions for further research are given.

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PART 1

CHAPTER 2

Perceptions and Reasons Regarding E-Cigarette Use among Users and Never-users: A Narrative Literature Review

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Perceptions and Reasons Regarding E-Cigarette Use among Users
and Non-Users: A Narrative Literature Review.
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Abstract

This paper aims to provide an in-depth understanding of the attractiveness of e-cigarettes for several different groups. For this purpose, perceptions of and reasons for e-cigarette use were systematically reviewed as reported by e-cigarette users, cigarette smokers, dual users, and never-users, among both adults and youth. MEDLINE® (Please define if appropriate) and Scopus were used to search for relevant articles, and references of included studies were also investigated. Two reviewers screened all titles and abstracts independently, blinded to authors and journal titles (Cohen's Kappa = 0.83), resulting in 72 eligible articles. Risk perceptions, perceived benefits, and reasons for e-cigarette use were categorized in themes and sub-themes. Risk perceptions included harmfulness in general, and specific health risks. Perceived benefits included improved taste and smell, and safety for bystanders. Reasons for use included (health) benefits, curiosity, smoking cessation, and friends using e-cigarettes. The findings highlight that there is a variety of perceptions and reasons mentioned by adult and youth e-cigarette users, cigarette smokers, dual users, and never-users. As such, this overview provides valuable information for scientists, public health professionals, behavior change experts, and regulators to improve future research, risk communication, and possibilities to effectively regulate e-cigarettes.

Introduction

Electronic Nicotine Delivery Systems (ENDS) are devices that vaporize a solution of nicotine, additives, glycerin, and propylene glycol that is inhaled by the user.¹⁻⁴ Electronic cigarettes are the most common type of ENDS. The variety of electronic cigarette (e-cigarette) devices available on the market is rapidly increasing. While early models mimic conventional cigarettes (in shape and size), newer models vary in product specifications (shape, size, battery, and tanks).²⁻⁶ In addition to product specifications, design and flavor characteristics are increasingly elaborate and appealing.⁷⁻⁹ Research in recent years has demonstrated that the appeal of e-cigarettes has increased rapidly.^{2-6,10} The prevalence of e-cigarette use is increasing, mostly among cigarette smokers, but recent research suggests that e-cigarette use is also increasing among non-smokers, and may even be a gateway to smoking.^{2,3,9,11-22} Glasser et al.³ noted that, regardless of smoking status, e-cigarettes are perceived as less harmful and addictive, and effective as a smoking cessation aid. Nevertheless, risk perceptions and perceived benefits for e-cigarette use might be different for e-cigarette users than never-users. Moreover,⁶ and Glasser et al.³ indicated that reasons for e-cigarette use go beyond smoking cessation²³ among e-cigarette users. However, as the appeal of e-cigarettes is increasing among never-users, it is interesting to study the reasons never-users report that could lead them to initiate e-cigarette use, and whether these reasons differ from cigarette smokers switching to e-cigarettes. In order to better understand the process of switching from cigarettes to e-cigarettes or experimenting with e-cigarettes, it is important to have an insight into perceptions of e-cigarettes and reasons for use among different types of users.^{6,11,19-26} This paper therefore provides an overview of such perceptions and reasons among adult and youth e-cigarette users, cigarette smokers, dual users, and never-users.

The current overview provides scientists, public health professionals, behavior change experts, and regulators with key constructs for the development and validation of measures to assess perceptions of e-cigarettes and reasons for e-cigarette use. Public health professionals are able to use the overview on perceptions and reasons when developing health education and behavior change programs. On a population level, policy makers are able to use this inclusive overview to intensify smoking bans to avoid dual use and to target product characteristics of e-cigarettes attractive for specific user groups.

Methods Search

The search strategy developed for the purpose of this narrative review aimed to retrieve articles focusing on perceptions and reasons related to e-cigarette use without any restrictions on location. Databases searched (and interfaces)

were MEDLINE (Ovid) and Scopus (without date restrictions) till February 2018. Concepts included in the search were “electronic cigarette”, “perception”, “reason”, “opinion”, and “smoking cessation” (see Appendix 1 for the full search strategy). The references of all included articles in our review were examined for additional references. To check the completeness of our search strategy, the final list of records was checked for inclusion of prior identified relevant research.

Study Selection

Following the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) guidelines (see Figure 2.1. The PRISMA flow diagram), retrieved citations were screened, duplicates were eliminated, and the remaining citations were organized in EndNote.²⁷ Authors Kim A.G.J. Romijnders and Reinskje Talhout reviewed all titles using a previously agreed-upon exclusion criteria list (see Appendix 2). First, they independently screened a random sample of 86 titles and abstracts in which they were blinded to authors and journal titles, and reached strong agreement (Cohen’s Kappa = 0.83)²⁸. Second, two authors (Kim A.G.J. Romijnders, Reinskje Talhout) independently screened all titles and abstracts, still blinded to authors and journal titles, using an Excel workbook designed specifically for screening.²⁹ Exclusion criteria were hierarchical in order, meaning that if the first exclusion criterion applies, the other exclusion criteria were not checked. Exclusion criteria were the following: (1) The article was not about e-cigarettes; (2) The article discussed toxicology and vaping behavior; (3) The article was an opinion piece; (4) The article discussed the market or marketing of e-cigarettes; (5) The article was about harm reduction; (6) The topic of the article was regulation; (7) The article did not include subjective reports; (8) The article described the gateway effect; or (9) It was not an article.²⁷ The full exclusion decision tree can be found in Appendix 2. Full-text articles were reviewed to determine final eligibility with the same exclusion decision tree (Appendix 2),³⁰ but two additional exclusion criteria applied: (10) Conflict of interest, and (11) Age restrictions. To make a distinction between adults (>18) and youth (<18), studies needed to apply clearly defined age restrictions (adults >18 and youth <18). An article was considered for inclusion if it was a quantitative or qualitative study focusing on subjective reports of participants, reporting on perceptions and/or reasons for e-cigarette use. The Excel workbooks are available upon request from the first author.

Figure 2.1 The Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) guidelines. (a) Identification contains all records identified during the search. (b) Screening lists all reasons why articles were excluded based on title and abstract. (c) Eligibility records all the records available for full-text review. (d) Included reports all exclusion criteria used during full-text review.

Data Extraction

Kim A.G.J. Romijnders extracted all relevant findings from the included studies (see Appendix 3). Due to the variety in research designs, it was not possible to generate a single quality score according to STROBE.³¹ A single quality score,

generated by the STROBE checklist, would limit the scope of this narrative review for generating an extensive list of perceptions and reasons regarding e-cigarettes. The results were not limited to cross-sectional surveys with probability samples, or close-ended response options, but also include qualitative work. A deductive thematic analysis was performed to identify themes that appeared salient to the constructs: perceptions regarding e-cigarettes and reasons for e-cigarette use. The main constructs "Perceptions" and "Reasons" were used to categorize the major relevant findings in Appendix 3. The themes (for example, for reasons for e-cigarette use: "expected benefits" and "social environment") were used to extract major relevant findings (Appendix 3). Kim A.G.J. Romijnders and Reinskje Talhout formulated sub-themes after extracting relevant findings for perceptions about e-cigarettes and reasons for e-cigarette use. The sub-themes were salient to the themes, for example, for the theme "perceived safety of use", the sub-theme "perceived safety of ingredients" emerged as pertinent from the major relevant findings. Kim A.G.J. Romijnders coded the major relevant findings found in Appendix 3 according to the themes and sub-themes (e.g., for theme "expected benefits" the sub-themes "weight control" and "helps with concentration" were applied). Kim A.G.J. Romijnders and Reinskje Talhout agreed upon the themes and sub-themes before the coding of the major relevant findings took place. The coding led to an overview of perceptions of risks of e-cigarettes, perceived benefits of e-cigarettes, and reasons for e-cigarette use. To ensure the reliability of the meaning of themes and sub-themes during coding of articles, triangulation was used.

After coding, results were stratified by type of user and age. Adults were categorized as eighteen years or older, and youth were categorized as younger than eighteen years old. For each type of user, there was variability in reporting. For example, some studies report current use of e-cigarettes among current cigarette smokers without categorizing them as dual users, whereas other studies reported the current use of e-cigarettes with simultaneous current tobacco cigarette use as dual use^{32,33}. Therefore, measures for type of user were recorded for each included study as defined by the respective authors (Appendix 3). This review categorized perceptions and reasons regarding e-cigarettes using the classification of users as stated in the original study. E-cigarette users are users of e-cigarettes without differentiating for frequency of use, co-current use or past use of cigarettes. Similarly, no distinction was made among cigarette smokers concerning frequency, lifetime use, co-current or past use of other tobacco products or e-cigarettes. If an included study mentioned perceptions or reasons regarding e-cigarettes among dual users, this review categorized these perceptions and reasons among dual users. Similarly, never-users were classified as not using e-cigarettes or cigarettes. No distinction was made between former users or users that had never smoked. Summarizing, type of users were categorized according to their original type of user classification without an attempt to synthesize type of user across studies.

Results

A total of 65 studies from 72 articles met the eligibility criteria (see Figure 2.1).^{25,32-102} Articles report perceptions and reasons regarding e-cigarettes in 49 studies among e-cigarette users, 39 studies among cigarette smokers, 11 studies among dual users, and 19 studies among never-users, which are listed in an overview. The sample size ranged from 14 to 25,029 respondents. Most studies were conducted in the U.S. (n = 49), but studies were also conducted in the UK (n = 11), New Zealand (n = 6), Canada (n = 4), France (n = 2), Switzerland (n = 3), Australia (n = 2), and Belgium (n = 1) (see Appendix 3 for a full overview). Fifty-five articles reported data on adults, and seventeen on youth. Thirty-four studies had a cross-sectional design, seventeen had a qualitative design, three had a mixed methods approach, six were longitudinal, and twelve were cohort studies (see Appendix 3). Due to a variety of research designs, sample size, and changes over time, this paper is not a synthesis of most cited, most important, or most expressed perceptions and reasons by participants.²³ This section provides an overview of risk perceptions, perceived benefits, and reasons for e-cigarette use.

Risk Perceptions Related to E-Cigarettes

Perceived risks pertained to risks for individual e-cigarette users (e.g., unsafe components of e-liquids), and risks for the social environment of these users (e.g., risks for bystanders and the risk for an unborn child if used during pregnancy).^{25,32,34,36,37,39-41,45,47,49,50,52,54,56,57,59-61,63,65,66,68,70,72,73,77-79,81,83,85,86,88,89,93-95,97,98,101,102} Table 2.1 summarizes the different risk perception themes and sub-themes identified. This section reports perceptions mentioned by user groups. First, studies suggest that, compared to cigarettes, e-cigarettes were perceived by all user groups as being healthier, safer, and less addictive, as well as being safer for one's social environment, and safer to use during pregnancy than cigarettes.^{32,37,39-41,43,44,47-49,57,59,61,63,65,68,73,76,81,85,88,89,94,95,102} Second, studies performed in earlier years showed that e-cigarettes were perceived as being overall less harmful than cigarettes, while in later years this reduced harm perception changed.^{25,32,34,36,37,39-41,45,47,49,50,52,54,56,57,59-61,63,65,66,68,70,72,73,77-79,81,83,85,86,88,89,93-95,97,98,101,102} In more recent studies e-cigarettes were perceived as equally or more harmful than cigarettes among adult cigarette smokers,^{25,36,37,47,52,59,66} never-users,^{54,60,72,73,85,93,94} as well as youth cigarette smokers,^{25,36,37,52,56,59,66} and never-users.^{25,47,52} Third, specific flavors (candy and fruit flavors) were considered less harmful than other (tobacco) flavors among adult⁴⁹ and youth⁵⁶ e-cigarette users, adult⁷⁸ and youth^{25,56} cigarette smokers, and never-users⁵⁶. Summarizing, different themes and subthemes with regard to perceived risks for the individual e-cigarette user and risks for their social environment were specified. Flavors influence the risk perception of e-cigarettes among both adults and youth, and current data show that the risk perception of e-cigarettes increased compared to previous years.

Table 2.1 Risk perceptions about e-cigarettes reported by individual studies, clustered by type of user.

Themes and Sub-themes of Risk Perceptions	Never-users ^d		Smokers ^b		Dual Users ^c		E-Cigarette Users ^a	
	Adults	Youth	Adults	Youth	Adults	Youth	Adults	Youth
Risk Perceptions for the User								
Harmfulness	54,60,72,73,85	25,47,52	34,39,41,45,50,54,59,60,70,72,77,83,85,88,93,97,98,101	25,36,37,52,56,59,66	32		40,49,54,57,59,73,79,85,86,94	25,36,37,47,52,59,66
Harmfulness of flavors		56	78	25,56			49	56
Secondary harm as a gateway drug ⁹⁴								
Health risks			65				49,65	37,47
Reduced athletic performance							49	
Trouble breathing/Coughing							49	47
Cancer							49	47
Hearth attack							49	
Dental health issues							49	
Safety of use			63,68,88,89	37,59	63		37,40,57,59,102	37,59
Lack of safety of ingredients liquids				59				59
Risk Perception for the Social Environment of a user								
Harmful for bystanders	85						40,57,81,85	
Safety of use during pregnancy	61,73							

Note: ^a "E-cigarette users" are users of e-cigarettes as defined in the original study. For example, Bold, Kong, Cavallo, Camenga, Krishnan-Sarin ⁴⁴ included only ever users of e-cigarettes in their study, without differentiating for frequency of use, co-current use or past use of cigarettes. ^b "Smokers" are those who smoke cigarettes as defined in the original studies. For example, Biener, Song, Sutfin, Spangler, Wolfson ⁴³ defined cigarette smokers as those who had smoked at least 100 cigarettes in their lifetime and smoked every day or some days. No distinction is made among cigarette smokers concerning frequency, lifetime use, co-current or past use of other tobacco products or e-cigarettes. ^c "Dual users" are those who use e-cigarettes and cigarettes simultaneously as defined in the original studies. For example, Cheney, Gowin, Wann ⁴⁸ defined dual users as

current use of both e-cigarettes and cigarettes within the past week. If an included study mentioned perceptions or reasons regarding e-cigarettes among dual users, this review categorized these perceptions and reasons among dual users. ^d “Never-users” are those who did not use e-cigarettes or cigarettes at the time of included study as defined in the original study. For example, Patel, Davis, Cox, et al. ⁷⁶ defined never-users as those who report “not at all” to the question whether they had smoked cigarettes or used e-cigarettes. Never-users were classified as not using e-cigarettes or cigarettes, and no difference was made between former users and never users.

Perceived Benefits of E-Cigarettes

Perceived benefits of e-cigarettes mentioned in the literature are summarized in Table 2.2 and include (expected and actual) positive experiences (such as taste), social acceptance, avoidance of smoking restrictions, a cool and fashionable product, an effective smoking aid, and the safety for bystanders. In this section, perceived benefits of e-cigarettes for the user groups are shown. First, adult e-cigarette users ^{40,49,57,58,73,81,88,90,102} and adult cigarette smokers ^{37,39,42,50,63,68,70,78,88,89,99} noted health benefits and positive experiences of e-cigarette use. Dual users and never-users did not identify health benefits or positive experiences, although they did note some benefits for reducing cravings and safety for the e-cigarette user compared to cigarette smokers. Second, adult e-cigarette users, ^{40,41,49,57,81,85} dual users ⁸¹, and never-users ^{58,85,94,95} also saw benefits for bystanders of e-cigarette users. Third, youth noted only a few perceived benefits of e-cigarette use for individual use. They perceived e-cigarettes as safe to use for e-cigarette users and fashionable (youth e-cigarette users, ^{37,47,59} youth cigarette smokers, ^{37,59} and youth never-users ^{47,55}). Summarizing, individual user benefits revolved around convenience and attractiveness of the product, health benefits, positive experiences, safety, smoking cessation benefits, and social acceptability. Perceived benefits for the social environment of the user were mentioned by adult user groups (safety for bystanders and the environment).

Table 2.2 Perceived benefits of e-cigarettes reported by individual studies, categorized by type of user.

Perceived Benefits for Users								
Themes and Sub-themes of Perceived Benefits	Never-users ^d		Smokers ^b		Dual users ^c		E-Cigarette Users ^a	
	Adults	Youth	Adults	Youth	Adults	Youth	Adults	Youth
Addictiveness	Perceived as equally addictive		Perceived as equally addictive		Perceived as less addictive		Perceived as less addictive	
	73,94	47	39,41	59	32,81		73,81,94	47,59
Avoidance of smoking restrictions	73		50,63,68,88,89	37	63		49	37
A cool and fashionable product	73	47,55		37			73	37,47
Health benefits							90	
Healthier than cigarettes			42	37				37
Improved breathing			63		63			
Improved general well-being			63,78		63			
Decreased coughing			63		63			
Less likely to cause cancer			78					
Lower costs compared to cigarettes			50					
Positive experiences								
Mimics smoking routine		55	37	37				37
Enjoyable taste	73				81		81	
Throat hit					81		81	
Weight control					81		81	
Increases concentration								47
Safety of use			63,68,88,89	37,59	63		40,57,102	37,59
Safety of ingredients liquids		47,55		59			73	59
Smoking cessation purposes								
Nicotine replacement therapy	58,61,73,88,94		39,50,70,99		32,89		49,58,73,88	
Perceived Benefits for Users								

table continues

Themes and Sub-themes of Perceived Benefits	Never-users ^d		Smokers ^b		Dual users ^c		E-Cigarette Users ^a	
	Adults	Youth	Adults	Youth	Adults	Youth	Adults	Youth
Cut back on cigarettes			50					
Deal with cravings	58				89			
Social acceptability	58,94,95				81		41,49,81	
Perceived Benefits for the Social Environment of a User								
Safer for bystanders	85				81		40,57,81,85	
Safer for the environment (less pollution)							57	

Note: a “E-cigarette users” are users of e-cigarettes as defined in the original study. For example, Bold, Kong, Cavallo, Camenga, Krishnan-Sarin ⁴⁴ included only ever users of e-cigarettes in their study, without differentiating for frequency of use, co-current use or past use of cigarettes. b “Smokers” are those who smoke cigarettes as defined in the original studies. For example, Biener, Song, Sutfin, Spangler, Wolfson ⁴³ defined cigarette smokers as those who had at least smoked 100 cigarettes in their lifetime and smoked every day or some days. No distinction is made among cigarette smokers concerning frequency, lifetime use, co-current or past use of other tobacco products or e-cigarettes. c “Dual users” are those who use e-cigarettes and cigarettes simultaneously as defined in the original studies. For example, Cheney, Gowin, Wann ⁴⁸ defined dual users as current users of both e-cigarettes and cigarettes within the past week. If an included study mentioned perceptions or reasons regarding e-cigarettes among dual users, this review categorized these perceptions and reasons among dual users. d “Never-users” are those who did not use e-cigarettes or cigarettes at the time of included study as defined in the original study. For example, Patel, Davis, Cox, et al. ⁷⁶ defined never-users as those who report “not at all” to the question of whether they had smoked cigarettes or used e-cigarettes. Never-users were classified as not using e-cigarettes or cigarettes, and no difference was made between former users or never user

Reasons for E-Cigarette Use

This section reports reasons for use among e-cigarette users, cigarette smokers, dual users, and never-users. Never-users were asked about possible reasons for them to personally initiate e-cigarette use. Reasons for explaining the appeal of e-cigarettes go beyond smoking cessation (Table 2.3 ^{32,33,35,37,39-44,46,48-51,53,54,57,62,64-67,69-71,74-76,79,81-86,90,91,98,102}). Other reasons include expected benefits (enjoyable taste and a variety of flavors), experienced benefits (reduces stress and enables control of weight gain), avoidance of smoking restrictions by dual use of tobacco products and e-cigarettes, convenience of the product, curiosity, and influences from the social environment (e.g., recommended by friends). Smoking cessation was the most often reported reason for initiation of e-cigarette use among adult e-cigarette users,^{33,35,40-42,44,48,49,51,53,54,57,62,64-66,69,75,76,79,81,82,85,86,90,91,102}

cigarette smokers,^{39,42,43,46,50,69-71,76,83,84,98} dual users,^{32,33,67,81,82} and never-users⁷⁶. In addition, other expected benefits were reported by adult^{35,40,41,48,49,53,65,76,79,81,90} and youth^{44,59,75} e-cigarette users, adult^{46,76,84} and youth⁵⁹ cigarette smokers, dual users,^{32,48} and adult never-users⁷⁶ (see Table 2.3). In addition to expected benefits, adult^{33,35,40,41,48,53,65,74,76,79,81,85,90,91} and youth^{44,59,75} e-cigarette users and dual users^{32,33,48,81} reported additional experienced benefits such as health benefits and finding a new hobby. In summary, reasons for e-cigarette use go beyond smoking cessation. While smoking cessation is the reason most often reported in large-scale population surveys, most other reported reasons revolved around the health benefits of e-cigarette use compared to smoking.

Table 2.3 Reasons for e-cigarette use as reported by individual studies by type of user.

Themes and Sub-themes of Reasons for E-cigarette use	Never-users d		Smokers b		Dual Users c		E-Cigarette Users a	
	Adults	Youth	Adults	Youth	Adults	Youth	Adults	Youth
Expected benefits								
Enjoyable taste			46				40,53,65,81	
Expected health benefits								
Healthier than cigarettes					32,33		33,40,41,49,53,57,81	44,75,80
Improved breathing				37			91	37,47
Increased concentration		47			32			
Satisfy nicotine need					32		38,90	
Availability of variety of flavors	76		76,84	59	48		35,40,41,48,49,65,76,79	44,59
Weight control							41,81	75
Experienced benefits								
Avoidance of smoking restrictions by dual use of tobacco products and e-cigarettes	76	95	42,43,50,69,76,83,84	37	82		35,65	37,92,100
Possibility to alter technical specifications							40,74,90	
Weight control							41,81	
Mimics smoking routine				37	33		33,40,49,54,79,91	37
Experienced health benefits				37	32,33		33,40,48,49,53,81	37,75

table continues

Themes and Sub-themes of Reasons for E-cigarette use	Never-users d		Smokers b		Dual Users c		E-Cigarette Users a	
	Adults	Youth	Adults	Youth	Adults	Youth	Adults	Youth
Regain a sense of smell and taste							40,53	
Improved breathing								
Decreased coughing								
Improved dental health								
Increased athletic performance								47,75
Increased alertness								
New hobby (more friends)					33,48		33,48,91	
Aid to concentration		47			32			
Pleasure of product use					33		33,40,53,85,91	
Reduces stress			84		81		48,81	
Taste of flavors	76		76,84	59	32,33		35,40,41,48,65,76,79,81	44,59
Throat hit			84		81		40,81	
Convenience of product							91	
Easily accessible			71	37			40,48,71,91	37,80
Lower costs compared to cigarettes				37	32,33		33,38,40,41,69,74,79,85,87,96	37,75,100
Discreet in use (no lingering smell, able to hide use)								44
Practical in use (no lighter, no ashtray, one puff, and able to store the device)	76		71,76		48,76		40,48,71,76,91	
Curiosity								
A cool product	39,76		39,71,76,98	66	81		35,69,76,79,81,87,96,98	44,47,66,100
A fashionable product				37				37
Novelty (curious about novel product)	76		39,43,69,71,76,84,98				35,53,65,69,70,76,79,81,85	44,62,64,66,92,100

table continues

Themes and Sub-themes of Reasons for E-cigarette use	Never-users d		Smokers b		Dual Users c		E-Cigarette Users a	
	Adults	Youth	Adults	Youth	Adults	Youth	Adults	Youth
Smoking cessation purposes								
Alternative for smoking cigarettes			69				38,57,86	
Avoidance of withdrawal of nicotine							38,53	
Cut back cigarettes			50,83		32,33,81		33,42,79,81,87,96	75,92,100
Use as smoking cessation aid	76		39,42,43,46,50,70,76,83,84,98	100	32,33,67		33,35,38,40-42,44,51,53,54,62,64-66,69,75,76,79,81,85,87,90,91,102	44,51,62,64,66,75,92
Deal with cravings	76		71,76		32,33,82		40,54,76,79,82,85,96	
Social environment								
Fitting in		47						
Pressure of social environment		47	[41]					
Recommended by friends or family			69				96	92,100
Role models use e-cigarettes							41,49	92

Note: a “E-cigarette users” are users of e-cigarettes as defined in the original study. For example, Bold, Kong, Cavallo, Camenga, Krishnan-Sarin ⁴⁴ included only ever users of e-cigarettes in their study, without differentiating for frequency of use, co-current use or past use of cigarettes. b “Smokers” are those who smoke cigarettes as defined in the original studies. For example, Biener, Song, Sutfin, Spangler, Wolfson ⁴³ defined cigarette smokers as those who had at least smoked 100 cigarettes in their lifetime and smoked every day or some days. No distinction is made among cigarette smokers concerning frequency, lifetime use, co-current or past use of other tobacco products or e-cigarettes. c “Dual users” are those who use e-cigarettes and cigarettes simultaneously as defined in the original studies. For example, Cheney, Gowin, Wann ⁴⁸ defined dual users as current use of both e-cigarettes and cigarettes within the past week. If an included study mentioned perceptions or reasons regarding e-cigarettes among dual users, this review categorized these perceptions and reasons among dual users. d “Never-users” are those who did not use e-cigarettes or cigarettes at the time of included study as defined in the original study. For example, Patel, Davis, Cox, et al. ⁷⁶ defined never-users as those

who report “not at all” to the question of whether they had smoked cigarettes or used e-cigarettes. Never-users were classified as not using e-cigarettes or cigarettes, and no difference was made between former users and never users.

Discussion

This review provides a comprehensive overview of risk perceptions, perceived benefits, and reasons for use of e-cigarettes, as reported in Tables 2.1 – 2.3.

Perceptions and Reasons Among Users and Never-users

Current data showed a variety of perceptions about e-cigarettes and reasons for e-cigarette use reported by e-cigarette users, cigarette smokers, dual users, and never-users. For example, e-cigarettes were perceived as being less harmful by e-cigarette users. This perception of reduced harm could lead to use or, vice versa, by initiating e-cigarette use, the perception of harm may decrease. However, research showed that the perceived harm of e-cigarettes as compared to tobacco cigarettes has increased among all types of users over the years,³ and e-cigarettes are currently perceived as equally or more harmful than cigarettes. With regard to available flavors, which were shown to influence risk perceptions, fruit or candy flavored e-liquids were perceived as less risky compared to tobacco flavored e-liquids. E-cigarette users and cigarette smokers perceived benefits of e-cigarettes. In addition, adult e-cigarette users, dual users, and never-users noted advantages for the social environment when switching from cigarette smoking to e-cigarette use. Youth highlighted the trendiness of e-cigarettes as a perceived benefit, and perceived less health benefits than adults. The overview in this paper shows several positive perceptions and reasons which influence the initiation of e-cigarette use.

Based on these findings, tailored communication on risks and benefits of e-cigarette use could increase awareness about risks and benefits of e-cigarette use among user groups. For example, targeted risk communication on risks of e-cigarette use for never-users, and benefits of e-cigarette use compared to smoking for cigarette smokers would increase factual knowledge about risks of e-cigarette use among these user groups. If the latter were to perceive e-cigarettes as less harmful, they may be more inclined to switch to e-cigarettes. Furthermore, if never-users were not to perceive fruit- and candy-flavored e-liquids as harmless, they might be less inclined to initiate e-cigarette use. Summarizing, risks and benefits could be communicated to increase knowledge about e-cigarette use among user groups.

E-cigarette users expected (before initiation) and experienced (after continuation of use) benefits from e-cigarette use. In addition, this paper noted that reasons for

initiation of e-cigarette use evolved to reasons for continuation of e-cigarette use¹⁴. When positive outcome expectancies (theme: expected benefits, see Table 2.3)^{32,33,40-43,46,47,49,50,53,75,100,103} were realized by positive experiences when initiating e-cigarette use (theme: experienced benefits, see Table 2.3),^{32,33,40,41,49,53,75,84} people may continue using e-cigarettes. For example, all e-cigarette users expected health benefits from e-cigarette use compared to cigarettes.^{32,33,40-43,46,49,53,75,100} If health improvements are indeed experienced, this may lead to continued use of e-cigarettes and possibly quitting cigarette use^{32,33,40,49,53,75} (see Table 2.3).

Cigarette smokers and never-users also mentioned expected benefits from e-cigarette use. However, not all cigarette smokers continue with e-cigarette use after initiation or initiate e-cigarette use. In some cases, the expected benefits of e-cigarettes for cigarette smokers—the ability to mimic smoking behavior—did not result in the expected experience. Cigarette smokers who tried e-cigarettes often expressed the inability to mimic smoking behavior with an e-cigarette (e.g., as a result of taste, the weight of the device, not being able to hold the device in the same way as a tobacco cigarette).^{33,41-43,49} The experience of e-cigarettes did not live up to the outcome expectations of cigarette smokers. Consequently, managing outcome expectations (by assisting with device specifications choices or e-liquid flavors) in behavior change strategies for cigarette smokers may prevent dual use of e-cigarettes and cigarettes. Managing outcome expectations could also be used to prevent initiation among never-users, by focusing on expected disadvantages of use and negative experiences (such as stressing that it is not cool or fashionable to use e-cigarettes).

Applications

Perceptions and reasons regarding e-cigarette use provide additional input for public health education, behavioral change programs, and regulation. Regulation, such as warning labels on tobacco products, is used to target misperceptions regarding tobacco products on a population level. Public health education can use the overview, presented in this study of perceptions on risks and benefits, to highlight factual risks and benefits of e-cigarette use in tailored communication. For example, tailored risk communication on the reduced harmfulness of e-cigarettes compared to cigarettes may reduce misperceptions among cigarette smokers initiating e-cigarette use for smoking cessation purposes. With risk communication tailored to specific personal needs and personal outcome expectancies, behavior change experts are able to target these personal misperceptions and confirm factual risk perceptions and perceived benefits.

Policy makers can also use this overview for product regulation measures. For example, available e-liquid flavors play an important role in the initiation of e-cigarette use for both cigarette smokers looking for an alternative for cigarettes and for curious never-users.⁹ From a public health point of view, it is not desirable for never-users to be attracted by flavors in e-liquids, with the chance of initiat-

ing e-cigarette use. Future research should therefore focus on differences and overlap in specific flavor preferences among cigarette smokers and never-users to facilitate switching from cigarettes to e-cigarettes and discourage initiation of e-cigarette use among never-users.^{22,25}

Future Research

Heterogeneity in the reporting of types of users made it difficult to classify types of users. For future research, it is therefore of vital importance to formulate standard definitions for ever, current, and dual use of e-cigarettes to assess population effects of e-cigarette use. In defining e-cigarette use, it is important to distinguish between experimental and daily use. For example, asking about e-cigarette use during the previous 30 days does not distinguish between experimental and daily use.

This review noticed the lack of reporting on perceptions towards e-cigarettes and reasons for use among adult dual users and never-users, and youth never-users and dual users. Future research needs to identify the rates of dual use among youth. Overall, only perceptions of harm were assessed in extensive cross-sectional, cohort, and longitudinal studies compared to other risk perceptions, and less regarding perceptions in general.

E-cigarette use is a complex behavior, and response options in questionnaires assessing perceptions and reasons in general may not be representative for all users, cigarette smokers, dual users, and never-users. Our overview, in addition to the work of Gibson et al.²⁶ and Pearson et al.²⁴, validated measures such as the Fagerström test for nicotine dependence¹⁰⁴ and the International Tobacco Control measures¹⁰⁵, and adds insight into developing and validating items for measuring e-cigarette use, risk perceptions of e-cigarettes, perceived benefits of e-cigarettes, and reasons for e-cigarette use. Summarizing, validated measures provide insight into e-cigarette use to develop tailored information based on the needs of e-cigarette users, cigarette smokers, dual users, and never-users.

Limitations

Heterogeneity between the different papers in statistical methods and reporting makes it difficult to generalize findings across countries and study samples. Therefore, the results do not display analyses across countries. For this reason, the current paper was unable to display changes in risk perception over time. Due to the variability in reporting type of users and frequency of use, users were classified according to the classification of original articles. Consequently, this overview was unable to differentiate between former and never e-cigarette users, or to clearly differentiate between cigarette smokers and dual users, as not all cigarette smokers currently using e-cigarettes were classified in original studies as dual users of tobacco and e-cigarettes. In addition to a variety in study

designs, more studies were found reporting on adult perceptions and reasons than youth, and cigarette smokers than never-users. This means that some perceptions and reasons regarding e-cigarettes could have been missed among the understudied user groups.

Conclusions

This study is an exploratory narrative review into perceptions and reasons regarding e-cigarette use. Different perceptions of risks and benefits, and reasons for e-cigarette use were summarized for different types of users in themes and sub-themes, such as convenience, social environment, and disadvantages. Adults' perceptions and reasons for e-cigarette use are often related to smoking cessation, while youth like the novelty of the product. Tailored information about e-cigarettes for the different user groups is necessary to correct misperceptions about e-cigarettes and highlight the risks and benefits of e-cigarette use.

For public health professionals, behavior change experts, and regulatory science, our overview of risk and benefit perceptions of e-cigarettes, and reasons for e-cigarette use provides insight into the initiation of e-cigarette use.

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CHAPTER 3

A Deliberate Choice? Exploring the Decision to Switch from Cigarettes to E-Cigarettes

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A Deliberate Choice?
Exploring the Decision to Switch from Cigarettes to E-Cigarettes.
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Abstract

E-cigarettes are increasingly popular among both cigarette smokers and never-users. Although smoking cessation yields the most individual and population health benefits, switching to exclusive e-cigarette use offers some individual health benefits for cigarette smokers. However, e-cigarette use is not harmless, and its use among non-cigarette smokers should be prevented. Our study aims to explore the decision-making process about e-cigarettes among an e-cigarette users, cigarette smokers, and never-users. We conducted 12 semi-structured focus group interviews with e-cigarette users, cigarette smokers, and never-users. We performed a thematic analysis of the interview transcripts. First, knowledge reported by e-cigarette users was mainly based on other users' experiences. Second, cigarette smokers and never-users were more negative towards e-cigarettes than e-cigarette users. Third, e-cigarette users considered switching from cigarette smoking to e-cigarette use by deliberating relevant information, and weighing up the benefits and disadvantages of e-cigarette use versus smoking. Additionally, important factors in the decision-making process were a perception of risks and benefits of e-cigarettes compared to cigarettes, a supportive social environment about e-cigarette use, and trust in information offered about the risks and benefits of e-cigarettes. Our findings provide insight into what we can learn from the conscious decision-making process of e-cigarette users who switched from cigarettes to e-cigarettes. This information can be considered to develop targeted communications strategies to stimulate a conscious decision-making process, these may highlight benefits of switching to e-cigarettes for cigarette smokers, discussing the risks of smoking, and correcting misperceptions about the perceived risks and benefits of e-cigarette use.

Introduction

Electronic cigarettes (e-cigarettes) vaporize a solution of glycerin, propylene glycol, additives, and sometimes nicotine¹⁻⁵. While early models mimic conventional cigarettes (in shape, flavor, and size), the design characteristics of newer models and e-liquid flavors available are elaborate and attractive to both cigarette smokers and never-users.^{3,6-12} In 2018, 3.1% of the Dutch population ever used an e-cigarette. In addition, 23.1% of the Dutch population were smokers, of which one-third were between twenty and twenty-four years old.¹³

E-cigarettes have the potential to reduce the harm of cigarette smoking on smokers' health.¹⁰ Recent studies have argued that—while quitting the use of tobacco and related products yields the most health benefits—the health effects associated with exclusive e-cigarette use (and not dual use of cigarettes and e-cigarettes) are less harmful than those related to cigarette smoking.^{11,14-19} Still, e-cigarette use is not harmless, and consequently, the initiation of e-cigarette use among never-users needs to be prevented.^{10,11,20-22} To aid tobacco control that yields the most public health benefits for cigarette smokers and never-users, insight into differences in the decision-making process of e-cigarette users, smokers, and never-users is needed about e-cigarette use initiation. In particular, it is important to know whether the decision made by former cigarette smokers to switch to e-cigarettes, or by never-users to refrain from e-cigarette use, is consciously deliberated.

Previous research among different types of users and different age groups has described differences in reasons why initiating e-cigarette use is attractive.²³⁻²⁵ For example, cigarette smokers have argued that the expected health benefits of e-cigarette use compared to cigarette smoking and design similarities with cigarettes are reasons to initiate e-cigarette use.²⁵⁻²⁷ Non-using youth (<18 years) have stated curiosity as a reason to initiate e-cigarette use.²⁵ Despite previous research into reasons for initiating e-cigarette use,^{25,27} insight into the process of making a choice (decision-making) about e-cigarette use initiation lacks. This information is crucial to facilitate a conscious decision among cigarette smokers about switching to e-cigarettes and among never-users about refraining from experimenting with e-cigarettes.

A conscious decision-making process is defined by deliberating available and relevant information about the options, and by weighing advantages and disadvantages of the choice in the context of the decision-maker's attitudes²⁸⁻³⁰ Previous research found that smokers have not made a conscious and informed decision to initiate cigarette smoking, but that this decision is rather passive.^{28,29,31-34} Our study explores the deliberation process of successful switching among current e-cigarette users (former smokers), and the deliberation process of refraining from e-cigarette use among cigarette smokers and never-users. To the best of our knowledge, this is the first study to examine the decision-making process of

e-cigarette use among cigarette smokers and never-users. We explored whether e-cigarette users, cigarette smokers, and never-users have similar knowledge and attitudes regarding e-cigarettes, and if they used this knowledge to consider pros and cons of switching to, or refraining from e-cigarette use. By comparing differences in this process of e-cigarette use initiation between e-cigarette users, cigarette smokers, and never-users, we offer new information on the views and experiences of e-cigarette users who switched from cigarettes to e-cigarettes.

Methods

To explore the decision-making process about e-cigarette use, we conducted focus groups with three homogeneous groups consisting of adult e-cigarette users, adult cigarette smokers, and adolescent never-users who used neither cigarettes nor e-cigarettes. For each of these types of users, four focus groups were conducted. The study was approved by the Medical Ethics Committee of Zuyderland—Zuyd (16-N-84).

Recruitment

In June 2016, participants were recruited in the Netherlands, through an advertisement on Facebook®, Instagram®, Twitter®, and *scholieren.com* (a website targeted at adolescents in the Netherlands). Inclusion criteria were: awareness of e-cigarettes, being a current smoker (18+), e-cigarette user (18+), or never-user (13 to 17 years old), and fluency in Dutch. Adolescent never-users were selected because previous research showed differences in reasons for e-cigarette initiation among adult e-cigarette users, adult cigarette smokers, and adolescent never-users.²⁵ Appendix 4 shows the characteristics of included participants.

Procedure

The group discussions were based on a semi-structured protocol with open-ended questions and minimal steering to allow participants to freely discuss e-cigarettes.³⁵ The topic list of this protocol was developed to investigate decision-making according to the definition of van den Berg, Timmermans, ten Kate, van Vugt, van der Wal²⁹ and previous qualitative research conducted by Gray, Hoek, Edwards³¹ This topic list was tested in a pilot focus group and subsequently revised. While the same moderator (K.A.G.J.R.) led all group discussions, the observers varied. All focus groups were audio recorded, and flipcharts were used for participants to visualize the topics that had been discussed (see Appendix 5 for a detailed summary of the semi-structured protocol).

The focus groups were conducted between June and July 2016 and lasted approximately two hours. Informed consent was obtained before the start of

the focus group and after participation, the participants received an incentive of 30 euros. The focus group started with a general introduction. The discussion proceeded in four steps exploring participants' knowledge regarding e-cigarettes, their attitude towards e-cigarettes, their deliberation regarding e-cigarette use initiation, and their information needs (see Appendix 5 for a detailed summary).

Qualitative Coding and Analysis

All group discussions were transcribed verbatim. Qualitative data analysis comprised of three phases.³⁶ In the first phase, the first author applied descriptive level coding to a randomly selected focus group transcript, to deduce relevant themes and subthemes. The first author and the second coder (T.J.) then developed a descriptive thematic analysis. The second coder identified little additional text fragments to be relevant. In the second phase, the first and the second coder resolved minor differences in coding themes and subthemes to create a final coding taxonomy. A third coder (M.B.), who did not participate in the first phase of the coding process, reviewed the final coding taxonomy with the first author and minor adjustments were made. In the final and third phase, the first author and third coder coded all the transcribed focus groups.

Results

We conducted four focus groups with adult e-cigarette users ($n = 26$), four focus groups with adult cigarette smokers ($n = 17$), and four focus groups adolescent never-users ($n = 23$). All e-cigarette users reported to be former smokers. Overall, the sample was 47% female and 53% male, the average age of adult participants was 29.3 years (± 13.0 , min = 18, max = 58), and adolescents 15.3 (± 1.1 , min = 13, max = 17), and the sample was highly educated (applied sciences or university degree; 65%). Table 3.1 summarizes the demographic variables for e-cigarette users, cigarette smokers, and never-users. The following section describes themes, which were considered important in the overall decision-making process of e-cigarette users, smokers and never-users with illustrative quotes. Because of the explorative and qualitative nature of this study, the results are not meant to convey generalizability beyond the studied population. To describe themes and patterns in the data, we distinguish between rarely and commonly mentioned aspects.³⁷

Table 3.1 Demographic information of the study participants.

Demographics	Never-users	Cigarette smokers	E-cigarette users
Age μ ($\pm$)	15.2 ($\pm$ 1.1)	19.8 ($\pm$ 3.2)	31.8 ($\pm$ 12.2)
Education n(%)			
High	5 (22%)	7 (41%)	2 (8%)
Middle	8 (35%)	6 (35%)	15 (58%)
Low	10 (43%)	4 (24%)	9 (35%)
Gender n(%)			
Male	8 (35%)	8 (47%)	19 (73%)
Female	15 (65%)	9 (53%)	7 (27%)

Note: Demographic information is displayed for each user group.

Knowledge

When participants were asked to talk about what they knew about e-cigarettes, many participants were able to mention some facts about e-cigarettes. For example, many participants stated the variety of e-liquid flavors available, the rechargeable batteries of e-cigarettes, the lack of a burning process and tar, the variety of devices, and the ability to avoid smoking bans (quote 1).

'You use an e-liquid, there are a lot of flavors, you can choose whether you want with or without nicotine, and there are many different types...'
(#3_smoker about e-cigarettes)

Compared to cigarette smokers and never-users, e-cigarette users described more detailed information about e-cigarettes. E-cigarette users reported to have acquired much information in order to make a decision about e-cigarette use initiation, for example, about product characteristics, ingredients of e-liquids, and legislation regarding e-cigarettes. Knowledge reported by e-cigarette users was mainly based on user experiences. When asked how informed they felt, cigarette smokers and never-users stated that they did not search for information about e-cigarettes and expressed they did not know much about e-cigarettes. E-cigarette users felt very informed.

Attitude

Participants shared experiences, both positive and negative, with e-cigarettes and cigarettes. Cigarette smokers and never-users, were negative towards e-cigarette use, in general mentioning it was 'weird' (quote 2):

'I think it's [e-cigarettes] really weird and pathetic. Everybody will be

laughing at you.’ (#23_never-user)

All groups mentioned that using e-cigarettes has the advantage of avoiding smoking restrictions (quote 3).

‘It [e-cigarettes] is really easy to use [...] and you can even use it inside, great if you’re in the bus [...] Or you can use it for a just bit, instead of smoking an entire cigarette. I think I’d enjoy that...’ (#17_smoker)

Compared to e-cigarette users and never-users, many cigarette smokers were positive towards cigarette smoking. Regardless of the negative health effects associated with cigarette smoking, smokers expressed they really enjoy smoking. Several of the e-cigarette users reported a positive attitude about e-cigarettes and negative attitude towards smoking, based on knowledge acquired beforehand. In general, e-cigarette users emphasized the positive aspects of e-cigarette devices and positive experiences, such as the variety of flavors and the adjustability of nicotine levels.

Deliberation

Many e-cigarette users consciously deliberated initiation of e-cigarette use versus continuation of cigarette smoking by using knowledge acquired and weighing up the benefits of e-cigarette use and disadvantages of cigarette smoking. For example, the personal health benefits of e-cigarette use, and the negative health issues for their social environment associated with secondhand smoking. They described this decision process of switching from cigarette smoking to e-cigarette use as a deliberation of benefits and disadvantages (quote 4):

‘Switching from cigarettes to e-cigarettes [...] it was a deliberate choice. I had an e-cigarette laying around and I tried it a few times. I liked the flavor and the satisfaction it gave me [throat hit from nicotine]. In the end I ordered a really nice one because I decided I was going to quit smoking. So yeah, it was a really deliberate choice...’ (#13_e-cigarette user)

Many cigarette smokers and never-users reported that they had not contemplated using e-cigarettes. Deliberation was often limited to brief passive moments when they were confronted with an e-cigarette in their environment (quote 5).

‘One of my friends had one [e-cigarette] and I thought: That might be a way to quit smoking.’ (#14_smoker)

When asked to compare e-cigarette use initiation with cigarette smoking initiation, e-cigarette users and cigarette smokers agreed that cigarette smoking initiation was not a conscious or deliberate choice. Many cigarette smokers expressed they passively discovered themselves to be smokers months or years

after they initiated smoking (quote 6).

'Everybody smoked, so I started too [...] there wasn't a point where I thought: OK, from now on I'm a smoker. All of a sudden, you just are one. Smoking is not a deliberate choice you make, something you really think about.' (#1_smoker)

In general, never-users did not show an interest in e-cigarettes or cigarettes. Pros and cons were not actively deliberated among never-users, but sometimes curiosity was reason enough to passively experiment with e-cigarettes or cigarettes.

Information Need of E-Cigarettes

When asked about their information need, all three groups stated they had several unanswered questions, such as, 'Are e-cigarettes harmful?', 'What are the benefits of e-cigarette use compared to cigarette smoking?', and 'What are the negative long-term health effects of e-cigarette use?'. E-cigarette users, compared to smokers and never-users had more questions about product characteristics, such as 'Are there results of quality tests of e-liquids available?'. Cigarette smokers and never-users wanted to know more about the successful quit attempts with e-cigarettes. They wanted to see a risk-benefit analysis of e-cigarette use versus smoking, and they wanted to know what the average duration of use was for e-cigarette use as a smoking cessation tool. All groups agreed that this information should be communicated to the public to facilitate smoking cessation for cigarette smokers. Many participants explained that there is a large body of information available, but that it is difficult to filter useful and correct information from the internet.

Additional aspects

This section describes additional aspects participants mentioned that played a role in their decision about e-cigarette use.

Risk perception

The risks of e-cigarettes versus cigarettes were discussed. E-cigarette users did not perceive any health risks of e-cigarette use (quote 7).

'So I thought: 'it's just vape. That can't be really harmful for you or your lungs. So if I just vape, and I don't do it every day [...] that won't be so wrong.' (#4_e-cigarette user)

Cigarette smokers stated that although they knew about the common risks of cigarettes, the specifics of how cigarettes cause smoking-related diseases were not clear. They also perceived the health risks of cigarettes as a problem for the

distant future, something to worry about later, when they were older. E-cigarette users tended to deliberate the risks and severity of cigarette smoking related diseases and acknowledged that the risks applied to them as former long-time cigarette smokers (quote 8):

'My grandfather smoked, like me, and you can see his health is getting worse and worse. He suffers from emphysema, I don't want that. So I wanted to quit.' (E-cigarette user_#26)

While never-users were aware of the risks of cigarette smoking, the risks of e-cigarettes were unclear to them. Similar to e-cigarette users, they mentioned that if it is just vape, it did not seem harmful (quote 7). E-cigarette users perceived e-cigarette use compared to cigarette smoking not as a risk, but as a lifestyle (quote 9):

'I often say that besides a hobby it's [e-cigarette use] also a lifestyle.' (#21_e-cigarette user)

Similar to e-cigarette users, cigarette smokers perceived cigarette smoking as an addiction, and they described triggers for the desire to smoke, such as alcohol consumption. Never-users perceived both e-cigarette use and cigarette smoking as addictive behaviors.

Social environment

All groups described the importance of their social environment with regard to e-cigarette use and cigarette smoking. In the initiation of e-cigarette use, the social environment was an important factor for many e-cigarette users (quote 10).

'My mother had one [e-cigarette], so I tried it too.' (#17_e-cigarette user)

Several e-cigarette users further noted that social support for e-cigarette use from their social environment grew after initiation of use, which they described as a sense of belonging to an e-cigarette community (quote 11):

'It's a community [...] Very similar to bikers! You know how they all greet each other on the road? The vaping community is the same.' (#21_e-cigarette user)

In general, participants expressed it was more acceptable to smoke than to use e-cigarettes. While cigarette smokers and never-users categorized e-cigarette use as "weird", cigarette smoking was still considered as acceptable by the several of participants and their social environment. When asked about the role of their social environment in their decision to initiate cigarette smoking compared to switching to e-cigarette use, cigarette smokers expressed that friends who smoked often influenced their decision (quote 12):

'One of my friends told me: 'Try a cigarette!' So I did, and I liked it and I continued smoking.' (#15_smoker)

Cigarette smokers did not describe the influence of friends as pressure, but they did describe the disappointment their parents expressed in response to finding out about their smoking behavior as embarrassing (quote 13):

'I was really afraid to tell my parents that I smoke [...] they were so disappointed.' (#11_smoker)

Never-users viewed e-cigarette use and cigarette smoking not as a social activity, but as peer pressure and addiction, not a choice. Never-users felt strongly about parental disappointment related to cigarette smoking and noted this as a specific reason why they would not start smoking cigarettes or start using e-cigarettes.

Trust in information

Due to the large body of information available about e-cigarettes, it was difficult for participants to make sure the available information is correct. E-cigarette users and cigarette smokers mistrusted evidence-based information, and relied on anecdotal user experiences (quote 14):

'Researchers often don't know what they are doing (#20_e-cigarette user) [...] yes we need to know about the experiences of e-cigarette users.' (#16_e-cigarette user)

Unlike e-cigarette users and cigarette smokers, never-users explained they rather receive scientific information because they trust this information to be true.

Discussion

We explored the decision-making process of e-cigarette use initiation among adult e-cigarette users, adult cigarette smokers, and adolescent never-users. Compared to e-cigarette users, cigarette smokers and never-users did not make a conscious decision to refrain from e-cigarette use. They have acquired different information and have different attitudes. Several of e-cigarette users perceived the risks of cigarette smoking as personally relevant. They acquired information and formed an attitude about e-cigarettes. Finally, their knowledge, attitudes, pros, and cons were deliberated and a conscious decision was made to initiate e-cigarette use. Additionally, lack of information seeking, perception of risk of smoking related diseases, perception of risks and benefits of e-cigarette use compared to cigarette smoking, support to switch to e-cigarettes, a sense of belonging to e-cigarette users, and trust in information offered about e-cigarettes showed to be important factors for a participant in a decision-making process about e-cigarette use.

A possible barrier in the decision-making process is the large body of contradicting information available and lack of trust in scientific evidence. Although e-cigarette users appear knowledgeable, their reported knowledge did not match scientific consensus. We categorized this type of knowledge as beliefs, and these beliefs were primarily based on anecdotal user experiences found online. This finding matches research that shows that experienced e-cigarette users are eager to share their advice and experiences about switching with cigarette smokers.³⁸ Due to these beliefs, e-cigarette users perceived e-cigarettes as harmless. Research has showed that confirmation bias and online information may lead to misperceptions about the safety of e-cigarettes.³⁹⁻⁴² These beliefs and misperceptions about the harmfulness of e-cigarettes may hinder the process of making a conscious and informed decision about e-cigarette use initiation. Thus, there is a clear need for further research on targeted communication strategies to facilitate the conscious deliberation of relevant and evidence-based information about e-cigarette use. These strategies need to highlight advantages and disadvantages of switching to, or refraining from e-cigarette use, and correcting misperceptions about perceived risks and benefits of e-cigarettes.⁴³ This will emphasize the public and individual health benefits of e-cigarette use initiation for cigarette smokers and the disadvantages for never-users.

Cigarette smokers did not contemplate to switch to e-cigarettes, or consciously decide to continue smoking. Our results indicate that though cigarette smokers are aware of the health risks of cigarette smoking, they do not perceive the long-term health risks of smoking as personally relevant. Additionally, they perceive e-cigarettes as weird, smoking as a normal, social behavior,⁴⁴ and, possibly due to their young age ($19.8 (\pm 3.2)$), display an optimism bias about their ability to quit in time before serious health effects occur.^{30,45} This optimism bias greatly diminishes cigarette smokers' interest to acquire knowledge about the benefits and disadvantages of switching to exclusive e-cigarette use, and deliberate these pros and cons of e-cigarette use compared to smoking.^{30,45,46} Low perceived susceptibility and severity of risks associated with cigarette smoking, a lack of knowledge, and a social environment in which e-cigarette use is considered weird and smoking is considered normal or encouraged, hinders smokers to deliberate the pros and cons of switching to e-cigarettes or smoking cessation.

Similar to cigarette smokers, never-users did not actively deliberate e-cigarette use initiation. Adolescent never-users mentioned that if they were to start e-cigarette use, it would be out of curiosity. The risks of e-cigarette use were unclear to never-users, but because it was just vape, e-cigarette use was perceived as harmless. This lack of perceived personal risks of e-cigarette use may diminish the interest to acquire knowledge about the disadvantages of e-cigarette use. Without information seeking and information about advantages and disadvantages of e-cigarette use for never-users, no deliberation can take place.²⁹ A lack of deliberation of the risks associated with e-cigarette use, and curiosity about e-cigarette use may result in a tendency to initiate experimenting

with e-cigarettes among some adolescents. Low perceived risk of e-cigarettes and a lack of knowledge hinder never-users to make a deliberate decision to refrain from e-cigarette use.

This qualitative study shows that cigarette smokers and never-users did not consciously deliberate information about the risks and benefits of e-cigarettes use to make a decision to refrain from e-cigarette use initiation. The differences and similarities in the decision-making process of e-cigarette use among the different user groups raise a question. Namely, can insights into the conscious decision-making process of e-cigarettes users who switched from cigarette to e-cigarettes be used to stimulate cigarette smokers to consciously deliberate something they consider 'weird'? Further research is necessary to investigate how cigarette smokers can be stimulated to consciously deliberate a switch to e-cigarettes.

Because of the explorative nature of this study, the results are not meant to convey generalizability beyond the study population, and thus, these findings are limited to a specific geographic context and time. Respondents were asked to participate in a two-hour discussion, which may have attracted individuals more inclined to talk about cigarette smoking and e-cigarette use. Additionally, we asked e-cigarette users, cigarette smokers, and never-users to consider their decisions about initiation in retrospect, knowledge and attitudes may be different when first faced with the decision. Participants' knowledge, attitudes, and deliberation process might be influenced by their level of education, and living in different areas of the Netherlands. Further research is necessary to explore the impact of education on a decision about e-cigarettes.

Conclusions

To conclude, our exploration of the decision-making process of e-cigarette initiation identifies distinct differences between the decision-making process of current cigarette smokers, e-cigarette users, and never-users. Current e-cigarette users (former smokers) in this study made a conscious decision to switch from cigarettes to e-cigarettes, but current cigarette smokers and never-users did not contemplate or deliberate e-cigarette use initiation. E-cigarettes have a potential public and individual health benefit for cigarette smokers, as switching to exclusive e-cigarette use is less harmful than cigarette smoking. E-cigarette use is not harmless, initiation of e-cigarette use and cigarette smoking should thus be prevented among never-users. Several of the e-cigarette users deliberated personally relevant risks of cigarette smoking, which made them interested in switching to a less harmful alternative. These findings underline the importance to explore the possibility to learn from the decision-making process of e-cigarette users, in order to support cigarettes smokers with their decision about switching to e-cigarettes and never-users with their decision to refrain from e-cigarette use.

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CHAPTER 4

E-liquid flavor preferences and individual factors related to vaping: a survey among Dutch never-users, smokers, dual users, and exclusive vapers

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E-Liquid Flavor Preferences and Individual Factors Related to Vaping: A Survey among Dutch Never-Users, Smokers, Dual Users, and Exclusive Vapers.
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Abstract

Appealing product characteristics, such as flavors, may stimulate e-cigarette use. While switching to e-cigarettes may reduce harm for smokers, concerns exist about e-cigarette use among never-smokers. The role of flavors in the decision to switch to or refrain from vaping is unclear. This study used a bottom-up approach to investigate the relation between flavor preferences and individual factors related to vaping between various user groups. A cross-sectional survey was conducted among never-users ($n = 407$), smokers ($n = 138$), dual users ($n = 122$), and exclusive vapers ($n = 61$) in the Netherlands. Demographics, attractiveness of product characteristics, flavor preferences, and individual factors related to vaping (knowledge, trust, perceived susceptibility, attitude, social influence, deliberation, and intention) were assessed. The availability of different flavors was the most attractive characteristic of e-cigarettes. Dual users and exclusive vapers had most often used tobacco and menthol/mint flavors when they first started vaping. Compared to dual users, exclusive vapers currently used more fruit and sweet flavors. Never-users who were interested in trying an e-liquid flavor had more knowledge about and a more positive attitude towards e-cigarettes. Smokers who were interested in trying a flavor had a more positive attitude towards e-cigarettes and experienced the social influence towards not using e-cigarettes as less strong than those who did not want to try any flavor. Hence, individual factors related to vaping differed depending on whether never-users and smokers wanted to try an e-liquid flavor. This means that flavors may moderate differences found in individual factors related to vaping, or vice versa.

Introduction

Although vaping prevalence in the Netherlands is currently rather low (3%),¹ the use of electronic cigarettes (e-cigarettes) increased worldwide in recent years.^{2,3} The majority of e-cigarette users are former or current smokers⁴⁻⁶ and literature has showed that e-cigarette use (i.e., vaping) may be associated with smoking cessation and reduction.^{7,8} In the Netherlands, e-cigarettes are more often used by daily smokers (12%) compared to non-daily smokers (4%). Worldwide, vaping is also becoming increasingly popular among adolescent non- and never-smokers.^{3,9,10} The regulation of e-cigarettes in order to optimize public health benefits is challenging and is currently an important topic of debate. Compared to cigarette smoking, vaping may reduce harm among smokers,¹¹⁻¹⁴ but literature showed that e-cigarettes contain toxic ingredients.¹¹ In addition, concerns have been raised that vaping may contribute to nicotine addiction and the renormalization of cigarette smoking in adolescent never-smokers.^{3,15-18} Consequently, from a public health perspective, the initiation of vaping by current non- and never-smokers and, thereby, exposure to potentially toxic ingredients should be prevented.¹⁸

Research is needed to better understand differences between the initiation of e-cigarette use by current smokers versus non-smokers in order to inform regulators about policy making regarding e-cigarettes in order to develop targeted health communication for smokers, non-smokers, and e-cigarette users. Previous studies found differences in individual factors related to e-cigarettes among never-users, smokers, dual users, and e-cigarette users.¹⁹ Individual factors that were found to differ included, for example, knowledge, perceived susceptibility, severity, trust, attitudes, deliberation, social influence, and intention.¹⁹⁻²³ Furthermore, literature showed that the importance of product characteristics such as design, price, and flavors may differ between adult smokers and adolescent non-smokers.²⁴⁻²⁷ However, the relation between e-cigarette product characteristics and individual-level factors has been neglected.

A recent study hypothesized that there is an important interplay between individual-level factors and the characteristics of tobacco products.²⁸ Since product characteristics (e.g., flavors, design, and price) influence e-cigarette appeal²⁴⁻²⁷ and may influence a person's attitude towards e-cigarettes,^{24,28} such an interplay may also exist for e-cigarettes. However, thus far, most studies on e-cigarettes focused either on product characteristics,²⁹ or on socio-cognitive factors related to vaping behavior.³⁰ In contrast, researchers in the food and nutrition domain have already recognized the importance of the interaction between product characteristics and individual-level decision-making factors in food choice.³¹⁻³³ For example, a model by Shepherd³¹ shows that food choice is influenced by the interaction between physical or chemical properties of food, such as flavors (product factor), and the individual's perception of and attitude towards those sensory properties (individual-level factors). Furthermore, flavors

and other sensory properties are recognized as by far the most important factors in the acceptance and rejection of food products.³²

Similarly, since e-liquid flavors are recognized as an important reason for e-cigarette use,²⁴ flavors may interact with individual-level factors related to vaping. Moreover, the availability of many different, mostly sweet, e-liquid flavors is an important reason for vaping among different types of users.^{24,29} Research showed that for most e-cigarette users, and in particular for youth, the first and current e-liquid had a flavor other than tobacco.^{26,34,35} In addition, flavors increase the probability of choosing e-cigarettes in an online discrete choice experiment among youth, for both never-users and ever-users of e-cigarettes.³⁶ Therefore, besides investigating product characteristics as reasons for e-cigarette use, additional research is needed to investigate the interaction between flavors as an e-cigarette product characteristic and individual factors related to vaping.

To increase our understanding of differences in e-cigarette appeal between user groups, this study firstly investigates which product characteristics are found attractive by Dutch never-users, smokers, dual users, and exclusive vapers. Secondly, we aim to determine the flavor preferences of Dutch never-users, smokers, dual users, and exclusive vapers. Thirdly, we aim to explore whether eight individual factors related to vaping differ between never-users and smokers who reported to be interested in trying an e-liquid flavor compared to those who reported not to be interested in trying any e-liquid flavor.

Methods

A cross-sectional survey was conducted in the Netherlands among never-users of e-cigarettes and cigarettes, cigarette smokers, dual users of e-cigarettes and cigarettes, and e-cigarette users. The survey was administered in May 2017 through the online survey panel Flycatcher, which is an ISO-certified independent research panel specialized in online research.³⁷ The study was approved by the Medical Ethics Committee of Zuyderland – Zuyd (17-N-88). The recruitment, participant characteristics, and survey were previously described in Romijnders, Pennings, van Osch, de Vries, Talhout³⁸.

Recruitment and Participant Characteristics

In total, 12,750 invitations were sent to panelists who met the following inclusion criteria: being able to understand Dutch; being aware of e-cigarettes; aged 13–17 years (adolescents) or 18 years and older (adults). Sample size was determined based on a power of 80% to identify a minimal difference of 1 on a 7-point Likert scale for attitude (based on previous literature³⁹) as significant at $p < 0.05$. The sample cannot be considered representative of the Dutch population, as oversampling for the smokers and e-cigarette users was

performed in order to achieve sufficient observations. Participants were asked to provide consent before the start of the survey. Parents of panelists under the age of 18 had previously provided consent for participation of their child in research questionnaires. Overall, 1307 surveys were completed, and the response rate was 10.3% (69.7% for adults, $n = 694$; 5.2% for adolescents, $n = 613$). For the current study, respondents were eligible if they met the definition of one of the following user groups (see Appendix 6): never-users are participants who reported to never have smoked and never used an e-cigarette; smokers are participants who reported to currently exclusively use cigarettes on a daily or weekly basis; dual users are participants who reported to currently simultaneously use cigarettes on a daily or weekly basis and e-cigarettes on a daily or weekly basis; vapers are participants who reported to currently exclusively use e-cigarettes on a daily or weekly basis.⁴⁰

It should be noted that these definitions, similar to studies performed before,³⁹ includes individuals who had no history of smoking prior to becoming an exclusive vaper. In addition, and due to the cross-sectional nature of the data, no transitory phases for dual users and exclusive vapers can be determined.⁴⁰ We aimed for mutually exclusive groups. Hence, as the group of exclusive vapers may also include former smokers and the group of exclusive smokers may also include former vapers, former users were not included as a separate group. An overview of the items used to determine whether respondents met our definitions can be found in Appendix 6. In total, 728 participants met the eligibility criteria of this study. Of those, 394 were adults (62.4% female) and 334 were adolescents (46.7% female).

Survey

The current study included measures on basic demographics, attractiveness of e-cigarettes, flavor preferences, and individual factors related to vaping. The survey included routing to ensure that participants were asked about relevant items only (e.g., never-users were not asked which flavor their first e-cigarette had). A full overview of the items and concepts is available in Appendix 6.

First, participants were asked about basic demographics, and smoking and vaping characteristics.^{19,24,40-44} Educational level was determined based on the Dutch version of the International Standard Classification of Education (ISCED).⁴⁵

Second, participants were asked to evaluate the attractiveness of eight product characteristics of e-cigarettes from a predetermined list using a check all that apply (CATA) approach that was based on previous research^{19,24}. For the items that were used to assess demographics and attractiveness of product characteristics, see Appendix 6.

Third, interest in trying an e-liquid flavor (for never-users and smokers), and the first and current e-liquid flavors used (for dual and e-cigarette users) were assessed. For the items that were used to assess flavor preferences, see Appendix 6. To assess flavor interest among never-users and smokers, multiple flavor categories⁴⁶ (CATA) or the option “none of the flavors” were selected. If the latter answer option was selected, no flavor category could be selected simultaneously. E-cigarette users and dual users were asked about their current and first e-liquid flavor used: “Which flavor do you currently use most? If possible, please specify the name of the flavor” and “Which flavor did you try first? If possible, please specify the name of the flavor.” For both current and first flavor used, dual users and e-cigarette users could select only one flavor category⁴⁶ and had to specify their choice through an open question. The answer options for never-users, smokers, dual users and e-cigarette users were: tobacco, menthol/mint, nuts, herbs, spices, coffee/tea, cocktails, alcohol, other, sodas, sweet (chocolate, vanilla, desserts, or other), fruit, milk products, candy, floral, unflavored, and none of the flavors. The closed answer options that were used to assess flavor preference in all user groups were recoded according to the thirteen main categories of the recently published e-liquid flavor wheel,⁴⁷ except for the option “none of the flavors”. Recoding the reported flavor preferences resulted in the in the following thirteen main categories: tobacco (survey item: tobacco), menthol/mint (survey item: menthol/mint), nuts (survey item: nuts), spices (survey items: herbs, spices), coffee/tea (survey items: coffee; tea), alcohol (survey items: alcohol, cocktail; alcohol, other), other beverages (survey items: soda; sweet, other), fruit (survey item: fruit), dessert (survey items: sweet, dessert; milk product), other sweets (survey items: sweet, chocolate; sweet, vanilla), candy (survey items: sweet, candy), other flavors (survey items: floral; other) and unflavored (survey item: unflavored). Open answers from dual and e-cigarette users were assessed by two authors (KR and EK) to support recoding of the closed answers according to the categories of the e-liquid flavor wheel.⁴⁷ In some cases, multiple survey items were associated with one flavor category (e.g., the survey answer options “sweet, chocolate” and “sweet, vanilla” were both recoded to the other sweets flavor category). For equal weight of the flavor categories, each participant could obtain a maximum score of “1” for each flavor category. Thus, participants who reported being interested in both chocolate- and vanilla-flavored e-liquids received a total score of “1” for the other sweets flavor category.

Fourth, individual factors related to vaping were assessed (see Appendix 6 for the items that were used). Evidence-based knowledge about smoking and vaping was measured with 12 statements that were either correct or incorrect. We consider evidence-based knowledge as knowledge that is based on scientific consensus—that is, information provided by the Dutch National Institute of Public Health and the Environment (RIVM) and previous research.^{19,48,49} The knowledge items were summed (1 = correct, 0 = incorrect; ‘I don’t know’ was categorized as incorrect). Furthermore, a 7-point Likert scale was used to assess trust in information (two items),⁵⁰ perceived susceptibility towards e-cigarettes

(three items: item A, item B, item C),^{51,52} severity related to vaping (four items^{51,52}), attitude towards e-cigarettes (four items),^{39,48} social influence (one item),⁵³ deliberation about vaping (three items),⁴⁸ and intention to start using e-cigarettes (one item). A scale was computed for trust in information, severity related to vaping, attitude towards e-cigarettes, and deliberation of the pros and cons of vaping, by averaging the scores of the two items for trust (Cronbach's $\alpha = 0.915$), the four items for severity (Cronbach's $\alpha = 0.639$), the four items of attitude (Cronbach's $\alpha = 0.927$), and the three items for deliberation (Cronbach's $\alpha = 0.656$). No scale could be computed for perceived susceptibility towards e-cigarettes (Cronbach's $\alpha \leq 0.6$)—thus, for each user group, the three mean scores for perceived susceptibility towards e-cigarettes and the three mean scores for perceived susceptibility towards cigarettes (for each individual survey item) were used. Similarly, for each user group, the mean score for each item regarding intention and social influence was determined.

Data Analysis

IBM statistics SPSS version 24 (IBM, Armonk, NY, USA)⁵⁴ was used for data analysis. No data were excluded. Attractiveness of product characteristics, and the e-liquid flavor categories preferred (for never-users and smokers, excluding those who selected the answer option “I don’t want to try any flavor”) and firstly and currently used (for dual and exclusive vapers) were analyzed using frequencies. Flavor preferences were presented in a pie chart as the percentage of the total number of responses.

Spearman correlation analyses showed that age ($p < 0.05$), gender, and level of education (<0.05) were significantly associated with individual factors related to vaping. However, these Spearman correlations were small, ranging from -0.211 to 0.169 . Age, level of education, and gender were therefore excluded from further analyses due to small or non-significant correlations.

Individual factors were compared between both never-users and smokers interested in trying an e-liquid flavor and those not interested in trying a flavor (answer option: “none of the flavors”) using *t*-tests. Results were considered significant if $p < 0.05$.

Results

Of the 728 never-users, smokers, dual users, and exclusive e-cigarette users, 23.7% was highly educated (50.0% low education level and 26.2% middle education level), and the average age was $34.1 (\pm 20.2, \text{min} = 13, \text{max} = 84)$ (see Table 4.1).

Table 4.1 Participants' demographics and the attractiveness of e-cigarette product characteristics. Data are presented for adult and adolescent never-users ($n = 407$), smokers ($n = 138$), dual users ($n = 122$), and exclusive vapers ($n = 61$).

Participants' demographics and the attractiveness of e-cigarette product characteristics		Never-users ($n = 407$)	Smokers ($n = 138$)	Dual users ($n = 122$)	Exclusive vapers ($n = 61$)
Mean age ($\pm$ SD)		31 (18.6) ^D	35 (20.6)	37 (18.8) ^N	37 (19.4)
Gender	Male	44.0%	37.7%	53.3%	49.2%
	Female	56.0%	62.3%	46.7%	50.8%
Education	Low	52.1%	52.9%	43.4%	39.3%
	Middle	20.6% ^{D,E}	30.4%	35.2% ^N	44.3% ^N
	High	27.3%	16.7%	21.3%	16.4%
Attractive characteristics of e-cigarettes (%)	All the different flavors	10.3%	30.4%	34.4%	68.9%
	The product looks nice	6.6%	19.6%	22.1%	44.3%
	The nicotine level can be varied	4.7%	13.8%	15.6%	31.1%
	It is possible to alter the setting of the e-cigarette to my wishes	3.7%	10.9%	12.3%	24.6%
	Its varying designs	3.2%	9.4%	10.7%	21.3%
	You can blow nice smoke clouds with it (cloud chasing)	2.5%	7.2%	8.2%	16.4%
	Price of the product	2.0%	5.8%	6.6%	13.1%
	Price of the e-liquids	2.0%	5.8%	6.6%	13.1%

^{N,D,E} Superscripts indicate significant differences in a row between user groups ($p < 0.05$), with N = never-users, D = dual users, and E = exclusive vapers. Significant differences between user groups were determined for age, gender, and education using Bonferroni post-hoc corrections. General note: due to rounding, percentages may not add up to 100%.

Attractiveness of Product Characteristics

Table 4.1 shows attractiveness of e-cigarette product characteristics, stratified by user group. From the e-cigarette product characteristics assessed, all groups reported flavors as the most attractive.

E-Liquid Flavor Preferences

Of the 407 never-users, 68% selected the option “none of the flavors” ($n = 278$ participants) and 32% selected to be interested in trying one or more e-liquid flavor” and 32% ($n = 248$ responses)). Of the 138 smokers, 20% ($n = 27$ participants) were interested in none of the flavors and 80% ($n = 208$ responses) selected to be interested in trying one or more e-liquid flavor categories.

Figure 4.1 shows e-liquid flavor preferences as the percentage of each flavor category for never-users and smokers. Never-users were mostly interested in trying e-liquid flavors from the menthol/mint (19% of 248 responses) and sweet categories, such as other sweets (19%) and fruit (14%). Smokers were mostly interested in e-liquids with tobacco flavor (30%), followed by menthol/mint (18%) and other sweets (9%).

Of the 122 dual users, 120 reported the flavor of their first e-cigarette used and 121 reported the flavor they currently use (see Figure 4.2). Of the 61 exclusive vapers, 58 reported the flavor of both their first and current e-cigarette. Among dual users, the most frequently reported flavors of their current and first e-cigarette used were similar: tobacco (52% vs. 53%), menthol/mint (26% vs. 27%), other sweets (10% vs. 11%), and fruit (7% vs. 6%). Among exclusive vapers, differences were observed in the most frequently reported flavors of their current and first e-cigarette used: tobacco (43% vs. 53%), menthol/mint (19% vs. 28%), and fruit (14% vs. 9%) and other sweets (14% vs. 7%).

Figure 4.1 Interest in trying e-liquid flavors among never-users (left) and smokers (right). Never-users ($n = 278$; 68%) and smokers ($n = 27$; 20%) who selected the option “none of the flavors” were excluded from this visualization, and hence the pie charts visualize 248 responses from 32% of the never-users and 208 responses from 80% of the smokers. Data are presented as percentages of the total number of responses, not of the total sample sizes.

Figure 4.2 Flavors used on current (top) and first (bottom) e-cigarette exposure among dual (left) and exclusive vapers (right). Participants could select only one flavor category to indicate the flavor of their current and first e-cigarette used. Data are presented as percentages of the total number of responses, not of the total sample sizes.

Individual Factors Related to Vaping

Table 4.2 shows differences in individual factors related to vaping between never-users and smokers. In addition, differences within the groups of never-users and smokers between those who were interested in trying an e-liquid flavor and those who did not want to try any flavor are shown. Never-users who were interested in trying a flavor had significantly less knowledge about e-cigarettes compared to never-users who did not want to try any e-liquid flavor ($p < 0.05$). Not surprisingly, never-users and smokers who were interested in trying a flavor were significantly more positive towards e-cigarettes and had a significant higher intention to start vaping, compared to never users and smokers who reported not wanting to try any e-liquid flavor ($p < 0.05$), within both never-users and smokers. Never-users who were interested in trying a flavor reported a lower perceived susceptibility (item C) than never-users who did not want to try a flavor ($p < 0.05$). In addition, smokers who were interested in trying a flavor considered the social influence towards not using e-cigarettes as less strong, which means

that the smokers who were not interested in trying an e-cigarette flavor more often find that society thinks that one should not vape ($p < 0.05$).

Table 4.2 Individual factors related to vaping. Data are presented for never-users and smokers.

Individual factors related to vaping			Never-users (n = 407)	Smokers (n = 138)
Knowledge about e-cigarettes and cigarettes (±SD)	Overall		9.3 (1.5) *	8.4 (1.8) *
	Those interested in trying a flavor		8.9 (1.7) °	8.4 (1.7)
	Those who did not want to try any flavor		9.4 (1.4) °	8.3 (2.1)
Trust in information (±SD)	Overall		5.2 (1.1)	4.9 (1.4)
	Those interested in trying a flavor		5.2 (1.0)	4.9 (1.4)
	Those who did not want to try any flavor		5.2 (1.4)	5.1 (1.5)
Perceived susceptibility about vaping (±SD)	A	Overall	4.9 (1.3) *	4.3 (1.2) *
		Those interested in trying a flavor	4.8 (1.3)	4.2 (1.2)
		Those who did not want to try any flavor	4.9 (1.3)	4.4 (1.2)
	B	Overall	5.0 (1.2) *	4.3 (1.2) *
		Those interested in trying a flavor	4.8 (1.2)	4.3 (1.2)
		Those who did not want to try any flavor	5.1 (1.2)	4.5 (1.2)
	C	Overall	4.9 (1.2) *	4.3 (1.2) *
		Those interested in trying a flavor	4.8 (1.3) °	4.2 (1.2)
		Those who did not want to try any flavor	5.0 (1.2) °	4.6 (1.2)
Severity of vaping (±SD)	Overall	4.6 (1.1) *	4.4 (1.1) *	
	Those interested in trying a flavor	4.6 (1.1)	4.4 (1.2)	
	Those who did not want to try any flavor	4.6 (1.1)	4.1 (1.1)	
Attitude towards e-cigarettes (±SD)	Overall	2.1 (1.1) *	3.5 (1.1) *	
	Those interested in trying a flavor	2.6 (1.2) °	3.7 (1.0) °	
	Those who did not want to try any flavor	1.9 (1.0) °	2.9 (1.2) °	
Social influence (±SD)	Overall	5.1 (1.7) *	4.4 (1.5) ^N	
	Those interested in trying a flavor	4.9 (1.7)	4.2 (1.5) °	
	Those who did not want to try any flavor	5.2 (1.7)	5.1 (1.2) °	

table continues

Individual factors related to vaping		Never-users (n = 407)	Smokers (n = 138)
Deliberation on the pros and cons of e-cigarette use (±SD)	Overall	2.8 (1.5)	3.0 (1.5)
	Those interested in trying a flavor	2.9 (1.6)	3.1 (1.4)
	Those who did not want to try any flavor	2.7 (1.5)	2.7 (1.7)
Intention to start vaping (±SD)	Overall	1.2 (±0.8) *	2.5 (±1.7) *
	Those interested in trying a flavor	1.4 (1.1) °	2.7 (1.7) °
	Those who did not want to try any flavor	1.1 (0.6) °	1.6 (1.4) °

* Indicates significant differences ($p < 0.05$) in a row between user groups. ° Indicates a within-group significant difference ($p < 0.05$) between those who were interested in trying any e-liquid flavor and those who were not interested in trying any e-liquid flavor (only for never-users and smokers). Knowledge was determined using 12 statements. A higher score represents more knowledge, with 0 = no correct answers and 12 = correct answers for all statements. Trust was assessed with two items, using a 7-point Likert scale; 1 low to 7 = high level of trust in information provided. Perceived susceptibility assessed the chance of developing cancer as a result of vaping with three statements: (A) If I vape, then my risk of developing some form of cancer during my lifetime is...; (B) I think that if I vape, my risk of developing some form of cancer during my lifetime is ...; (C) My feeling is that if I vape, the risk of developing some form of cancer during my lifetime is...; 1 = low to 7 = perception of cognitive risk of health risks related to e-cigarette use. Severity was assessed with four items, on a 7-point Likert scale ranging from very bad to not bad at all (1–7); Attitude was assessed with four items, using a 7-point Likert scale, with 1 = very negative towards e-cigarette use and 7 = very positive towards e-cigarette use. Deliberation was assessed with three items on a 7-point Likert scale, with 1 = no deliberation about E-cigarette use to 7 = very extensive deliberation about E-cigarette use. Intention to start vaping was reported on a 7-point Likert scale, with 1 = very low intention to start vaping and 7 = very high intention to start vaping.

Discussion

This study shows that the availability of different flavors was reported to be the most attractive product characteristic of e-cigarettes by all user groups, and that flavor preferences differ between never-users, smokers, dual users, and exclusive vapers. The first e-cigarette used by dual users and vapers mostly had a tobacco or menthol/mint flavor, but compared to dual users, we observed that exclusive vapers use more sweet- and fruit-flavored e-liquids than dual users. While tobacco was the most appealing flavor category among smokers, never-users were mostly interested in trying menthol- and sweet-flavored e-liquids. In addition, individual factors related to vaping differed within the groups of never-users and smokers. That is, never-users interested in trying a flavor had

less knowledge about cigarettes and e-cigarettes than those who did not want to try any flavor. Attitude was more positive, and intention to start vaping was higher among both never-users and smokers who were interested in trying a flavor compared to those not interested in trying a flavor. Perceived susceptibility of health consequences was lower among never-users who were interested in trying a flavor, and social influence regarding not using e-cigarettes was lower among smokers who were interested in trying a flavor. Thus, similarly to the role of flavors in food choice,^{31,32} our results indicate that interest in flavors may moderate the differences in individual factors related to vaping.

While concerns have been raised about potential e-cigarette use among never-users,^{3,9,55} the never-users in our study had a low intention to start vaping and more than two-third (68%) of the never-users did not want to try any e-liquid flavor. However, nearly one-third of the never-users were still interested in trying an e-liquid flavor. Not surprisingly, they perceived a lower susceptibility towards negative health consequences of vaping, had a more positive attitude towards e-cigarettes, less knowledge about cigarettes and e-cigarettes, and a higher intention to start vaping than never-users who did not want to try any flavor. It should, however, be noted that a causal relation between these findings was not examined. For example, never-users could report to find e-liquid flavors interesting because they were already interested in trying e-cigarettes. On the other hand, they may have become interested in trying e-cigarettes because of the appealing flavors that they recognize from palatable food products. This means that being interested in flavors has a positive effect on the decision to start using e-cigarettes, or vice versa. Nevertheless, our findings regarding the interest of never-users in e-liquid flavors indicate that never-users may be vulnerable to flavor marketing of e-cigarettes.^{26,27,56,57} For example, marketing of appealing e-liquid flavors may make never-users even more positive towards vaping, thereby potentially influencing their choice to initiate or refrain from vaping.¹⁹ This suggests that the reverse can also be true: adapting product characteristics, for example restricting e-liquid flavors or regulating other product characteristics, may reduce attractiveness and consequently make never-users more negative about vaping. Some characteristics of e-liquids are currently regulated by Tobacco Regulation in the Netherlands.^{58,59} However, legislation regarding e-liquid flavors currently does not exist. Further research is needed to help regulators decide whether and how the regulation of e-liquid flavors can improve public health.

This study showed that smokers who were interested in trying an e-liquid flavor had a more positive attitude towards e-cigarettes than smokers who were not interested in trying a flavor. In addition, smokers who were interested in trying a flavor considered the social influence towards not using e-cigarettes as less strong, which means that the smokers who were not interested in trying an e-cigarette flavor more often find that society thinks that one should not vape. Furthermore, two-third of the smokers reported interest in an e-liquid flavor

other than tobacco. This indicates that flavors could support the decision of smokers to switch to vaping,⁵⁷ for example by allowing the marketing of e-liquid flavors and other product characteristics that smokers find attractive.⁴ The role of e-liquid flavors in supporting both the decision to switch towards e-cigarette use (for smokers) and to refrain from using e-cigarettes (for never-users) demonstrates the complexity of developing future regulations on e-liquid flavors.

Additional support for the interest in flavors moderating differences in individual factors related to vaping is provided by the different patterns of e-liquid flavors used by dual users and exclusive vapers. In line with previous research, both groups mostly used tobacco and mint flavored e-cigarettes at initiation, but exclusive vapers currently used more fruit and sweet e-liquid flavors than dual users.^{5,34,60-62} This could be interpreted as vapers switching from tobacco to non-tobacco flavors over time, which is supported by a previous study.⁵ Because most adult exclusive vapers included in this study used e-cigarettes for 1 to 5 years and most dual users reported to vape for only less than 6 months (data not shown), it is possible that the dual users may switch to fruit or sweet e-liquid flavors in the future. Longitudinal research is needed to investigate whether and how e-liquid flavors could support dual users in their decision to switch to exclusive vaping. In addition, it would be interesting to investigate the process of e-liquid flavors (or other product characteristics) eventually not living up to dual users' expectation, thereby leaving them to quit vaping and relapse into exclusive cigarette smoking. This information could be used to, for example, stimulate an exchange of knowledge and experiences between exclusive vapers and dual users about the flavored e-liquids they use.⁶³

Future Research

Previous studies assessing individual factors related to vaping mostly focused their survey items on e-cigarettes in general. This means that participants are typically asked about their mental representation or beliefs of an unspecified e-cigarette, thereby not taking into account that the e-cigarette is a product that is available in various shapes, sizes, colors, flavors, and more. As our results suggest that flavors may moderate the differences in individual factors related to vaping, we recommend using survey items that represent a specific flavor or other product characteristic. For example, instead of only focusing on perceived susceptibility attitude towards e-cigarettes in general,^{64,65} researchers should also assess perceived susceptibility attitudes towards a specific e-liquid flavor categories, such as fruit, candy, and tobacco.⁴⁷

In addition, as other product characteristics may moderate differences found in individual factors related to vaping, the impact of for example price, labeling, and packaging of e-cigarettes and e-liquids on individual factors related to vaping should be investigated in different user groups⁶⁶ to determine which characteristics make up their "ideal" e-cigarette.

Furthermore, it would be interesting to use sensory research to investigate differences in e-liquid flavor liking between user groups, and how this relates to individual factors related to vaping. Finally, research is needed to investigate the interaction between product characteristics and individual factors related to new and emerging products, such as heated tobacco products and products containing nicotine salts. This will provide insight into which specific product characteristics are most appealing to vulnerable user groups, such as never-users and youth, and thus need to be regulated.

Limitations

Ideally, our sample size would be large enough to stratify our sample into different age groups and different flavor categories. However, our sample size was too small to determine differences in the preference of specific flavor categories between age groups (adults vs. adolescents), and differences in individual factors related to vaping between specific flavor categories. In addition, response rates among adolescents was very low, and the rather high education level of participants in this study was not representative of the Dutch population.^{67,68} In addition, the sample cannot be considered representative of the Dutch population, as oversampling for the smokers and e-cigarette users was performed in order to have sufficient observations. As a result, the percentages of smokers and vapers in our study do not reflect the actual percentages of smokers and vapers in the Dutch population.

Conclusions

This study demonstrates that being interested in flavors moderates the differences in individual factors related to vaping for never-users and smokers, or vice versa. While the availability of different flavors was reported to be the most attractive product characteristic of e-cigarettes in all user groups, the specific flavor preferences varied between never-users, smokers, dual users, and exclusive vapers. Importantly, individual factors related to vaping (knowledge, perceived susceptibility attitude, social influence, and intention to start vaping) differed between never-users and/or smokers who were interested in trying an e-liquid flavor and those who did not want to try a flavor. Our results confirm the importance and complexity of regulating e-liquid flavors in a way that both the decision to switch towards vaping (for smokers) and the decision to refrain from vaping (for never-users) are supported. Ideally, regulation should allow marketing of e-liquid flavors that stimulate smokers and dual users to keep or start using e-cigarettes. To make never-users more negative about and keep them from using e-cigarettes, product appeal should be reduced by, for example, restricting the marketing and promotion of e-liquid flavors that they find particularly appealing.

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CHAPTER 5

A Combination of Factors Related to Smoking Behavior, Attractive Product Characteristics, and Socio-Cognitive Factors are Important to Distinguish a Dual User from an Exclusive E-Cigarette User

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Abstract

Although total cessation of nicotine and tobacco products would be most beneficial to improve public health, exclusive e-cigarette use has potential health benefits for smokers compared to cigarette smoking. This study investigated differences between dual users and exclusive e-cigarette users provide information to optimize health communication about smoking and vaping. A cross-sectional survey ($n = 116$) among 80 current, adult dual users and 36 current, adult-exclusive e-cigarette users was conducted in the Netherlands. The questionnaire assessed four clusters of factors: (1) Past and current smoking and vaping behavior, (2) product characteristics used, (3) attractiveness and reasons related to cigarettes and e-cigarettes, and (4) socio-cognitive factors regarding smoking, vaping, and not smoking or vaping. We used random forest—a machine learning algorithm—to identify distinguishing features between dual users and e-cigarette users. We are able to discern a dual user from an exclusive e-cigarette user with 86.2% accuracy based on seven factors: Social ties with other smokers, quantity of tobacco cigarettes smoked in the past (e-cigarette users) or currently (dual users), self-efficacy to not vape and smoke, unattractiveness of cigarettes, attitude towards e-cigarettes, barriers: accessibility of e-cigarettes, and intention to quit vaping (A). This combination of features provides information on how to improve health communication about smoking and vaping.

Introduction

The use of electronic cigarettes (e-cigarettes) has increased worldwide in recent years.^{1,2} The majority of the e-cigarette users are currently former cigarette smokers that either switched completely to e-cigarettes or use e-cigarettes in addition to tobacco cigarettes.²⁻⁷ Concerns exist that e-cigarette use may attract (adolescent) never users, and thus, affect public health adversely, or even lead to dual use and a nicotine addiction.⁸⁻¹⁰ Although never use or total cessation of all nicotine and tobacco products would be most beneficial for all,^{8,11,12} exclusive e-cigarette use—and not dual use of both cigarettes and e-cigarettes, which has an adverse public health effect^{6,8,13}—has potential health benefits for smokers compared to cigarette smoking.¹³⁻¹⁸ However, exclusive e-cigarette use, especially among never-users, is not without risks itself.⁸ Consequently, it is recommended to be prevented among non-smokers.⁸ To improve public health, it is important to optimize health communication about smoking and vaping to the needs of never users, non-current users, exclusive smokers, dual users, and exclusive e-cigarette users. Since dual users and exclusive e-cigarette users are distinct groups,¹³ their information and communication needs are likely different. The present paper aims to increase our understanding of these two distinct groups and provide insight into factors that can be targeted with health communication.

Research has presented several differences between exclusive e-cigarette users and dual users, but the variability in results and definitions used makes it difficult to compare these differences.¹⁹ Review of relevant literature has identified four clusters of differences between dual users and e-cigarette users.^{9,13,19-34} While previous research looked at differences between dual users and exclusive e-cigarette users on an individual factor level or combined two clusters in an analysis, the goal of our study is to provide aggregated data by combining all the clusters of factors identified with machine learning.^{9,13,19-34} First, differences were found in current smoking behavior among dual users or past smoking behavior among e-cigarette users, and current vaping behavior. Research has found that dual users smoked for a longer time (i.e., more pack years) compared to e-cigarette users.^{9,21} Additionally, the number of cigarettes smoked per day increased the likelihood of initiating e-cigarette use,^{9,22} but no differences were found between dual users and e-cigarette users.²³ Smith, Gawron, Balwicki, et al.⁹ have demonstrated that experimenting with e-cigarette use increased over time from 20% in 2011 to 70% in 2016 in Poland, and while rates of exclusive daily smoking declined, rates of exclusive daily vaping increased.

Second, there is variability in differences reported in product characteristics of e-cigarettes used by dual users versus exclusive e-cigarette users. One study reported that dual users were more likely than exclusive e-cigarette users to use nicotine-containing e-liquids.⁹ In comparison, other studies found that nicotine concentration in e-liquids used did not differ between dual users and exclusive

e-cigarette users.^{23,24} Similarly, this variability in reported differences is observed in e-liquid flavors used. While one study found no differences between dual users and e-cigarette users in flavors used,⁹ another study found that tobacco e-liquid flavors were more popular among dual users than e-cigarette users.²⁵ These differences in product characteristics of e-cigarettes used may partly be explained by differences in regulations across countries. In the Netherlands, product characteristics of e-cigarettes, such as maximum levels of nicotine per e-liquid (20mg/ml in the Netherlands), and the maximum volume of e-liquids (10ml in the Netherlands) are regulated through the Tobacco regulation.^{35,36}

Third, differences have been observed in the perceived attractiveness of product characteristics of cigarettes and e-cigarettes.^{19,25-28} Dual users and exclusive e-cigarette users differed in how they perceived the attractiveness of the ability to avoid smoking restrictions with e-cigarettes,²⁹ lower costs of e-cigarettes compared to cigarettes,²⁴ and the variety of e-liquid flavors available.^{19,26} These attractive aspects are a reason to initiate e-cigarette use and may influence a person's attitude towards e-cigarettes.^{32,33} Although attractiveness and reasons related to e-cigarette use have previously been reported to differ between dual users and exclusive e-cigarette users.^{19,21,23} Fourth, socio-cognitive determinants regarding e-cigarette use differed between dual users and exclusive e-cigarette users. Dual users were less positive towards e-cigarettes than exclusive e-cigarette users.^{19,24} In addition, dual users perceived fewer risks of e-cigarettes compared to smoking than exclusive e-cigarette users.²¹ Risk perception differed between dual users and exclusive e-cigarette users.¹⁹ More often, partners, family, friends, and colleagues of e-cigarette users were fellow e-cigarette users.^{24,30} E-cigarette users also had less desire for cigarette smoking than dual users, and they found it easier than dual users not to smoke.^{23,24,30} Furthermore, while some situations triggered dual users to smoke cigarettes, these situations did not trigger exclusive e-cigarette users.^{23,24,34} For example, if dual users experienced stress, were with friends, or had just eaten dinner, they preferred cigarette smoking over vaping.^{23,24,34} Dual users were found to be less motivated to quit cigarette smoking or quit nicotine intake altogether than exclusive e-cigarette users.^{24,25}

While previous research looked at differences between dual users and exclusive e-cigarette users on an individual factor level or combined two clusters in an analysis, the goal of our study is to provide aggregated data^{37,38} from the combined four clusters of factors found in previous research with machine learning.^{9,13,19-34} With machine learning, we are able to provide the most relevant features from a variety and a large number of factors identified in the four clusters. These aggregated data could provide information to support the development and improvement of health communication about e-cigarettes in order to prevent the adverse health effects of dual use. With insight into the most relevant features, health communication may be able to target the differences between dual users and exclusive e-cigarette users to aid dual users who would like to switch to exclusive use in the future, or prevent dual use among exclusive users.

To explore relevant distinguishing features between adult dual users and adult-exclusive e-cigarette users in a cross-sectional survey, the following four clusters were combined with random forest: (1) Past and current smoking and vaping behavior; (2) product characteristics used; (3) attractiveness and reasons related to cigarettes and e-cigarettes; and (4) socio-cognitive factors regarding smoking, vaping, and not smoking or vaping.^{9,13,19-34}

Methods

For the purpose of this study, a cross-sectional survey was conducted among adult (18+), current dual users; and adult (18+), current exclusive e-cigarette users. Adult individuals who currently smoke and use e-cigarettes (i.e., vape) concurrently on a daily or weekly basis, are defined as dual users in the current study.¹³ In contrast, adult individuals who exclusively use e-cigarettes on a daily or weekly basis are defined as exclusive e-cigarette users.¹³ A full overview of the items reflecting all four clusters of factors used can be found in Appendix 6. The study was approved by the Medical Ethics Committee of Zuyderland—Zuyd (17-N-88).

Recruitment

In June 2016, participants were recruited in the Netherlands through an online survey panel (Flycatcher).³⁹ This online panel consists of more than 10,000 Dutch individuals and panel participants, who voluntary and actively opt-in (double-active-opt-in). Every year, panelists are asked to update their information. On average panelists complete eight surveys a year. Twelve thousand seven hundred fifty panelists were sent an invitation by email who met the inclusion criteria (being able to understand Dutch, being aware of e-cigarettes, being 13 years or older (adolescent (13–17 years old) and adults (18+))). The questionnaire was administered online, and participants were asked to provide consent before the start of the survey. With a response rate of 10.3%, 1307 participants completed the survey. To distinguish a dual user from an exclusive e-cigarette user, participants were eligible for our current study if they were adults who met the definition of either a dual user or exclusive e-cigarette user. In total, 116 participants ($n = 80$ adult dual users; $n = 36$ adult-exclusive e-cigarette users) of this subsample met the definition of dual users and exclusive e-cigarette users. User groups were determined with three questions: Type of user: 'I smoke or vape...'; frequency of use: 'How often do you smoke?'; and 'How often do you vape?' (see Appendix 6).

Questionnaire

The current study included measures (see Appendix 6) on basic demographics and the four identified clusters of differences. The questionnaire was only

accessible to Flycatcher panel members with a personalized link. Participants first answered a verification question to make sure that the questionnaire was filled in by the selected participants. All items used were mandatory. Responses were checked on quality by: Time to fill in the questionnaire, consistency in responses, open answer options, and straight lining (e.g. if the same response is chosen in a series of the statement).

Sociodemographic Measures

Sociodemographic measures included age, gender, and education. Educational level was determined based on the Dutch version of the International Standard Classification of Education (ISCED) (see Appendix 6).⁴⁰

Past and Current Smoking and Vaping Behavior

All participants were asked to report their vaping and smoking behavior. These measures included the type of user, lifetime smoking status,⁴¹ frequency of smoking and vaping, duration of smoking and vaping, and several others (see Appendix 6).

Product Characteristics Used

Product characteristics used were investigated by asking about e-liquid flavors used, nicotine concentrations, cigarette brands smoked and several others (see Appendix 6).

Attractiveness and Reasons Related to Cigarettes and E-Cigarettes

Attractiveness and reasons related to cigarette and e-cigarette users were investigated by asking: 'The E-cigarette is attractive because (more than one answer possible)'. Similar, reasons for cigarette use were investigated by asking: 'Which of the following statements applies to you? I smoke/I used to smoke: (More than one answer possible)' (see Appendix 6).

Socio-Cognitive Factors

To investigate socio-cognitive factors related to smoking, vaping, and not smoking and vaping, items were included in triplicate to investigate vaping, smoking behavior and not using e-cigarettes or cigarettes. For example, the attitude was assessed with four semantic-differentials about not smoking or vaping, cigarette smoking, and e-cigarette use by asking if participants thought 'not smoking or vaping was good or bad on a 7-point Likert scale'. To establish scales for attitude, deliberation, trust in information provision, social ties, self-efficacy, and barriers of accessibility of e-cigarettes a reliability analysis was performed to establish scales. If the reliability analysis showed sufficient internal consistency (Cronbach's alpha $\alpha \geq 0.60$), then items were included in a scale. An overview of internal consistency of scales can be found in Appendix 6. Unless otherwise stated, all determinants used a 7-point Likert scale as answer options, such as either 1 equals totally disagree to 7 equals totally agree or semantic-differentials, such as 1 equals really bad to 7 equals really good.

Data Analysis

SPSS data were exported and further preprocessed in Microsoft Excel for statistical data analysis in R statistical software version 3.5.1⁴² using the random Forest package. Descriptive analyses were performed to gain insight into the participant characteristics of the study sample. Chi-square tests and analyses of variance (t-tests) were performed to assess differences in characteristics between dual users and exclusive e-cigarette users.

To determine which aspects were important to distinguish a dual user from an e-cigarette user, analyses were performed using random forest.⁴³ Random forest (RF) is a machine learning algorithm that classifies an outcome (dual use versus e-cigarette use) of an individual using an ensemble of decision trees with predictor variables (including demographics, smoking and vaping behavior, product characteristics, attractiveness and reasons related to cigarettes and e-cigarettes, and socio-cognitive factors). For the RF, a data table with 163 items and concepts (features) for 80 dual users and 36 exclusive e-cigarette users was used. Using 5-fold cross-validation, the data were randomly split into subsets containing approximately the same ratio of dual users and e-cigarette users: In a training set (80% of the data) and test set (20% of the data). In each cross-validation the training set was used to build an RF classifying model consisting of 1000 trees to predict if a participant in the test set is either a dual user or an exclusive e-cigarette user, this was done five times. After the five cross-validation runs, the overall prediction accuracy was calculated. Additionally, RF assessed the relative importance of each prediction variable by determining how much the error increased as a result of random rearrangement of the data for that variable (R settings: Type = 1, scale = TRUE). The resulting variable importance factor (averaged per factor across the five cross-validations) was used to calculate the corresponding *p*-value, which was adjusted to the Benjamini-Hochberg False Discovery Rate (FDR)⁴⁴ to correct for multiple testing. The variables with FDR adjusted *p*-values (FDR < 0.05) were used for a new round of RF classification to confirm the accuracy that could be obtained with these markers.

Results

Participants Characteristics

Of the 116 dual users and exclusive e-cigarette users, 43.1% was male and 56.9% female, 28.4% was highly educated (26.7% low education level, and 44.8% middle education level), and the average age was 49.1 (± 12.5 , min = 21, max = 79). Age did not significantly differ between dual users and exclusive e-cigarette users.

Differences between Dual Users and Exclusive E-Cigarette Users

All differences between dual users and exclusive e-cigarettes on the 163 predictor variables included in our analysis are reported in Appendix 7. Table 5.1 reports the significant differences found between dual users and exclusive e-cigarette users.

Differences in Past and Current Smoking and Vaping Behavior

Significant differences in tobacco and e-cigarette behavior were observed (see table 5.1) between dual users (that currently both smoke and vape) and exclusive e-cigarette users (former smokers that are currently only vaper-only) concerning onset of tobacco smoking, quantity of tobacco cigarettes smoked in their past or current smoking behavior, and lifetime status of tobacco smoking (Fägerstrom index) ($p < 0.05$). All exclusive e-cigarette users smoked more than 100 cigarettes in their lifetime. The onset of smoking was longer ago among e-cigarette users (i.e., more pack years) than dual users. In addition, when they still smoked ($n = 36$, all current e-cigarette users have a history of smoking), exclusive e-cigarette users smoked more cigarettes a day than current dual users smoke at the moment of the survey ($p < 0.05$). No differences were observed in how long dual users and exclusive e-cigarette users have been vaping (i.e., onset of vaping).

Differences in Product Characteristics Used

No significant differences between dual users and exclusive e-cigarette users were observed in product characteristics used, such as current or first used concentrations of nicotine in e-liquids, or e-liquid flavors (see Appendix 7).

Differences in Attractiveness and Reasons Related to Cigarettes and E-Cigarettes

Differences were observed between dual users and exclusive e-cigarette users in the perceived attractiveness of e-cigarettes (see table 5.1). Compared to exclusive e-cigarette users, dual users more often found e-cigarettes to look nice, and the variety of e-liquid flavors appealing ($p < 0.05$). Dual users reported more often than exclusive e-cigarette users that avoiding smoking restrictions and the novelty of e-cigarettes were reasons to vape ($p < 0.05$). For cigarettes, dual users found the flavor of tobacco and the variety of brands to be more attractive than exclusive e-cigarette users ($p < 0.05$). E-cigarette users found the adjustable settings and nicotine concentrations of e-cigarette more attractive than dual users ($p < 0.05$). Compared to dual users, e-cigarette users reported health benefits and e-cigarettes as an alternative for smoking more often as reasons for e-cigarette use ($p < 0.05$). In addition, e-cigarette users found the cigarette to be unattractive more often than dual users ($p < 0.05$). In particular,

they found it unattractive how smokers smell after smoking a cigarette ($p < 0.05$). No differences were observed in unattractive product characteristics of the e-cigarette, such as the design, the e-liquid flavors, or the price.

Differences in Socio-Cognitive Factors

E-cigarette users had a more positive attitude towards e-cigarettes and had a more negative attitude towards smoking compared to dual users ($p < 0.05$) (see table 5.1). Compared to exclusive e-cigarette users, dual users felt more connected—their social ties with smokers were stronger—to other smokers and they more often had a partner, family, friends, and colleagues who smoked (Social influence (f), $p < 0.05$). Dual users had higher levels of deliberation about not smoking or vaping, and although they had a higher intention to quit vaping than exclusive e-cigarette users ($p < 0.05$), their self-efficacy to quit vaping and smoking was lower ($p < 0.05$). Dual users also perceive fewer risks related to smoking compared to e-cigarette users ($p < 0.05$). Significant differences were also found in information-seeking behavior, dual users less often used a Dutch Vape forum as a source of information than exclusive e-cigarette users ($p < 0.05$), and they would like to receive more information about e-liquids than exclusive e-cigarette users ($p < 0.05$). Dual users would find information independent if it was presented under the auspices of the national government ($p < 0.05$). Finally, exclusive e-cigarette users would find information more independent and reliable if researchers report no conflict of interest ($p < 0.05$).

Table 5.1 Significant differences between dual users and exclusive e-cigarette users.

	Dual Users (n = 80)	E-Cigarette Users (n = 636)
(1) Past and current smoking and vaping behavior	n = 80	n = 36
Quantity of tobacco cigarettes smoked in the past (e-cigarette users) or currently (dual users)	Current smoking quantity ^A	Past smoking quantity ^A
< ½ package p. day	16.3%	2.8%
½ – 1 package p. day	63.7%	36.1%
1 package p. day	13.8%	22.2%
> 1 package p. day	6.3%	38.9%
Lifetime status of tobacco smoking		
<100 cigarettes in life	6.30%	0.00%
>100 cigarettes in life	93.70%	100.00%
Onset of tobacco smoking		
<6 months	1.3%	2.8%
6–12 months	1.3%	0.0%
1–5 years	8.8%	0.0%
5–10 years	11.3%	0.0%
>10 years	77.5%	97.2%

table continues

	Dual Users (n = 80)	E-Cigarette Users (n = 636)
Onset of vaping		
<6 months	35.0%	13.9%
6–12 months	20.0%	16.7%
1–5 years	41.3%	61.1%
5–10 years	3.8%	8.3%
(2) Product characteristics used	n = 80	
<i>No significant differences were found</i>		
(3) Attractiveness and reasons related to cigarettes and e-cigarettes	n = 80	n = 36
Attractiveness of e-cigarettes		
The product looks nice	18.8%	5.6%
Due to all the different flavors	46.3%	25.0%
Because it is possible to alter the setting of the E-cigarette to my wishes	20.0%	38.9%
Because the nicotine level can be varied	45.0%	66.7%
Not applicable, I do not find the E-cigarette/vaper attractive	8.8%	0%
Attractive characteristics of cigarettes (yes%)		
The product looks nice	7.5%	0%
Due to all the different flavors	30.0%	11.1%
Because you can smoke different brands	26.3%	5.6%
Not applicable, I do not find the cigarette attractive	28.8%	72.2%
Unattractiveness of cigarettes		
The price of the product	35.0%	58.3%
Because you stink after you have smoked a cigarette	43.8%	66.7%
Reasons for e-cigarette use		
For their health advantages: effects on health, fewer ingredients than a cigarette.	42.25%	72.2%
As an alternative to cigarettes: it is like the smoking or because of the throat hit	28.8%	50.0%
To get around the smoking ban (to be able to vape in places where smoking is normally forbidden).	22.5%	5.6%
To try something new: out of curiosity about new products, different flavors, different apparatus/designs, for pleasure, as a hobby, or because it is cool/trendy/classy.	11.3%	0%

table continues

	Dual Users (n = 80)	E-Cigarette Users (n = 636)
(4) Socio-cognitive factors regarding cigarette use, e-cigarette use, and not smoking or vaping	n = 80	n = 36
Attitude towards e-cigarettes	4.5 (0.8)	5.0(0.8)
Attitude towards smoking	3.5(1.2)	2.7(1.2)
Barrier: accessibility of e-cigarettes	5.2(1.1)	4.8(1.5)
Deliberation not using e-cigarettes and cigarettes	4.5(1.4)	3.9(1.3)
Independency of information: (e)	50.0%	72.2%
Independency of information: (h)	18.8%	5.6%
Information need: (j)	7.9%	0%
Information source used: not applicable	6.3%	0%
Information source used (h)	6.3%	22.2%
Intention to quit vaping A.	3.8(2.0)	2.9(1.8)
Intention to quit vaping B.	3.6(2.4)	2.3(1.8)
Reliability of information (e)	51.3%	75.0%
Risk perception of smoking (cognitive) A	4.7(1.3)	5.3(1.1)
Self-efficacy to not vape or smoke	3.9(1.2)	4.8(1.2)
Social Influence A	4.2(1.7)	3.2(1.6)
Social influence D	33.8%	13.9%
Social influence F	3.6(1.1)	4.1(1.1)
Social Ties with other smokers (n = 79)	3.3(1.1)	2.3(1.2)

Note: Data on are presented as means (SD) or percentages of dual users, and exclusive e-cigarette users. All factors presented here are significant. A complete overview of all included variables in the random forest can be found in [Appendix 6](#). [^] Quantity of tobacco cigarettes smoked in the past or currently displays the current smoking behavior of dual users, and the past smoking behavior of exclusive e-cigarette users before they switched to exclusive e-cigarette use; Independency of information: (e) If the researchers themselves have no vested interest in the results; Independency of information: (h) If the research is under the auspices of the national government, if there is a governmental logo; Information need: (j) I would like more information about the e-liquids available; Information source used: Not applicable: I never search for information; Information source used: (h) Dutch Vape forum or Acvoda (Active for vaping); Intention to quit vaping A. Please indicate on a scale from 1 to 7 your intent to quit vaping in the next 6 months; Intention to quit vaping B. Please indicate which of the statements indicates your intention best; Reliability of information: (e) I find research reliable if the researchers have no conflict of interest to declare; Risk perception of smoking (cognitive) A: If I smoke, then my risk of developing some form of cancer during my lifetime is...; Social Influence A: Society thinks that you should not smoke E-cigarettes; Social influence D: Smoking status partner (% of yes); Social Influence F: How many of your family, friends or colleagues use cigarettes?

Identifying Unique Factors that Discriminate Dual User from an Exclusive E-Cigarette User

Random forest analysis on dual use versus e-cigarette use identified 7 of the 163 factors as contributing significantly to the prediction accuracy (FDR 5%). Together, these seven factors allowed for 86.2% prediction accuracy. Figure 5.1 shows the 25 highest-ranking relevant distinguishing features, with the top seven significant factors after adjusting for multiple testing. The seven most relevant factors to distinguish a dual user from an exclusive e-cigarette user are (FDR 5%): Social ties with other smokers, quantity of tobacco cigarettes smoked in the past (e-cigarette users) or currently (dual users), self-efficacy to not vape and smoke, unattractiveness of cigarettes, attitude towards e-cigarettes, barriers: accessibility of e-cigarettes, and intention to quit vaping (A) (see table 5.1 for significant differences between dual users and exclusive e-cigarette use).

Figure 5.1. Top twenty-five factors to distinguish between dual users and e-cigarette users. Bar lengths indicate the variable importance factors, the seven significant (FDR 5%) factors are shown in dark gray.

Discussion

We used random forest—a machine learning algorithm—to identify important and unique distinguishing features between dual users and exclusive e-cigarette users. Based on the random forest, adult, current dual users and adult, current exclusive e-cigarette users can be distinguished from each other with 86.2% accuracy based on three out of four included clusters of factors: Current and past smoking behavior, unattractiveness of cigarette product characteristics, and socio-cognitive factors regarding smoking, vaping, and not smoking and vaping. Similar to previous research,^{9,23,24} our random forest analysis found no distinguishing features between dual users and exclusive e-cigarette users in product characteristics used.

First, regarding current and past smoking behavior, previous research found that dual users reduce the number of cigarettes smoked a day.^{25,45} Our findings also indicate that adult, current dual users ($n = 80$) currently smoked fewer cigarettes a day than e-cigarette users did in the past, when they were cigarette smokers ($n = 36$).^{25,45} Research found that the number of cigarettes smoked per day increased the likelihood of initiating e-cigarette use,^{9,22} the reduced level of current smoking quantity a day among dual users may hint at a transitory phase of switching completely to exclusive e-cigarette use.⁴⁶ Similar to PATH⁴⁷ studies in the US, longitudinal research in the Netherlands is needed to investigate transitory phases of smoking and vaping to increase our understanding of dual use and exclusive e-cigarette use.

Second, exclusive e-cigarette users found cigarettes more unattractive than dual users. This unattractive aspect of cigarettes was a distinguishing feature between dual users and exclusive e-cigarette users. Further research is necessary to understand if increasing the unattractiveness of cigarettes might facilitate smokers—including dual users—to switch to exclusive e-cigarette use. Additionally, similarly to earlier results, dual users found the variety of e-liquid flavors available an attractive characteristic of both e-cigarettes and cigarettes, which is similar to earlier results, and they more often than exclusive e-cigarette users vape to avoid smoking restrictions.^{19,25-29} Consequently, research is needed to gain insight into attractive aspects of e-cigarettes and unattractive aspects of cigarettes for smokers and dual users to identify factors that health communication can target. By targeting the identified distinguishing factors, health communication strategies can stress the pros of e-cigarettes and the cons of cigarettes for smokers and dual users. Furthermore, research into attractive and unattractive aspects of cigarettes and e-cigarettes is needed among never smokers and vapers to target preventive health communication strategies at vulnerable non-smokers and non-vapers.^{19,24,30}

Third, in contrast with previous research,²³ our results show that various socio-cognitive factors are important to distinguish a dual user from an exclusive

e-cigarette user. Dual users experienced more social ties with other smokers than exclusive e-cigarette users, and contrary to dual users, exclusive e-cigarette users had higher levels of perceived self-efficacy to not smoke or vape.^{30,34} In addition, dual users had a more negative attitude towards e-cigarettes than exclusive e-cigarette users, which is supported by previous research.²⁴ Lastly, dual users, more often than exclusive e-cigarette users, had a partner who smoked. These factors could be targeted with health communication to aid smokers and dual users who want to switch to exclusive e-cigarette use or quit smoking.

Finally, the results from our random forest analysis provide insight into factors that had a unique contribution in distinguishing the dual users from exclusive e-cigarette users, which may have a practical implication for the improvement of health communication about smoking and vaping. Further research is needed to test effective communication strategies that target these factors to prevent the adverse health effects of dual use. The seven features provide a first insight into the most relevant features that health communication may be able to target to aid dual users who would like to switch to exclusive use in the future, or prevent dual use among exclusive users. Health communication strategies that stress the pros of e-cigarettes for cigarette smokers; that provide tools on how to cope with the pressure of a social environment to smoke cigarettes; and that provide tools on how to better cope with not smoking cigarettes to increase motivation to fully switch from cigarettes to e-cigarettes should be tested. Factors that can be targeted in health communication could focus on supporting smoking cessation among smokers and dual users by managing outcome expectancies of e-cigarette use compared to cigarette smoking, improving social ties of smokers and dual users with exclusive e-cigarette users,^{24,30,34} making cigarettes seem less attractive,⁴⁸ strengthening positive attitudes towards e-cigarettes as a smoking cessation tool with inoculation messages and build resistance for a pro-smoking social environment of smokers and dual users,⁴⁹ and providing guidance in the deliberation process of smoking cessation.⁵⁰

Limitations

To ensure one-time smokers or exclusive e-cigarette users were excluded in our analysis, the subset of dual users and exclusive e-cigarette users was relatively small, but sufficient in size for classification by methods, such as random forest. Due to our small sample, further research is needed to investigate the generalizability of the features found in the current study. In addition, due to the cross-sectional study design, no causal conclusions can be drawn on the most relevant distinguishing features. Selection bias may have occurred, as an online panel was used, which include individuals who are motivated to fill in questionnaires.

Conclusions

This study combined factors from four different research angles into a single machine learning analysis to identify the most relevant distinguishing features for discerning a dual user from an exclusive e-cigarette user. Our results demonstrate that it is a combination of features from three clusters that discern a dual user from an exclusive e-cigarette user: Current and past smoking behavior, the unattractiveness of cigarette product characteristics, and socio-cognitive factors regarding smoking and vaping. This particular combination provides new and relevant information regarding the differences between dual users and e-cigarettes users that can be applied to develop improved health communication targeted to prevent adverse health effects related to dual use.

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PART 2

CHAPTER 6

A deliberate choice? Exploring factors related to informed decision-making about childhood vaccination among acceptors, refusers, and partial acceptors

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A deliberate choice? Exploring factors related to informed decision-making about childhood vaccination among acceptors, refusers, and partial acceptors.
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Abstract

In light of the decline in childhood vaccination coverage, the question rises concerning what factors play a role in informed decision-making about childhood vaccination. Insight into factors related to this decision helps us to support parents' informed decision-making about childhood vaccination. We conducted 12 semi-structured focus group interviews across the Netherlands based on the definition of informed decision-making: three with acceptors, three with refusers, and six with partial acceptors to ask about knowledge, attitudes, deliberation, and information needs. We performed a thematic analysis of the transcripts. Acceptors viewed the decision to participate in the National Immunization Program (NIP) as self-evident. Refusers and partial acceptors, however, reported extensively deliberating the pros and cons of accepting or refusing the NIP in much detail. Their answers indicated that their knowledge was not always evidence-based. In addition, refusers and partial acceptors perceived fewer risks of vaccine-preventable diseases (VPDs), more risks of side-effects of vaccines, less social support from their environment, and less trust in child welfare centers (CWCs) and information provided than acceptors. We observed distinct differences in factors related to decision-making about childhood vaccination between acceptors, refusers, and partial acceptors. Acceptors may perceive accepting childhood vaccinations as self-evident, refusers may rely mostly on anecdotal information rather than evidence-based information to weigh up the pros and cons of side-effects of vaccines and the VPDs, and partial acceptors may elaborately deliberate the pros and cons of each vaccine and VPD individually, which was time-consuming, and difficult. To strengthen and support decision-making among parents, more elaborate dialogues are needed between Child Vaccine Providers (CVPs) and parents. These discussions could also build trust between parents and CVPs, discuss the evidence-based advantages of childhood vaccinations, and decrease parents' susceptibility to anecdotal information and misperceptions about childhood vaccinations shared by parents.

Introduction

Childhood vaccinations are very successful interventions to protect against vaccine-preventable diseases (VPDs).¹⁻⁴ In the Netherlands, the National Immunization Program (NIP) offers vaccinations free of charge and on a voluntary basis.⁵ Nowadays within the NIP, vaccinations are offered against 12 childhood diseases (i.e., polio, diphtheria, tetanus, pertussis, rubella, measles, mumps, disease caused by *Haemophilus influenzae* type b, meningococcal ACWY disease, hepatitis B, pneumococcal disease and cervical cancer caused by human papillomavirus (HPV)).⁵ In recent years, vaccination coverage has declined in various countries, including the Netherlands (from 95.4% in 2014 to 92.6% in 2018, for DTaP-IPV vaccination estimated for two-year-olds).^{5,6} Due to this decline, the question arises of whether this is an informed decision and how their decision could be supported or strengthened.

In recent years, informed decision-making has gained more attention in the context of childhood vaccination.² Often, research classifies decisions as informed when decision-makers have relevant *knowledge* about the subject and the decision reflects the *attitudes* of the decision-maker.⁷ In behavior theories, an informed decision is defined as informed when also the consequences are *deliberated*, and the pros and cons are considered in-depth.⁸ Lehmann, de Melker, Timmermans, Mollema² quantified how many parents accepting and refusing vaccinations made an informed decision about accepting childhood vaccinations. They found that refusers made a more informed decision about childhood vaccination than acceptors. While refusers elaborately deliberated the decision, acceptors had more evidence-based knowledge about vaccinations. In addition to knowledge, values, and deliberation, research has revealed additional important factors related to the decision about accepting childhood vaccinations. For example, risk perception, positive beliefs about the effectiveness and safety of vaccines, anticipated regret about VPDs and side-effects, trust in the NIP and information about the NIP, decisional conflict, positive social environment towards accepting the NIP, and low perceived barriers, such as vaccinations being free of charge^{2,8-15}. Research has focused on decision-making about accepting vaccinations among parents^{2,16,17}, but insight into whether parents also consider other options, such as refusing or partially accepting vaccinations is lacking. This may yield important information on how to support parents in making an informed decision about childhood vaccinations, and how supporting informed decision-making may reduce decisional conflict and vaccine hesitancy,¹⁸⁻²⁰ positively affect intention to accept childhood vaccinations, and thus, the vaccination coverage.²¹

Consequently, this qualitative study explores similarities and differences in factors related to decision-making about childhood vaccination among parents who accept (acceptors), refuse (refusers), or partially accept (partial acceptors) childhood vaccinations with regard to accepting, refusing, or partially accepting childhood vaccinations. We examined whether acceptors, refusers, and partial

acceptors have similar knowledge and attitudes about childhood vaccinations, and how they evaluated the pros and cons of accepting, refusing, and partially accepting childhood vaccinations.

Methods

To explore differences in factors related to informed decision-making of acceptors, refusers, and partial acceptors, we set up three focus groups with acceptors, three with refusers, and six with partial acceptors (three with parents are delaying vaccinations and three with parents who are refusing some vaccinations. As no new themes emerged in the last of the three focus group sessions, it was deemed that saturation was reached. Eligibility was determined based on the age of their child (two years old, born in 2013 and 2014, see table 6.1). We chose to include the age of the child as an eligibility criterion to be able to classify parents of these children in the three groups: acceptors, refusers, and partial acceptors, based on their decision at the time of the focus groups about five vaccination moments (child is approximately two years old)). These five vaccinations moments were chosen to limit recall bias, and to make sure that parents made a conscious decision not to vaccinate, rather than through circumstances, such as sickness. Focus group discussions were chosen to stimulate an interactive discussion among peers.^{22,23} This study was approved by the Medical Ethics Committee of Zuyderland – Zuyd (16-N-84).

Recruitment

We invited 300 acceptors, 399 refusers, and 464 partial acceptors. Participants were randomly selected within each group from Praeventis, the individual vaccination database in the Netherlands of the RIVM. Possible participants received an invitation. Three large municipalities were selected from various parts of the Netherlands to promote a diverse selection of participants. The invitees received a letter of invitation containing the goal and procedure of the study. We did not differentiate between mothers and fathers, but only one parent from the same household could participate in a focus group. The parents could choose themselves which of the two would participate. Interested parents could register by following a link to an online registration form; a registration number was used to access the registration form. This number was checked for duplicates, so only one parent from the same household was included in the study. We asked about age, gender, level of education, availability, and contact information of parents. The final selection of participants for focus groups was based on the parents' availability and vaccination status of the child to ensure an open discussion among parents. Age, gender, and level of education were used to reduce selection bias. Education level was determined based on the Dutch version of the international standard classification of education (ISCED).²⁴ Parents received an e-mail containing information on the date, time, and place of the focus group

from the first author. All parents were also contacted by phone by the first author to ensure participation. Of the total of 1163 invited parents, we received 197 applications (109 (55%) acceptors, 32 (16%) refusers, 56 (29%) partial acceptors). A complete overview of participant characteristics is reported in Appendix 8.

Table 6.1 Definitions of acceptors, refusers, and partial acceptors

Parental group	Definition
Acceptors	Acceptors are parents (at least one of whom was born in the Netherlands) of children born in 2013 or 2014, who received all vaccinations scheduled according to the Dutch NIP.
Refusers	Refusers are parents (at least one of whom was born in the Netherlands) of children born in 2013 or 2014 who received none of the vaccinations scheduled according to the Dutch NIP.
Partial acceptors	Parents who partially accept childhood vaccinations are parents (at least one of whom was born in the Netherlands) who refuse or delay some vaccines of children born in 2013 or 2014. For example, some of these children did not receive any PCV ^a , but received four doses of DTaP-IPV-Hib-HBV ^a vaccines; or they did not receive four doses of DTaP-IPV-Hib-HBV ^a vaccines but did receive three doses of PCV ^a vaccine; or their first DTaP-IPV-Hib-HBV ^a vaccine was delayed more than four months.

Note: childhood vaccination status was determined by reported vaccination status for DTaP-IPV-Hib-HBV, PCV, MenC, BMR vaccination status in the Dutch Praeventis status for vaccination uptake reporting. ^a D = Diphtheria, HBV = Hepatitis B, Hib = Hib disease, M = Measles, Men C = Meningococcal disease type C, B = Mumps, PCV = Pneumococcal disease, IPV = Polio, R = Rubella, T = Tetanus, aP = Whooping cough

Procedure

The focus group sessions were conducted between February 13, 2017 and March 2, 2017 at convenient locations in three large cities across the Netherlands. Written informed consent was obtained before the start of the session, and after participation the parents received a 30 euro incentive. The number of participants per focus group varied between two and eight but on average a focus group consisted of five parents, and a session lasted approximately two hours. A semi-structured protocol based on the definition of informed decision-making⁸ with open-ended questions was used to ensure minimal steering from the moderator and to allow participants to discuss all relevant subjects.²⁵ All focus group sessions were audio recorded, and flipcharts were used so that participants could visualize the topics that had been discussed.

The topic list of this protocol was developed according to the definition of

informed decision-making of van den Berg, Timmermans, ten Kate, van Vugt, van der Wal ⁸ and previous research conducted by Lehmann, de Melker, Timmermans, Mollema ² to investigate decision-making. A pilot focus group session was conducted with colleagues to test the topic list, after which the topic list was revised. The revised and final topic list was used during all focus group sessions, but specific phrasings of questions were adapted to fit specific groups (Appendix 9).

The first author (K.A.G.J.R. a female, academic behavioral scientist) moderated all focus group sessions, but the observers varied between authors: SS, MS, and LM. The focus group session started with a general introduction, and an opening question asking about participants' *knowledge* of childhood vaccination, using a mind map to visualize the topics mentioned for participants. In the second part of the session, participants were asked about their *attitude* and positive and negative aspects towards accepting, refusing, and partially accepting childhood vaccination. Participants were asked to provide individual positive and negative aspects that might have influenced their decision, on Post-its. These were shared in the group after everybody had time to consider their answers. *Deliberation and Information needs* were explored by discussing to what extent participants considered all risks and benefits of accepting, refusing, or partially accepting childhood vaccinations, and their need and understanding of information. The semi-structured protocol with open-ended questions allowed participants to discuss additional aspects related to their decision-making with each other.

Analysis

All focus groups were audio recorded and anonymously transcribed using transcription software F4.²⁶ All observers kept field notes, and these were used during the transcription of the focus group session and to add context to a transcript. For example, if one participant made a comment and another participant was vigorously shaking his or her head in disagreement, this was noted in the transcript, or during the mind map exercise; if a participant walked in late for a session, this was reported in the transcript.

The focus group transcripts were thematically analyzed using Nvivo 9^{23,27} to identify factors that appeared to be related to decision-making about childhood vaccination. The qualitative data analyses consisted of four phases. In the first phase, two observers (SS and MS) and the first author deduced relevant themes and subthemes from a random selection of the transcript of the first focus group (acceptors), and discussed and improved these with the first and last authors.^{2,8} Second, the observers SS and MS used these relevant themes and subthemes to develop a coding list. They then used this list to code another random selection of the transcript of the first focus group and explore possible additional relevant codes. After this, the first author and two observers discussed the code list, and the initial coding of a section of the first focus group transcript. Third, the two

observers independently coded the entire transcript of the first focus group to look for additional codes, using the improved code list. The first author also coded this transcript to check for additional relevant codes. The coding list was discussed among the observers and the first author to resolve any differences and to add additional codes to create a final coding taxonomy. In the fourth and final phases, the final coding taxonomy was used to code the transcripts individually by KR, SS, and MS. The first author checked two additional transcripts of two other focus groups (refusers and partial acceptors) to ensure the coding taxonomy was used accordingly and checked for additional relevant codes; in this phase, no new codes were deemed necessary.²⁸ Examples of the final coding taxonomy are: anticipated regret regarding infectious diseases, beliefs about the importance of herd immunity, beliefs about the competence of the immune system of their child, Child Welfare Center, source of information, knowledge, and trust in competence of the CVP.

Results

We set up three focus groups with acceptors (n=19), three with refusers (n=12), and six with partial acceptors (n=24), of which three with parents delaying vaccinations and three with parents refusing some vaccinations. Since no clear differences were found between parents who delay some vaccinations and parents who reject some vaccinations, we discuss the findings of these parents as one group. Of the 55 participants, 75% were female and 25% were male, with an average age of 39 years (± 5.7 , min=27, max =58), 96% of the participants were highly educated (i.e. university education) (Appendix 9). Because of the explorative and qualitative nature of this study, the results are not intended to be generalized beyond the study population.²⁹

Knowledge about childhood vaccination

When asked to talk about what they knew about childhood vaccination, most parents were able to mention some facts. For example, they shared facts about the NIP schedule, inclusion of combination vaccines in the NIP, the tasks of the CWCs, the high vaccination coverage in the Netherlands, low risk for susceptibility of VPDs in the Netherlands, differences in vaccination schedules between the Netherlands and other European countries, religious reasons parents may have to refuse childhood vaccinations, and the importance of herd immunity. While acceptors were able to report most evidence-based information about childhood vaccination during a mind mapping exercise, they expressed the most doubts about being well-informed when asked how informed they felt. Refusers and partial acceptors reported different information based on studies and anecdotal evidence acquired on, for example, vaccine-critical websites and social media. When asked about how informed they felt, they stated that they felt very informed (quote 1):

My knowledge of vaccines and immunization is high... I think that some of these diseases are really good for the development of a child, as part of their natural development. I know that there are studies that show that the hand-eye coordination of a child improves after they got sick [from a VPD]. ... I really think that by experiencing diseases [VPDs] you'll be stronger later in life. (quote 1 – #49_refuser)

Refusers mainly shared justifications based on knowledge that was discordant with scientific consensus, and rather referred to anecdotal evidence they acquired from vaccine-critical websites and social media (quote 2).

Herd immunity is based on a lie. Herd immunity doesn't exist! It's all got to do with hygiene, that's why all the VPDs have disappeared. (quote 2 – #49_refuser)

Attitudes about childhood vaccination

Parents shared their thoughts, both positive and negative, on childhood vaccination. The overall attitude of acceptors and partial acceptors was positive towards vaccinations (quote 3).

Vaccines are one of the best inventions ever! (quote 3 – #37_partial acceptors)

Most acceptors mentioned that they did not just perceive individual benefits, but they also perceived aiding the herd immunity with childhood vaccinations as a great public benefit (quote 4).

The public benefit of vaccination is a really important aspect for me. (quote 4 – #21_acceptor)

Acceptors were mostly negative towards refusing vaccinations, except for the vaccine against hepatitis B. Acceptors noted that they did not see the added benefit of the recently added hepatitis B vaccination (quote 5) (note: hepatitis B vaccination was introduced in the Netherlands in 2011):

This is one vaccine that makes me wonder: 'do we really need it?' We didn't receive this vaccine growing up, but because there are risk groups, all our children have to receive Hepatitis B in a cocktail...? (quote 5 – #23_acceptor)

Partial acceptors consciously assessed the pros and cons of accepting or refusing each individual vaccination, and were therefore not outspokenly negative or positive. Refusers were mostly negative about the NIP and vaccinations. They discussed negative aspects about the Dutch NIP and vaccines, such as the perceived early start of vaccinations, the lack of possibility to discuss alternatives

and doubts with people in their social environment or with CVPs, the rigidity of a standardized schedule, the lack of transparency of the NIP, combination vaccines, and the perceived mandatory nature of the NIP.

Deliberation about childhood vaccination

During the focus group sessions, parents were asked to discuss deliberating childhood vaccinations. Most acceptors reported not giving the pros and cons of childhood vaccinations much thought, but when asked about their perceived pros and cons, all were able to share theirs. This lack of deliberation was not perceived as negative, since acceptors viewed childhood vaccination not as a choice but as self-evident. They mentioned that there is not much thought needed to deliberate the pros of childhood vaccination (quote 6).

For us, childhood vaccination is really self-evident. It's not that I didn't think about alternatives, I knew you could decide to delay vaccines. But I considered it self-evident, why would the NIP exist if it wasn't good...? (quote 6 – #26_acceptor)

Compared to acceptors, refusers and partial acceptors did deliberate the pros and cons of childhood vaccinations. Refusers and partial acceptors deliberated the pros and cons of the VPDs *versus* side-effects of vaccines. They also consciously deliberated the pros and cons of accepting or refusing each individual vaccination. They mentioned that this was an elaborate, time-consuming, and difficult process. They explained it was difficult to find trustworthy information and that they did not feel supported in their decision-making. When asked how deliberate they perceived their decision, refusers and partial acceptors reported to have made a very deliberate choice. When asked how they had made a deliberate choice, parents explained (quote 7):

You look at the pros and cons for each disease, plus... I like statistics. So I look at the diseases and at the statistical risks of the disease. You read about vaccinations in general, those pros and cons you consider as well. We looked at each disease separately, what is the story behind the vaccine... then you make a decision. (quote 7 – #51_refuser)

Information need about childhood vaccination

When asked about their information needs, parents stated that several of their questions remained unanswered. They reported concerns about contradictory information being available, which they find difficult to navigate. Most parents in this study mentioned that when they asked their CVPs about the contradicting information they received no or unsatisfactory answers, such as childhood vaccinations are safe. Most parents explained they wanted to know why vaccinations were safe or why vaccinations worked (quote 8):

Childhood vaccination is really a diabolical dilemma... do we know what it does to you? What is going into my child? (quote 8 – #6_acceptor)

Most parents agreed that the information provision about the NIP was currently inadequate (brochures and CVPs). They mentioned that the tone of voice of information about the NIP by CVPs is patronizing, which made parents feel that they were perceived as stupid and bad parents (quote 9).

We need to start open discussions and not just a one-way flow of information from the government or health professionals: 'you are just a stupid citizen and you should listen and follow our advice'. We ARE equal and we want an open dialogue. (quote 9 – #34_partial acceptor)

Refusers and partial acceptors noted that information about symptoms and case fatality rates of the VPDs was lacking. They also reported that information about the consequences of their choice about childhood vaccinations, for example how they should act if their child shows symptoms of one of the VPDs, was not available. Acceptors and partial acceptors realized that their search for information about childhood immunization is influenced by their beliefs and that they will search for information that confirms their initial opinions.

Additional factors related to decision-making about childhood vaccination

Risk perception: severity and susceptibility of VPDs and side-effects of vaccines

Both the severity and susceptibility of VPDs and side-effects of vaccines were expressed as being influential in the decision to accept, refuse, or partially accept vaccines. Acceptors perceived the severity and susceptibility of the VPDs as great, which increased their anticipated regret should they not accept all childhood vaccinations. Unlike acceptors, partial acceptors and refusers perceived the risks of alleged side-effects of vaccines as great. For example, epilepsy, lactose intolerance, and an underdeveloped immune system were mentioned. They also mentioned other strategies to boost the immune system of their child (quote 10):

Delaying the NIP was a deliberate choice because I was breastfeeding my child. Her immune system would strengthen through me, through breastfeeding... (quote 10 – #16 partial acceptor)

Neither refusers nor partial acceptors perceived all VPDs as being a risk. These parents mentioned that experiencing a disease would aid the development of their child (quote 1). Among refusers and partial acceptors, the severity and susceptibility of each VPD was debated separately (quote 11).

It really depends on the type of disease [VPD]. I'm thinking, really... how likely is it he or she will get polio? The risk is so small, that's why I was comfortable with my decision to refuse this vaccine. (quote 11 – #13_partial acceptor)

In the end, acceptors and partial acceptors described the anticipated regret of the risk of a VPD as being a decisive factor in their decision about childhood vaccination (quote 12):

You would just never forgive yourself if your child would get sick... that's why you vaccinate your child. The risk is too great. (quote 12 – #39 partial acceptor)

Norms in parents' social environment towards childhood vaccination

The importance of norms in their social environment often recurred as a factor related to decision-making about childhood vaccination. Acceptors stated that their decision was confirmed by a strong social norm expressed by friends, parents, and the CWC, which reinforced their decision to accept vaccinations. Acceptors explained that they and society perceive the refusal of vaccination as being negative or the wrong choice, describing it as selfish. Refusers and partial acceptors felt criticized by the same social norm in society, and among friends and family for their decision (quote 13), since the majority of society perceived accepting childhood vaccination as self-evident (quote 6).

The debate makes me very uncomfortable... You enter a war zone as soon as you mention you refused the NIP, I didn't tell my family... I just didn't feel like starting a war with them (quote 13 – #11_refuser)

Refusers and partial acceptors stated that their social environment changed due to their choice; for example, they no longer had the same friends.

Trust in information provision

Due to the tone of voice of the information (brochure and information from CVPs) about the NIP, many participating parents experienced a lack of trust in this information (quote 14):

The information brochure of the NIP is presented so black and white, and blunt, that I start mistrusting it... (quote 14 – #23_acceptor)

Lack of trust was related to one-sided information provided, and parents concluded that trustworthy information would discuss both pros and cons of childhood vaccination and would appeal to a variety of parents.

Trust and confidence in child vaccine providers

Most participating parents lack confidence in the knowledge of CVPs at CWCs

about childhood vaccinations and their skills to address their doubts about childhood vaccinations. When asked what they would like to change about the CWC, they all stated that they needed room for a dialogue in which parents and CVPs are equal, without a condescending tone of voice. In particular, the lack of time CVPs took to discuss childhood vaccinations was perceived as negative, and the tone of voice of the CVPs was experienced as haughty. Some refusers or partial acceptors even mentioned that the latter was a reason to refuse or partially accept vaccinations (quote 15).

I wanted to discuss childhood vaccination, but that was not possible... they just didn't want to discuss it with me. At the time, I was still trying to decide what to do; it was not my intention to refuse... (quote 15 – #28_refuser)

Discussion

We explored whether Dutch parents made an informed decision about childhood vaccination and factors related to informed decision-making about accepting, refusing, or partially accepting childhood vaccination. Our qualitative study was based on the definition of informed decision-making⁸ and assessed factors associated with the ongoing assessment phase of parents' informed decision-making.¹⁷ Knowledge, attitudes, and deliberation differed among parents. Acceptors perceived accepting childhood vaccinations as self-evident, refusers relied mostly on anecdotal information rather than evidence-based information to weigh up the pros and cons of side-effects of vaccines and the VPDs, and partial acceptors described an elaborate, time-consuming, and difficult deliberation to weigh up the pros and cons of each vaccine and VPD individually. In line with previous research,^{2,8,9,11-15,30-34} besides knowledge, attitudes, and deliberation, other factors were reported in relation to informed decision-making. For example, all participating parents mentioned their information needs about childhood vaccination in general and about vaccine safety, a need for a supportive social environment, and a strong social norm to vaccinate their children. While acceptors trusted the information provided, refusers and partial acceptors considered that there was a lack of open dialogue with CVPs, one-sided information provision about the NIP, and lack of trust in the CWC. While acceptors reported the severity and susceptibility about VPDs and anticipated regret about their child getting sick from a VPD when not vaccinating as factors related to decision-making, refusers and partial acceptors mentioned side-effects of vaccines.

Acceptors could recall more evidence-based information about the NIP than refusers and partial acceptors; they were negative about refusing childhood vaccinations and positive about the NIP. Although previous research indicates that acceptors tend to be uninformed,¹⁷ and acceptors in our study felt uninformed, we found that they were able to provide more evidence-based information than

other parent groups. Acceptors strongly believed that childhood vaccination is an action that benefits not only their child (individual benefit), but also herd immunity (societal benefit) and they described a positive and strong social norm in place regarding this belief, which is confirmed by Brunson¹⁷. This strong social norm was also perceived by refusers and partial acceptors, but they perceived this norm as judgmental.³⁵ Overall, acceptors did not perceive uptake of childhood vaccinations as a choice which needs much deliberation because they considered it as self-evident, and this finding is confirmed by previous research.^{2,36}

All participating parents mentioned inadequate information provision, stating that the mere response of 'vaccines are safe' is not satisfactory. Similar to refusers and partial acceptors, acceptors perceived this type of information provided by the CWC as condescending. This may also be why acceptors did not feel informed. Stimulating an open dialogue between parents and CVPs may increase parents' feeling of being informed^{30,35,37-39}. The lack of discussion with CVPs, the perception that childhood vaccination is self-evident, and the patronizing tone of voice of CVPs may leave parents vulnerable for anti-vaccination messages about alleged risks and side-effects of childhood vaccination.^{30-34,39-41} As suggested by Benin, Wisler-Scher, Colson, Shapiro, Holmboe³⁷, attitudes towards childhood vaccination are continuously developing and shifting. Therefore, it is important to strengthen existing positive attitudes about childhood vaccination and build resistance for future anti-vaccination messages, as well as to discuss the arguments and anecdotal evidence used on anti-vaccination websites.⁴²

Refusers may base their arguments against vaccination mainly on anecdotal evidence and were negative about childhood vaccinations in general. They indicated that they had consciously deliberated the pros, but mostly the cons of participating in the NIP, and some mentioned that they did not know about alternative vaccination schedules at the time of decision-making. Compared to acceptors, refusers may believe that the risks of vaccine side-effects are more severe than the risks of VPDs, and that they do not trust the information about the NIP offered by CVPs. Refusers mostly preferred to acquire anecdotal evidence from vaccine-critical websites and social media platforms, such as Facebook®. They reported searching and gathering information supporting anti-vaccination arguments.^{43,44} In addition, using search engines to gather information about childhood vaccination leads to selection bias due to previously used search terms and the ranking of websites by search engines.⁴⁵

Partial acceptors may elaborately deliberate the pros and cons of each vaccine and VPD individually, which resulted in a feeling of decisional conflict regarding the benefits and risks of vaccines *versus* the perceived benefits and risks of experiencing VPDs. Some parents lost their trust in the competence of CVPs when their questions were ignored, or when the CVPs were not able to answer their questions. Because their questions remained unanswered, their decisional conflict increased.^{17,18} This feeling of decisional conflict may lead parents to

search for anti-vaccination arguments and diminishes the positive attitude of parents about childhood vaccination. In addition, partial acceptors described a lack of social support from friends, family, and CVPs with regard to their choice to partially accept childhood vaccinations. Research shows that decisional conflict and lack of discussion between parents and CVPs at the CWC influences the information seeking behavior of parents navigating anti-vaccination websites.^{39,41} In an open discussion among CVPs and parents, inoculation messages about childhood vaccination can strengthen existing positive attitudes and build resistance for anti-vaccination messages.⁴² These messages are similar to a vaccination, parents could be trained to resist attacks on their positive beliefs about childhood vaccination by practicing their response to anti-vaccination messages.⁴²

Finally, many participants expressed the need for more information about childhood vaccination.³⁰⁻³⁴ This information need was not met by the CVPs. Refusers and partial acceptors mentioned that they accessed vaccine-critical websites because their questions are ignored by CVPs. Furthermore, they view the current information provision as insufficient, and they distrust the information provision about the NIP. All groups agree that the tone of voice of CVPs at the CWC is condescending. The inadequate information provision and condescending tone of voice do not meet the information needs of parents, and our research confirms findings from Benin, Wisler-Scher, Colson, Shapiro, Holmboe³⁷ indicating that this leads to a lack of trust among parents regarding CVPs and CWCs. Our results demonstrate that merely disseminating evidence-based knowledge does not lead to a trusting relationship between parents and the CVP. Research found that some CVPs find it difficult to discuss alternative vaccination decisions with parents.^{46,47} CVPs need to have knowledge about the NIP, time, and skills to discuss childhood vaccinations with all parents³⁷. In particular, it is important to not exclude parents refusing or partially accepting childhood vaccination. In this way, evidence-based information can be exchanged, misperceptions and doubts can be addressed, positive attitudes can be strengthened, questions can be answered, and the various options for childhood vaccination can be discussed. To increase factual knowledge about childhood vaccination and facilitate discussion skills among CVPs to build trusting relationships with parents, the Dutch public health institute developed an e-learning tool, and funds were made available by the government to reduce time constraints to discuss childhood vaccination with parents in 2017-2018.⁴⁸ The e-learning tool was adopted by over one thousand CVPs in 2017.⁹ While further research and monitoring is needed to evaluate the implementation, adoption, and effectiveness of this tool, these changes and measures may stimulate an open dialogue, increase informed decision-making, reduce decisional conflict, and increase trust between parents and CVP professionals.^{10,48,49}

Application and further research

To gain more insight into which factors played a role in informed decision-making about childhood vaccination among acceptors, refusers, and partial acceptors, population surveys are necessary. The outcome of such quantification can be used to support informed decision-making on the part of parents about childhood vaccination.

Acceptors, refusers, and partial acceptors agree that the information provision is currently not sufficient. Refusers and partial acceptors would like more information on consequences of and susceptibility to VPDs and possible side-effects of childhood vaccinations. Such information is a potential measure to counter anti-vaccination messages, and to increase informed decision-making about childhood vaccinations.^{3,11,37,44,50} Betsch, Renkewitz, Haase⁴³ showed that numeric information, in combination with narratives about the susceptibility to VPDs and side-effects of vaccines had the greatest impact on parents' risk perception towards childhood vaccination. Further research is necessary to test how a combination of numeric risk communication and narratives can inform parents about the low level of individual susceptibility of VPDs, which may have severe consequences; and the greater individual susceptibility of side-effects after a childhood vaccination, which are mild, pass quickly, and have no lasting effects.^{3,34,38,39,41,43} The information on risk communication and narratives can be used in a communication approach of CVPs at the CWC to answer the questions of parents in detail and thus build a trustworthy relationship. In addition, our results show that while parents accepting childhood vaccinations are not interested in refusing or partially refusing childhood vaccinations, refusers and partial acceptors are highly interested in elaborate information about various vaccination options. Refusers appeared to be interested in hearing more about partially accepting childhood vaccination instead of refusing the NIP. Compared to refusing childhood vaccinations, there are more health benefits associated with partially accepting the NIP. Still, accepting all childhood vaccinations yields the most individual and public health benefits for children, so the possible adverse effects of informing parents – such as acceptors switching to refusers or partial acceptors – need to be prevented. Further research is necessary to investigate the individual and public health effect of informing parents about these options of childhood vaccinations.

Strengths and limitations

This study explored whether parents make an informed decision, and factors related to the decision about childhood vaccination (e.g. accepting, refusing, or partially accepting), by examining parents' knowledge, attitude, and deliberation, and additional factors concerning accepting, refusing, and partially accepting childhood vaccinations. There are several limitations in this study.²² Selection bias may have occurred. Respondents were asked to participate in a two-hour

discussion, which may have attracted individuals more inclined to talk about childhood vaccination. In addition, 96% of the persons in our sample were highly educated, and this percentage is not a reflection of the Dutch population. We drew a randomly selected sample within each municipality, but mainly higher educated parents responded to our invitation. We suggest that further research consciously includes other segments of the population, and that differences between low and higher educated parents should be investigated. Because of the overrepresentation of higher educated parents, and the explorative and qualitative nature of this study, the results are not able to be generalized to Dutch parents.²⁹

We asked parents to consider their decision in retrospect, thereby possibly introducing recall bias. However, children were not older than two years old and the last vaccinations for which parents had made a decision was no later than ten months prior to the focus group sessions. Even though the moderator followed rigorous training for focus groups, interviewer bias may be a factor. There was one moderator to standardize a possible bias, and the moderator took measures to remain as neutral as possible in dress, tone, and body language.

Conclusion

To conclude, our exploration of informed decision-making and factors related to decision-making about childhood vaccination identifies distinct differences in knowledge, attitudes, and deliberation of parents. The findings can facilitate informed decision-making among parents by promoting an open dialogue at the CWC, and improving the type and form of information presented. An open dialogue between parents and CVPs may increase deliberation among parents, strengthen positive attitudes, prevent misperceptions, and resolve decisional conflict.

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CHAPTER 7

Deciding on childhood vaccination:
differences in decisional conflict and
determinants between parents who
accepted, refused, and partially
accepted childhood vaccination

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PART 3

CHAPTER 8

Exploring differences in knowledge,
attitude, and deliberation:
an illustration of next to best health
decisions in the cases of childhood
vaccination and smoking behavior

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CHAPTER 9

General Discussion

Every day we make decisions about our own health and the health of others, for example, when a parent makes a decision about childhood vaccination. When making health-related decisions, there can be different options to choose from. Public health professionals often inform the public about an option they recommend based on scientific evidence. However, this healthiest, recommended option might not be suitable for everyone, due to their personal values, priorities with regard to health, experiences, opinions, and the norms of their social environment. Consequently, in these cases people may choose options that match their individual values and goals but that are considered by public health professionals to be, for example, *next to best*. From a public health and scientific point of view, next to best health options are less harmful or less healthy than the unrecommended health option, but not less harmful or less healthy compared to the recommended health option. Another option people may choose is the unrecommended option, which is considered as being unhealthy by public health experts and science.

Not smoking, and accepting childhood vaccination are both choice options that are recommended by public health experts since they promote health.¹⁻⁸ Whether people consider that the advantages of these recommended choice options outweigh those of alternative choice options depends on their values, preferences, experiences, and social environment.⁹⁻¹⁶ In this thesis we explored two examples of decisions we identified as a next to best health decision: e-cigarette use and partially accepting childhood vaccinations. To expand our understanding of these next to best health decisions, we had two aims. First, we aimed to examine determinants that influence the decision about smoking behavior and childhood vaccination, both qualitatively and quantitatively. Second, we examined the extent to which decisions regarding smoking behavior and childhood vaccination adhere to the criteria of informed decision-making. With the insights into the factors related to the decision and whether the decisions adhered to the criteria of informed decision-making, we are able to better facilitate and support decision-making about smoking behavior and childhood vaccination. In this thesis, we used the three criteria knowledge, attitude, and deliberation of informed decision-making of van den Berg, Timmermans, ten Kate, van Vugt, van der Wal¹⁷ to investigate how people made a decision about the recommended, unrecommended, and next to best health option. We defined a decision as being informed if the decision-maker has relevant evidence-based knowledge about the subject, has an attitude towards the subject that reflects his or her choice (i.e. the choice is value-consistent), and has deliberated all options.¹⁷⁻²³ This definition of informed decision-making is based on a Rational Decision model, which reflects a rational style in decision-making with an emphasis on thorough and logical processing.^{24,25} It is important to investigate the criteria of informed decision-making because supporting informed decision-making may reduce decisional conflict, and reducing decisional conflict may support decision-making.²⁶⁻²⁸ With regard to smoking behavior, increasing informed decision-making about smoking cessation and lowering decisional

conflict regarding smoking cessation may support smokers in their efforts to quit smoking.²⁹ With regard to childhood vaccination, increasing informed decision-making and decreasing decisional conflict may reduce vaccine hesitancy³⁰⁻³² and it may positively affect intention to accept childhood vaccinations, and therefore also positively affect the vaccination coverage.³³ According to the Elaboration Likelihood Model³⁴, people can make a decision through two types of routes: the central route or the peripheral route.³⁴ To make an informed decision, it is important that people use the central route of processing. Central processing could lead to decisions that are less vulnerable to unobjective information,^{35,36} or decisional regret²⁷ and result in a higher level of sticking to a healthy choice.³⁴ With the studies described in this thesis, we aimed to increase our understanding of the next to best health decisions in order to improve health communication and support decision-making. **Part 1** of this thesis provided an exploration of factors related to the decision about never-use, smoking, and e-cigarette use. **Part 2** explored factors related to the decision about accepting, refusing, and partially accepting childhood vaccination, and decisional conflict experienced by parents with regard to their decision to accept, refuse, or partially accept childhood vaccinations. **Part 3** operationalized the criteria of informed decision-making¹⁷ about smoking behavior and childhood vaccination. As such, it provides insights into the extent to which recommended, unrecommended, and next to best health decisions adhere to the criteria of an informed decision. To conclude this thesis, the current chapter summarizes the main findings and discusses the conclusions and implications of these findings for research, health communication, and policy.

Main findings

Part 1 Exploring the decision about never-use, smoking, and e-cigarette use

In *part 1*, we focused on determinants that are related to the decision regarding never-use, smoking, and e-cigarette use (*first aim of this thesis*). Our systematic narrative review of *chapter 2* about reasons and perceptions regarding e-cigarettes among never-users, smokers, and e-cigarette users (i.e. both dual users of cigarettes and e-cigarettes, as well as exclusive e-cigarette users) showed that e-cigarette users perceived e-cigarettes as being less harmful than cigarettes. Different reasons and benefits were reported by never-users, smokers, dual users, and e-cigarette users. Reasons and benefits of e-cigarettes reported by never-users were the novelty of the product and its potential to aid their concentration. Smokers mentioned that it mimics the smoking routine, whereas dual users reported benefits of avoiding smoking restrictions. E-cigarette users reported benefits of increased athletic performance and that e-cigarettes are discrete to use. In addition to these reported individual benefits, several benefits were mentioned for the social environment of a user, such as that e-cigarette use

is safer for bystanders and that there is less environmental pollution.

Chapter 3 described – through qualitative analysis – determinants reported by never-users, smokers, and e-cigarette users in relation to the decision concerning smoking behavior and e-cigarette use. Besides knowledge, attitudes, and deliberation, these were perception of risks and benefits of e-cigarettes compared to cigarettes, influence of the social environment concerning e-cigarette use, and trust in information about the risks and benefits of e-cigarettes from the government. Additionally, we found that e-cigarette users used user experiences (i.e. a vape forum) as their main source of information about e-cigarette use and they reported that switching from cigarettes to e-cigarettes was a deliberate decision. Results from the qualitative exploration of *chapter 3* also revealed that e-cigarette users, compared to never-users and smokers, reported anecdotal information found on e-cigarette users fora, perceived few risks of e-cigarettes compared to cigarettes, reported a sense of community and support with and by other users. Never-users and smokers perceived e-cigarettes as being less harmful than cigarette smoking, which we also found in our narrative literature review (*chapter 2*).

A limitation of many studies looking at determinants is that they do not take into account the attractiveness of e-cigarette product characteristics. However, e-liquid flavors were reported to be an important reason to use e-cigarettes in *chapter 2*. Hence, the role of product characteristics and, in particular, e-liquid flavors regarding e-cigarette use was explored in depth in *chapter 4*. Our results – from a quantitative analysis described in *chapter 4* – demonstrated that menthol/mint and sweet e-liquid flavors were reported to be preferred by never-users. Tobacco and menthol/mint e-liquid flavors were preferred by smokers and dual users, and sweet and fruit flavors were preferred by e-cigarette users compared to other flavor categories.

Finally, our exploration of differences – through quantitative analysis – between dual users and exclusive e-cigarette users in *chapter 5* identified seven distinguishing features, namely: compared to exclusive e-cigarette users, dual users felt more connected with other smokers (i.e. their social ties with smokers were stronger), exclusive e-cigarette users smoked more in the past than dual users do in the present, self-efficacy to quit vaping and smoking was lower among dual users, e-cigarette users found the cigarette to be unattractive more often than dual users, e-cigarette users had more positive attitudes towards vaping than dual users, dual users perceived more barriers to accessing e-cigarettes, and finally, dual users had a higher intention to quit vaping than e-cigarette users.

Part 2 Exploring the decision about childhood vaccination

In *part 2* we focused on factors related to the decision about accepting, refusing, and partially accepting childhood vaccinations (*first aim of this thesis*). *Chapter*

6 of this dissertation explored – through a qualitative study – the decision regarding childhood vaccination among parents who accepted, refused, and partially accepted childhood vaccination. Our findings demonstrated that partial acceptors mentioned perceiving few risks of vaccine-preventable diseases (VPDs), risks of side effects of vaccines, low social support from their environment, low trust in Child Welfare Centers (CWCs), and information provided from these CWCs.

Chapter 7 described the results of a quantitative analysis on determinants and decisional conflict related to decision-making among acceptors, refusers, and partial acceptors. Overall, trust in the National Immunization Program (NIP) was high among acceptors but moderate among refusers and partial acceptors. Acceptors perceived the susceptibility of side effects of vaccines as being lower compared to the susceptibility of VPDs if you refuse (some) vaccines. Refusers and partial acceptors perceived the susceptibility of side effects of vaccines as being higher compared to the VPDs. While anticipated regret towards negative consequences of VPDs was high among acceptors when considering refusing childhood vaccinations, anticipated regret among refusers and partial acceptors with regard to potential side effects for the child was high when considering accepting vaccines. All parents reported a social norm favoring accepting childhood vaccinations. Partial acceptors experienced more barriers with regard to vaccination than refusers and acceptors. On the decisional conflict scale, acceptors scored highest on uninformed, refusers scored highest on unsupported, and partial acceptors scored highest on uncertainty.

Part 3 Exploring knowledge, attitudes, and deliberation

In *chapter 8* we examined to what extent decisions about smoking behavior and childhood vaccination adhere to the criteria of informed decision-making (*second goal of this thesis*). Our results showed that never-users and acceptors both had relatively low levels of deliberation. In addition, our findings indicate that cognitive beliefs of refusers and partial acceptors are not in accordance with scientific evidence about childhood vaccination. Partial acceptors scored in-between refusers and acceptors on knowledge, scores on attitudes, and deliberation with regard to accepting, refusing, and partially accepting childhood vaccination. In contrast, vaccine refusers had deliberated their decision thoroughly, smokers were found to report low levels of deliberation. Smokers and e-cigarette users were most positive about not smoking or using e-cigarettes, and acceptors, refusers, and partial acceptors were most positive towards their own behavior.

Reflection on main findings

Exploring smoking behavior and childhood vaccination

This thesis is structured around the exploration of the next to best health decisions regarding smoking behavior and childhood vaccinations. To expand our understanding of these next to best health decisions, we first reflect on the criteria of informed decision-making, such as knowledge and cognitive beliefs, attitudes, and deliberation and the extent to which these decisions about smoking behavior and childhood vaccination adhered to the criteria of informed decision-making. Second, we reflect on additional factors related to the decisions about smoking behavior and childhood vaccinations, such as perceived susceptibility and severity, trust in information, anticipated regret, social support, and self-efficacy.

Knowledge and cognitive beliefs

This thesis indicates that those who opted for the recommended option (i.e. never-users and vaccine acceptors) had higher levels of knowledge about smoking behavior and childhood vaccinations, respectively, than those choosing unrecommended and next to best health options (e.g. smokers, e-cigarette use, vaccine refusers and partial acceptors). Other studies also found that never-users and vaccine acceptors had high levels of knowledge about smoking and childhood vaccinations, respectively.^{5,37,38} With regard to the unrecommended option (i.e. smokers and vaccine refusers) and next to best choice (i.e. e-cigarette users and partial acceptors) option, our results demonstrated that although smokers and e-cigarette users, as well as refusers and partial acceptors, stated that they were familiar with the common health risks of smoking or refusing childhood vaccinations, respectively (*chapters 3 – 8*), the level of evidence-based knowledge among those who chose the unrecommended and next to best health options was low. These findings are in line with studies reporting low levels of knowledge among smokers in the United States,^{38,39} Canada, the United Kingdom, and Australia.³⁹ In addition, findings from a previous study among vaccine refusers and partial acceptors also showed low levels of knowledge among these groups.⁵ To the best of our knowledge, no such previous findings with regard to low or high levels of knowledge about e-cigarettes could be identified among e-cigarette users.

Even though our results showed low levels of evidence-based knowledge among those choosing the unrecommended and next to best options, *chapter 3* and *chapter 7* demonstrated that e-cigarette users, vaccine refusers, and partial acceptors felt very informed. Interestingly, no such findings could be identified in previous research. A possible explanation may be that e-cigarette users, vaccine refusers, and partial acceptors all reported extensively searching for information with regard to their decision. However, e-cigarette users, vaccine refusers, and partial acceptors – but not necessarily smokers – mainly shared

justifications based on information that was discordant with scientific consensus in our qualitative studies (*chapters 3 and 6*), and these findings were confirmed in our quantitative studies (*chapter 8*). This information may lead to or stimulate cognitive beliefs – found in *chapters 3, 6, and 8* – that are not in accordance with scientific evidence, which has been reported in previous literature.⁴⁰⁻⁴² In addition, their information-seeking behavior, such as using non-scientific sources rather than searching for scientific information, may confirm their cognitive beliefs or decision. Examples of such non-scientific sources could be user experiences, vaccine-critical websites, or social media^{9,43-50} where parents share experiences with childhood vaccinations.^{9,51-56} This phenomenon of looking for information to confirm a decision taken is also called bolstering: the reinforcement of a chosen option over the alternatives by selective information-seeking and processing. Janis and Mann⁵⁷ have suggested that bolstering may facilitate arriving at a decision or occur after a decision has been made. In the latter case, refusers or partial acceptors, for example, would look for information that reinforces their chosen option over accepting vaccinations, and will therefore for instance use vaccine-critical websites.⁵⁸ Among smokers specifically, an explanation for low levels of evidence-based knowledge might be found in the cognitive dissonance theory of Festinger⁵⁹. Their actions – smoking – may be in conflict with their scientifically correct knowledge about smoking behavior, causing cognitive dissonance.^{9,60} This conflict between their smoking behavior and their knowledge of the health risks of smoking may lead them to rely on cognitive beliefs that are in line with their behavior and decision, which might be why they answer the knowledge statements incorrectly.

Attitude

We identified attitudes about all three health options among those who chose for the recommended, unrecommended, and next to best health options. Those who opted for the recommended health option were most positive towards their own decision, and not outspokenly negative or positive towards the next to best health option. Those who opted for the next to best health decisions reported most positive attitudes towards their own behavior. In addition, e-cigarette users were not outspokenly negative or positive towards not smoking and not using e-cigarettes (i.e. never-use), but outspokenly negative towards smoking (*chapters 3, 4 and 8*). Partial acceptors on the other hand were not outspokenly negative or positive towards accepting or refusing childhood vaccinations (*chapters 6, and 8*). Although positive attitudes among partial acceptors towards accepting childhood vaccination have been identified before,⁵ to the best of our knowledge no such findings could be identified about attitudes towards the unrecommended or next to best health options. The not outspoken negative or positive attitudes towards accepting, refusing, and partially accepting childhood vaccinations among parents who partially accepted childhood vaccinations may indicate an ambivalence with regard to their decision.⁶¹ In addition, with regard to those who chose the unrecommended option, our findings suggest that while vaccine refusers were very positive towards their own choice – which is in line with

previous research⁵ – smokers were negative towards smoking. Previous research confirmed that smokers are often negative towards their own behavior,⁶² and findings of the ITC Netherlands National Report⁶³ revealed that Dutch smokers had a negative opinion about their own behavior. A possible explanation is cognitive dissonance related to smoking. In this case their knowledge about the health consequences of smoking is in conflict with their behavior, causing negative attitudes and dissonance.^{9,60}

Deliberation

Deliberation about smoking behavior and childhood vaccination was highest among those who opted for the next to best health option. Research previously identified high levels of consideration among partial acceptors and e-cigarette users.^{5,64}

With regard to the next to best health option, e-cigarette users consciously deliberated initiation of e-cigarette use *versus* continuation of cigarette smoking by using knowledge acquired and by weighing the benefits of e-cigarette use and disadvantages of cigarette smoking (*chapters 3 and 8*). Partial acceptors deliberated accepting, refusing, and partially accepting childhood vaccinations (*chapter 8*). Our findings from *chapters 6, 7, and 8* suggest that partial acceptors made a decision about each vaccine offered to them separately, and not an overall decision to partially accept childhood vaccinations. They – as well as vaccine refusers – described an elaborate, time-consuming, and complex deliberation process (*chapter 6*).

With regard to the recommended health option, never-users and vaccine acceptors reported giving their decision little thought. Vaccine acceptors specified this was not perceived as negative because they viewed their decision about childhood vaccination as self-evident. Since the current vaccination coverage is high (90%), but is decreasing⁶⁵, it could be argued that low levels of deliberation among parents accepting all the childhood vaccination is not a problem.⁶⁵ However, parents who are not making a deliberate decision might be vulnerable for negative messages about their decision,⁹ and it is therefore important that they understand why they decided for the recommended option and deliberate this decision in order to build resilience.⁶⁶ Deliberation about e-cigarette use was relatively low among smokers compared to levels of deliberation about childhood vaccinations among refusers. A possible explanation of low levels of deliberation among smokers about a less harmful alternative may be provided by their nicotine addiction, which may make it difficult for them to consider an alternative to smoking.⁶⁷⁻⁶⁹

Exploring informed decision-making

This thesis described the differences and similarities found in knowledge, attitude, and deliberation. Overall, those who opted for the recommended health option lacked deliberation about their decision. Those who opted for the unrecommended or next to best health options had low levels of knowledge. In addition, smokers did not deliberate much and were relatively negative with regard to their own behavior. With regard to the second goal of this thesis, the findings of *chapters 2 – 6, and 8* show that in our studies, the decisions about smoking behavior and childhood vaccination did not adhere to at least one of the criteria of the definition of an informed decision. Although similarities were found in the three criteria of informed decision-making for the recommended, unrecommended, and next to best health options, there are differences in the context of these exemplary cases.

With regard to the two different contexts in which these decisions are made, several aspects could be considered. Smoking is an addictive behavior, which may make it difficult to make an informed decision about smoking cessation or switching to e-cigarettes.⁶⁷⁻⁶⁹ In our studies too, smokers lacked evidence-based knowledge, had relatively negative attitudes towards their own behavior, had relatively low levels of deliberation regarding smoking, e-cigarette use, or not smoking or using e-cigarettes. Vaccination decisions were not characterized by addictive features. Another possible explanation of the lack of commonalities in these unrecommended decisions may be that smokers are confronted with the health consequences of smoking by health warnings, pictorial warnings, or stories about sick smokers on a daily basis, for example, when they buy a pack of cigarettes.⁷⁰⁻⁷³ Vaccine refusers, compared to smokers, are not often confronted with the possible health consequences of their decision about childhood vaccination due to the herd immunity realized by the high vaccination coverage. Furthermore, parents are invited to actively make a decision about childhood vaccination for their child through a letter of invitation and an information brochure.^{74,75} Although there is no invitation for never-users to actively decide about *not* initiating cigarettes or e-cigarettes, never-users and vaccine acceptors both had high levels of evidence-based knowledge, positive attitudes towards their own decision, and low levels of deliberation. The findings of our thesis suggest that although there is no invitation for never-users to deliberate their decision, similar factors, such as high levels of evidence-based knowledge, trust in evidence-based information, positive attitudes towards the recommended option, perceptions of high susceptibility and severity of consequences of the unrecommended and next to best health options, and positive social norms about the recommended options play a role in the decision about the recommended health option in general. Both never-users and vaccine acceptors might be vulnerable for negative messages about their decision,⁹ and it is therefore important that they understand why they decided on the recommended option and deliberate this decision in order to build resilience.⁶⁶ The following section

describes additional factors that may be related to informed decision-making.

Additional factors related to decision-making about smoking behavior and childhood vaccination

Perceived susceptibility and severity

Our findings and previous research^{6,76} suggest that for those who opted for the unrecommended or next to best health options, perceived susceptibility and severity were reported to be in relation to their decisions (*chapters 2 – 7*), which is in line with previous research about the unrecommended option.^{43,44,46,66,76-119} With regard to the next to best health options, our findings suggest that partial acceptors, similar to vaccine refusers, do not perceive the susceptibility and severity of VPDs as being as high as the susceptibility and severity of side effects of vaccines. Previous studies have shown that the greater perceived susceptibility and severity of possible side effects versus the lower perceived susceptibility and severity of VPDs influenced decisions about accepting or refusing childhood vaccination.^{66,77-87} The perceived susceptibility and severity of side effects of vaccines and VPDs if a parent had partially accepted vaccines was not previously investigated. A possible explanation for the perceived higher risks of side effects versus the risks of a VPD among vaccine refusers and partial acceptors might be the cognitive beliefs of vaccine refusers and partial acceptors.^{51,120-122} For example, cognitive beliefs with regard to long-term side effects of vaccines, a belief that vaccines are no longer necessary because VPDs no longer occur in the Netherlands, or about the ineffectiveness of vaccines (*chapter 8*) may explain why some parents perceive the severity of side effects of vaccines to be greater. Additionally, a possible explanation for a moderate perceived severity of VPDs might be that partial acceptors – and to some extent refusers – perceive some VPDs as childhood diseases that are essential for the development of their child.⁸⁵ Another explanation might be that parents see children experience the mild side effects of a vaccine more often than the severe consequences of a VPD and therefore, they perceive the susceptibility and severity as greater.

With regard to e-cigarette use as a next to best decision compared to smoking cessation or not initiating cigarettes or e-cigarettes, our results demonstrated that e-cigarette users perceived fewer risks of e-cigarettes than never-users and smokers (*chapters 2, 3, and 4*), which was also found in other research.^{43,44,46,88-111} An explanation of this low perception of harm of e-cigarettes among e-cigarette users may be due to the use of e-cigarettes itself. For example, e-cigarette users expected (before initiation) and experienced (after continuation of use) health benefits from e-cigarette use. It is possible that positive outcome expectancies and experiences lead to a low perception of harm.^{43,90,94,105,123-126} In addition, we found that while never-users and e-cigarette users reported the health risks associated with smoking as important (*chapters 2 and 3*), smokers are unrealistically optimistic about their own susceptibility to bad outcomes, which was supported by previous findings.^{67,127-129} This optimism bias may explain why

these smokers did not (yet) switch to a less harmful alternative.

Trust in information

Trust in information about smoking behavior (in general) and childhood vaccination (i.e. information brochure^{74,75}) provided by public health experts was higher among never-users and vaccine acceptors than among those who chose for the unrecommended or next to best health option (*chapters 3, 4, 6, and 7*), which was also found in previous studies on both subjects.^{51,120,130-132}

With regard to vaccine acceptors, in previous research trust was shown to be one of the decisive factors in the decision regarding accepting childhood vaccinations.^{51,86,121,133} In our studies, acceptors reported trusting the NIP and the information about the NIP (*chapters 6 and 7*), and this trust in information may explain why acceptors scored higher on evidence-based knowledge about childhood vaccination. A possible explanation for their trust in the NIP may be that because the NIP was developed by the government, it engenders an inherent sense of trust.¹³⁴ Additionally, parents who accepted vaccines perceived childhood vaccination as being self-evident (*chapter 6*). According to previous research, it may be that because acceptors trust the NIP and the information about the NIP, they do not think this information needs much further deliberation^{51,86,121,133} which may in part explain why they scored high on feeling uninformed about childhood vaccination (*chapter 7*).^{79,81,135,136} However, they reported having made a conscious decision to accept all childhood vaccinations (*chapters 6 and 8*). It seems that because acceptors trust the NIP, in their opinion trust is the reason that they feel they made a conscious decision.^{51,66,87,120-122} The lower levels of trust found among refusers and partial acceptors versus acceptors may be related to scoring high on not feeling supported (*chapter 7*) in decision-making about childhood vaccinations.^{78,85,137} This may be because Child Vaccine Providers (CVPs) were reported to not have enough time or knowledge to answer questions (*chapter 7*), which was also identified in previous research^{51,120,130,131}, or because the tone of voice of the information provided by the government was perceived as condescending and untrustworthy (*chapter 7*).^{85,138-140}

With regard to decisions about smoking behavior, we found that never-users, smokers, and e-cigarette users trusted information about smoking from the government or public health experts (*chapter 3*), which was in line with previous research.¹³² Possibly this is because the health risks of smoking were regarded as common knowledge and the information about consequences of smoking are widespread due to health warnings and pictorial warnings.⁷⁰⁻⁷³ E-cigarette users however distrusted information provided by public health experts about e-cigarettes; to the best of our knowledge, this was not investigated before. A possible explanation might be bolstering, which was explained above.

Anticipated regret

The role of anticipated regret in healthy behavior, such as exercising,

practicing safe sex, eating healthily, and not using drugs, has previously been documented.^{66,79,81,135,136,141-146} Anticipated regret seemed to be an important factor related to the decision about childhood vaccination, but was not mentioned in the qualitative study (*chapter 3*) in relation to decisions about smoking behavior. Therefore, measures of anticipated regret were not included in our questionnaire about smoking behavior.

Vaccine acceptors mentioned anticipated regret with regard to their child experiencing a VPD if they were to refuse vaccines for their child as an important consideration in their decision to accept childhood vaccinations (*chapter 6*). With regard to the next to best option, partial acceptors reported high levels of anticipated regret if they were to accept all childhood vaccinations and their child were to experience side effects due to a vaccine (*chapter 7*), and high levels of anticipated regret if they were to refuse all childhood vaccinations and their child were to experience a VPD. For some vaccines, partial acceptors may experience anticipated regret with regard to accepting this vaccine because they may consider the side effects of a vaccine to be more serious than their child experiencing a VPD. In the case of other vaccines, partial acceptors may experience anticipated regret if they were to refuse these vaccines because sometimes the side effects of the vaccine were not considered to be more serious than their child experiencing the disease.^{66,147} This assessment of the anticipated regret of regarding vaccines and VPDs may be made for each vaccine of the Dutch NIP, separately. In addition, possible anthroposophical convictions, such as a conviction that some VPDs are childhood diseases or some VPDs aid the development of child may also influence anticipated regret.^{56,66,85,86} This experienced anticipated regret in combination with perceived susceptibility and severity may explain why partial acceptors refuse some vaccines and accept others.⁸⁵

Social norms

For both smoking behavior and childhood vaccinations, this thesis revealed strong social norms in place with regard to not smoking and not using e-cigarettes, and accepting childhood vaccination, which have been identified previously.^{43,47,66,78,129,148-160} E-cigarette users, partial acceptors, and refusers specifically reported not feeling supported in their decision because they felt criticized by this strong positive social norm regarding accepting childhood vaccinations and not smoking or using e-cigarettes (*chapters 3, 6 and 7*), which was also found in studies conducted in the US.^{52,53,87,152}

With regard to the next to best health options, e-cigarette users noted the importance of social support with regard to e-cigarette use (*chapters 3 and 5*). They described a sense of community among e-cigarette users, similar to for instance the sense of belongingness described by bikers (*chapter 3*). The importance of support when switching from cigarettes to e-cigarettes was also previously reported by e-cigarette users.^{148,150,161} Additionally, partial acceptors

reported not feeling supported by their social environment or CVPs (*chapters 6 and 7*). One of the reasons they did not feel supported in their decision about childhood vaccination were barriers experienced, such as believing that the staff at the CWC did not acknowledge their questions about vaccinations (*chapters 6 and 7*).

Self-efficacy

While practical barriers, such as conveniently located CWCs,⁸⁷ were previously found to be important in decision-making concerning childhood vaccination,¹⁶² our results indicate that parents perceived no practical barriers with regard to making an appointment at the CWC or the accessibility of a CWC (*chapter 7*). This might be because the NIP of the Netherlands is well organized.^{32,66,163} Partial acceptors did report difficulty when sorting through the information with regard to an alternative vaccination schedule. With regard to smoking behavior, research has shown that self-efficacy is an important factor in this decision.^{148,149,164} Schoren, Hummel and de Vries¹⁴⁸ showed that e-cigarette users were most confident in their ability to not use e-cigarettes in particular situations compared to smokers and dual users, which was confirmed by the findings of our study described in chapter 5. *Chapter 5* showed that dual users were less confident in their ability to not use e-cigarettes or not smoke compared to e-cigarette users.

E-cigarette product characteristics

This thesis demonstrated that product characteristics seem to be important in the decision about e-cigarette use. Product characteristics of e-cigarettes were mentioned by never-users, smokers, dual users, and e-cigarette users as reasons to use e-cigarettes, and several characteristics, such as the availability of many e-liquid flavors, were mentioned as benefits (*chapters 2 and 3*). Indeed, the variety of flavor^{43,90,91,93,95,97,100,103,165-167} and the ability to alter technical specifications^{90,119,168} were previously found to be reasons for e-cigarette use. The attractiveness of several product characteristics was investigated in this thesis, and we found that all types of users (i.e. never-users, smokers, dual users, and exclusive e-cigarette users) found the availability of different e-liquid flavors to be the most attractive feature of e-cigarettes (*chapter 4*).

While concerns have been raised about potential initiation of e-cigarette use among never-users,¹⁶⁹⁻¹⁷¹ the never-users in our study had a low intention to start vaping and more than two-thirds (68%) of the never-users did not want to try any e-liquid flavor. Our findings suggest that although never-users found e-liquid flavors to be the most attractive aspect of e-cigarettes, attractiveness may not translate into an intention to try e-cigarettes among the never-users. Furthermore, two-thirds of the smokers reported interest in an e-liquid flavor other than tobacco. This may indicate that e-liquid flavors could support the decision of smokers to switch to vaping,¹⁷² for example by allowing the marketing of e-liquid flavors and other product characteristics that smokers find attractive.¹⁷³ Different patterns of e-liquid flavors used by dual users and exclusive vapers were found. In line with

previous research,^{91,174-178} both dual users and exclusive e-cigarette users mostly used tobacco- and mint-flavored e-cigarettes at initiation, but exclusive vapers currently used more fruit and sweet e-liquid flavors than dual users. This could be interpreted as vapers switching from tobacco to non-tobacco flavors over time, which is supported by a previous study.¹⁷⁸ Because most adult exclusive vapers included in this study had been using e-cigarettes for one to five years, and most dual users reported vaping for only less than six months (appendix 7), it is possible that the dual users may switch to fruit or sweet e-liquid flavors in the future. The role of e-liquid flavors in supporting both the decision to switch towards e-cigarette use (for smokers) and to refrain from using e-cigarettes (for never-users) demonstrates the complexity of developing future regulations on e-liquid flavors.

Methodological considerations

To explore the decisions regarding smoking behavior and childhood vaccination, both qualitative and quantitative methods were used to provide a broad overview of factors that are important in these decisions. Additionally, this thesis was the first to compare findings of factors important in smoking behavior and childhood vaccination, and to discuss similarities and differences. Several methodological considerations were discussed in the individual chapters of this thesis. Here we will discuss the most important considerations, such as a lack of guidelines on what sufficient knowledge and deliberation means, what an informed decision actually is, response bias, and definitions of smokers and e-cigarette users.

With regard to how we measure knowledge, no consensus could be found in literature of informed decision-making with regard to a definition of knowledge.^{42,134} In this thesis, *knowledge*⁴² was defined as an evidence-based and justified belief based on scientific consensus and information.^{5,75,160,179-181} *Knowledge* was assessed by asking whether a statement was considered 'true', 'false', or 'I don't know' and categorized according to the definition of informed decision-making¹⁷ into sufficient (i.e. correct answers) and insufficient (i.e. incorrect and 'I don't know' answers) using Abbott's blind guessing formula. *Cognitive beliefs* were also investigated. These beliefs were defined as a mental representation, or a conviction that something is true,¹⁸² and assessed by asking whether someone completely disagreed or agreed with a statement. If one's beliefs were in accordance with what experts consider to be true, the belief is equivalent to knowledge.¹³⁴ According to previous research, people make a decision based on what they believe to be true – and not necessarily evidence-based knowledge – so it is not surprising that people answered the knowledge statements in accordance with what they believe.¹⁸³⁻¹⁸⁵ In addition, answering a question with 'I don't know' does not equal 'false', and thus the categorization of sufficient and insufficient knowledge does not cover whether people are aware what is true according to scientific evidence. Consequently, using the current

definitions of informed decision-making¹⁷ it remains unclear whether people know what is correct according to scientific evidence, whether people are not aware of what is true according to scientific evidence, or whether they do not believe the scientific evidence. Hence, to gain more insight into these aspects, it may be relevant to combine awareness of what is true according to scientific evidence (i.e. knowledge) and relevant cognitive beliefs. The combination of two such measures would increase our understanding of which information participants use to make a decision, whether participants are informed but do not believe the information – which means providing them with scientific information will not increase their knowledge¹⁸⁶⁻¹⁹⁵ – or whether they are actually not informed or misinformed, which means they need additional information.⁴²

With regard to knowledge, it is unclear when a decision is based on sufficient information as there are no guidelines on what people would need to know to qualify as sufficiently informed.^{17,42} While the definition of informed decision-making is very rigid and strict, it is not based on uniform standards of knowledge. A similar case could be made for levels of deliberation. In accordance with the definition of informed decision-making of van den Berg, Timmermans, ten Kate, van Vugt, van der Wal¹⁷, we used the midpoint of the scale to determine whether levels of deliberation were high or low. However, similar to knowledge, there are no guidelines on when a decision-maker deliberated a decision sufficiently. Moreover, according to the decision-maker, these levels of sufficient knowledge or deliberation may vary according to the subject, and the decision-maker may therefore favor a different decision style for each decision.^{134,196} Additionally, in the case of value-consistency in decision-making, attitudes are often used as a proxy for values in current studies but it is unclear whether attitudes are informative enough to be used as a proxy of values related to decision-making.¹⁹⁷ Research is needed to investigate what people exactly would need to know (i.e. in terms of content), how much information people need (i.e. sufficient versus insufficient), how to measure knowledge, to what extent they need to deliberate to make a decision, or what makes the decision value-consistent. Research is also needed on how to balance the amount of information to make a decision and the information that is deemed relevant and necessary by the public in making a decision about smoking behavior and childhood vaccination.

Moreover, it is important to reflect further on the nature of what an informed decision is, as some questions have yet to be answered. Most definitions of informed decision-making suggest that individuals need to be informed and that the decision should reflect the decision-makers' values.^{18-22,27,198-202} The conceptualization of informed decision-making that we used is based on the definition of van den Berg et al.¹⁷ since they have added the process of deliberation of different choice options. Furthermore, these definitions dichotomize the decisions into informed or uninformed.^{17-22,27,198-202} However, previous research debated whether it is wise to dichotomize the decisions into an informed versus uninformed decision as this results in a crude distinction that does not reflect

the variety in the levels of informed and uninformed decisions.^{17,134,203} This was one of the reasons that we did not dichotomize the decisions into informed or uninformed but investigated whether the decisions about smoking behavior and childhood vaccination adhered to one or more of the criteria of the definition of informed decision-making. Further research is needed to identify whether informed decision-making could also be regarded as a scale on which people can score differently. Second, should knowledge, value consistency, and deliberation all be equally important for defining and operationalizing informed decision-making? It is unclear whether these three criteria constitute *the* criteria or factors that make a decision informed, and if all three are necessary for a decision to be informed. Research is needed to investigate if other determinants may be important in supporting decision-making, which may depend on the type of decision and on the style of the decision-maker. In addition, deliberation could be considered to entail a process of considering and thinking about a variety of factors, including perceived susceptibility and severity, trust, anticipated regret, social support, and self-efficacy; the importance of these factors may differ per decision, situation, and person. Consequently, given this unclarity, it also remains unclear how to best facilitate informed decision-making, and more research is needed to explore this complex process.

Moreover, by asking respondents to consider their decision in retrospect, we may have introduced response bias. It is likely that scores on factors important in the decisions about smoking behavior and childhood vaccination at the time of conducting this study do not fully reflect the scores of the factors at the time of decision-making, opening up the possibility of cognitive dissonance.^{59,204,205} Asking participants to consider a decision that has not yet been made was not possible in our studies because we wanted to compare the factors that played a role in the decisions for the recommended, unrecommended, and next to best decisions. These categories were made based on the behavior of participants, and thus we needed to wait until participants performed the behavior to make a categorization. Further research is needed to explore if scores or the importance of determinants of decision-making change during the decision-making process. For example, by setting up a cohort of soon-to-be parents to follow these parents through time and vaccination decisions.

With regard to the definitions of never-users, smokers, and e-cigarette users, there was no consensus in the literature about these definitions. The decision to not smoke or vape, to initiate smoking, start dual using cigarettes and e-cigarettes, or switching to e-cigarette use is dynamic, as people may change products over time, which means that different transitory phases can be determined. Our current studies were all cross-sectional, which is why we only offer a snapshot of the types of users and frequency of use among never-users, smokers, and e-cigarette users (i.e. both dual users of cigarettes and e-cigarettes, and exclusive e-cigarette users). Further research is needed to investigate how to best present the dynamic behaviors of never-use, smoking, dual use,

and e-cigarette use in static definitions of use. Such research could build on the International Tobacco Control surveys,^{206,207} which use standardized survey measures to enable cross-country comparisons,²⁰⁷ so that the transitory phases of never-use, exclusive smoking, concurrent use of cigarettes and e-cigarettes, and exclusive e-cigarette use can be followed to investigate possible differences in tobacco product and e-cigarette use. Subsequently, a Delphi study – with experts in the field of e-cigarette use – could be asked to define characteristics of never-users, smokers, and e-cigarette users.²⁰⁸ These types of studies could be used to further specify definition of use, such as the classification system offered by Borland, Murray, Gravelly, et al.²⁰⁹, and to identify additional features to distinguish exclusive smokers, dual users, and exclusive e-cigarette users.

Recommendations for further research, health communication, and policy

Based on the research presented in this thesis, several recommendations for further research, health communication and policy can be identified.

Recommendations for further research

Various recommendations for further research were discussed in the individual chapters of this thesis. Here we will highlight the need for research with regard to the next to best health option.

Next to best health options

In the Netherlands, the RIVM is responsible for providing the public with information about smoking behavior and childhood vaccination, for example through an information brochure and a website.^{74,75,180,181,210} Although not smoking or using e-cigarettes and accepting childhood vaccinations can be considered as most beneficial for public health,²¹¹⁻²¹⁵ e-cigarette use or partially accepting childhood vaccination has potential individual and public health benefits compared to smoking or refusing all vaccines.^{2,3,7,8,122,211,216-221} However, in itself, e-cigarette use and partially accepting childhood vaccinations are not beneficial for individual health nor without risks.^{214,222,223} Consequently, these options are not recommended from a public health perspective. People search for information that reinforces their chosen option or may facilitate arriving at the desired decision,^{57,58} and thus, it is important to provide evidence-based information about all options. Based on our results, we would recommend further research to investigate the effects of communicating about the recommended health options (e.g. not smoking or using e-cigarettes and accepting childhood vaccinations), the unrecommended option (e.g. smoking or refusing childhood vaccinations), and the next to best health options (e.g. e-cigarette use and partially accepting childhood vaccination). Such research – focused on for example childhood vaccination – could consist of testing the effect, appreciation, and acceptance

of providing information on the recommended, unrecommended, and next to best health options on decision-making and intention to accept childhood vaccination in comparison to standard information (i.e. the information currently provided by RIVM). These insights into the effects of communicating about the recommended, unrecommended, and next to best health options could aid public health experts in determining the goals of health communication and the communication needs of the public.

Recommendations for health communication

Building on the recommendation to investigate the effects of communicating about the recommended health options, the unrecommended option, and the next to best health options, specific suggestions can be provided with regard to the communication techniques relevant to achieve the different goals. With regard to communicating about recommended and other options, it is important to articulate clearly which particular goals public health experts want to achieve. They may consider it their goal to provide scientific information without providing advice or decisional support. Another goal may be to facilitate informed decision-making even though the consequence of this may be that more people will choose for the unrecommended or next to best option rather than the recommended option, thereby increasing public health risks. An alternative goal may be to make sure that as many people as possible choose the recommended health option to increase public health gain. With the latter aim, several motivational techniques can be applied to steer the public in the desired and recommended direction.^{224,225} Rigorous testing of possible decisional effects of providing information on all options will allow public health experts and policy-makers to make an informed decision on possible adaptation of current communication efforts. The following section describes several techniques that can be used to support informed decision-making and techniques that may be used to promote uptake of the recommended health option. Here, we will focus on knowledge and cognitive beliefs, attitude, and deliberation.

Knowledge, attitude, and deliberations

Chapters 3 – 8 suggested that evidence-based knowledge about smoking behavior and childhood vaccination was low among those who opted for the unrecommended or next to best health options, that people have positive attitudes towards their own decision, indicating a high level of value consistency, and that those who opted for the recommended health option generally displayed low levels of deliberation.

A goal of health communication may be to provide scientific information without providing advice or decisional support. In order to do so, several channels could be used, such as circulating the information brochures about the NIP.²²⁵ In addition, websites could be used to provide information with more detail but layered in order to provide the extent of information desired by the audience.^{9,225-229} Such

techniques facilitate the sharing of scientific information.

Another goal of health communication may be to facilitate informed decision-making. Several techniques could be used. One example could be the provision of an online decision aid to support informing decision-makers, reflecting on values that are important for the decision-maker, and stimulating the deliberation of choice options and information.^{29,136,230-235} In health decisions, decision aids proved successful in increasing knowledge compared to usual care, to improve judgements of the perceived susceptibility and severity that are in accordance with scientific evidence; they were also effective in choosing a health option that was in accordance with the decision-makers' values, indicating a high level of value consistency, and were effective in reducing scores of decisional conflict to levels that indicate informed decisions.²³⁴ To increase knowledge, it is important to provide risk information in a combination of numeric and narrative risk information and to incorporate the beliefs and values of the decision-maker.^{13,203,236-238} An example of an evidence-based technique to increase knowledge is elaboration of information.²²⁵ Elaboration stimulates the decision-maker to add meaning to the information that is processed, it consists of easy and understandable information, with direct instruction to accomplish the goal of the decision-maker.^{34,225,239} For example, smokers could be triggered about the negative health effects of smoking by being provided with messages that are personally relevant, such as explaining short-term instead of long-term health consequences. To further support informed decision-making, it is important to support decision-makers to clarify values and attitudes with regard to the health options. An example of such a technique is counseling.²²⁵ During counseling, examples of different choices and why people make these choices are provided, including scenarios or testimonials to describe the choice options. Decision-makers are encouraged to prioritize values that are important to them or are offered different features of health options with personal balance scales.²⁴⁰ A technique to support deliberation about all health options could be providing guidance in deliberating and considering the health options available to decision-makers.²⁴¹⁻²⁴³ This can be provided in a decision aid^{15,135,136,233,244-246} for example, by providing an option for decision-makers to make a list of advantages or disadvantages, risks, benefits, goals, and values ranked in order of what is important to them.^{241,242} about all options.

A goal of health communication could also be to make sure that as many people as possible choose the recommended health option to increase public health gain. An example of motivational techniques to increase knowledge to promote the recommended health option among those who chose for the unrecommended option and the next to best health option is persuasive communication in the form of narratives. This can be used to make sure the perception of susceptibility and severity of decision-makers is in line with scientific evidence. Due to identification with the characters in a narrative and the vividness of the risk information described, imaginability of the health threats

of the unrecommended health option is expected to increase, which in turn increases the likelihood of taking protective action. For example, in the case of childhood vaccination, the RIVM may use narratives to explain scientifically proven consequences of VPDs and vaccine side effects.^{6,12,75,180,247} These narratives may influence a parent to decide to accept childhood vaccinations, or they may potentially counter anti-vaccination messages and weaken negative beliefs because it is easier to recall and understand the information about risks compared with providing scientific information.^{6,10,13,25,51,55,248,249} In addition, narratives are known to reduce defensive reacting or counterarguing to health messages.^{250,251} Consequently, it may prove useful to use a more contextualized approach to inform parents who have persistent cognitive beliefs not in accordance with scientific evidence about evidence-based information. One technique that could be used is attitude inoculation.²⁵² Attitude inoculation messages work very similarly to a vaccination; decision-makers are trained to resist attacks on their positive attitudes towards the recommended health option by practicing their response to positive messages to the unrecommended or next to best health option.²⁵² In a decision-aid, inoculation messages could be used to strengthen existing positive attitudes, weaken attitudes that are positive towards unrecommended health options, and build resistance for marketing of tobacco and e-cigarettes and anti-vaccination messages, respectively.^{172,252-255} Another strategy could be motivational interviewing.^{225,256} Motivational interviewing pertains to an approach to enhance the internal motivation to switch to the recommended health option of a decision-maker based on their own arguments for change,^{225,256} and has previously been shown to be effective in changing vaccine hesitancy in Canada by increasing deliberation about the decision to accept childhood vaccinations.^{225,257}

Considerations for policy-makers

With regard to policy, we can offer some recommendations concerning an informed public and the regulation of e-cigarettes.

Informed decision-making

If policy-makers want to foster informed choices among the public concerning health options, our research and research by others indicates that it is important to identify the best conditions for facilitating such rational and informed decisions. Most definitions of informed decision-making suggest that individuals need to be informed and that the decision should reflect the decision-makers' values, and are based on a rational decision model.^{18-22,27,198-202} These definitions dichotomize the decisions into rational and informed or irrational and uninformed.^{17-22,27,198-202} Our results suggest that most participants may not have made optimal, rational, and informed decisions about smoking behavior or childhood vaccinations according to the criteria of informed decision-making. On the one hand, it could be that these three criteria are not absolute in explaining informed decision-making. On the other hand, the results may imply that public health policies are needed

to foster the identification of factors that facilitate informed decision-making among the general public, and to safeguard the public against factors that may hinder informed decision-making.^{194,258} In addition, it may not be preferable for the public to make rational and informed decisions in every case because it is cognitively tiring. Reconsideration and reorientation may be needed about what informed decisions are, which factors foster informed decision-making and which factors hinder it, and what or whether informed decision-making is desired.

E-cigarette product characteristics

The regulation of e-cigarettes in order to optimize public health benefits is challenging. Compared to cigarette smoking, e-cigarette use may reduce harm among smokers,²⁵⁹⁻²⁶² but due to their toxic ingredients it is not a harmless product.^{259,263} In addition, concerns have been raised that e-cigarette use may contribute to nicotine addiction and the renormalization of cigarette smoking in adolescent never-smokers.^{171,264-267} Consequently, from a public health perspective, the initiation of vaping by current non- and never-smokers and, thereby, exposure to potentially toxic ingredients should be prevented.²⁶⁷ Our findings showed that product characteristics may be an attractive aspect of e-cigarettes. However, the relation between product characteristics on the one hand, and how this may influence positive attitudes and an intention to start or switch to e-cigarettes on the other hand, remains unclear. The findings of *chapter 4* indicate that e-liquid flavors are an attractive aspect of e-cigarettes for never-users, smokers, and e-cigarette users. Therefore, more research is needed to investigate the relation between e-cigarette product characteristics, and attitude and intention concerning the next to best health option (i.e. e-cigarette use). Moreover, as e-cigarettes are marketed as an alternative to smoking, cessation research needs to monitor potential long-term side effects and when they occur, and whether usage of e-cigarettes are a real viable alternative for smoking cessation for certain groups.

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Valorization Addendum

Valorization Addendum

The main aim of this thesis was to explore two examples of decisions we identified as a next to best health decision. When making health-related decisions, there can be different options to choose from. For instance, a parent can decide to accept, refuse, or partially accept childhood vaccinations; or a smoker can decide to quit smoking or switch from smoking regular cigarettes to electronic cigarettes (e-cigarettes). Public health professionals often inform individuals only about a *recommended option*, i.e. the option that is scientifically proven to be the healthiest. For example, they provide a brochure in order to inform parents about vaccinating their children according to the schedule of the National Immunization Program (NIP).^{1,2} However, this recommended option might not be suitable for all individuals due to different personal values, priorities with regard to health, previous experiences, opinions, and the norms of their social environment. Consequently, in these cases people may prefer to choose options that match their individual values and goals; yet, these options may be considered by public health professionals as, for example, '*next to best*'. Next to best health options are – from a public health and scientific point of view – less harmful or healthier than the unrecommended health option, but less preferred than the recommended option. Another option people may choose is the unrecommended option, which is considered as being unhealthy by public health experts and science.

To expand our understanding of these next to best health decisions, we had two aims. First, we examined determinants influencing the decision about smoking behavior and childhood vaccination, both qualitatively and quantitatively. Second, we examined the extent to which decisions regarding smoking behavior and childhood vaccination adhere to the criteria of informed decision-making. The results may facilitate and support communication programs that incorporate decision-making about smoking behavior and childhood vaccination.

Relevance of research into next to best health decisions

E-cigarette use

In recent years a shift from recommended to next to best health options could be noticed. In the case of e-cigarettes, research has demonstrated that since their introduction in 2003, the appeal of e-cigarettes has increased rapidly.³⁻⁹ The number of people who smoke in the Netherlands is decreasing.^{10,11} In 2017, 23% of the adult Dutch population smoked cigarettes.¹¹ Of these 23%, 75% smoke daily. Three percent of Dutch adults use an e-cigarette. Ten percent of the current smokers sometimes use an e-cigarette, and daily smokers (12%) use an e-cigarette more often compared to non-daily smokers (4%). However, decision-making about e-cigarette use is largely uninvestigated, it is unclear how people make a decision about smoking and vaping behavior. In this thesis these decisions were investigated in order to provide information for health communication aimed to

support these decisions. The current chapter will provide information how the findings of this thesis might be used for health communication strategies aimed to support decisions about smoking and vaping behavior.

Partially accepting childhood vaccination

For childhood vaccination a decrease in the vaccination coverage and an increase in the unrecommended and next to best health option was found in previous years. Of all Dutch two-year-olds born in 2014 3.6% did not receive any vaccines according to the NIP and 5.2% received or delayed some vaccines, and of Dutch two-year-olds born in 2015 4.6% did not receive any vaccines according to the NIP and 5.2% received or delayed some vaccines.¹² However, the vaccination coverage does not provide insight into whether parents have questions or doubts regarding their decision or how parents made a decision about childhood vaccination. For example, parents who accept all childhood vaccinations, may still have doubts about their decision or even experience regret.¹³⁻¹⁵ Or parents who refused childhood vaccination may have based this decision on fear of side-effects their child may experience due to a vaccine. Because little is known about the doubts and regret parents may face with regard to accepting, refusing, and partially accepting childhood vaccination it is important to investigate decision-making. The current chapter will provide information about how the findings of this thesis might be used for health communication strategies aimed at supporting parents with decision-making about childhood vaccination.

Activities as a result from this thesis

Further steps for health communication

With regard to the next to best health option, further research is needed. Although recommended health options can be considered as most beneficial for public health,^{6,16-19} next to best health options have potential individual and public health benefits compared to unrecommended health options.^{16,20-30} However, in itself, next to best health options are not the most beneficial for individual health nor without risks.^{6,31,32} Consequently, these options are not recommended from a public health perspective.

Even though an option may not be recommended by public health experts, people search for information that reinforces their chosen option or may facilitate arriving at their desired decision,^{33,34} and thus, it is important to provide evidence-based information about all options. Based on our results, we recommended further research to investigate the effects of communicating about the recommended health options, the unrecommended option, and the next to best health options. The current findings have instigated several efforts targeting the communication about childhood vaccination. Efforts have been made to investigate the effects of communicating about the recommended, unrecommended, and next to best health options on decision-making. In particular, the effect of communicating about these options on the intention to towards accepting or refusing the

recommend health option and on decisional conflict experienced. Insights generated from these studies will further aid public health experts and policy makers in determining the goals of health communication. In addition, the results of such an experimental study may generate input for the communication effort of the RIVM. For example, the brochure presented to parents may be adapted as a result of this study.^{1,2,35-37}

Considerations for the RIVM

The RIVM is currently responsible for informing parents about the National Immunization Program. For this purpose, they use a standard brochure that all new parents receive after the birth of their child.^{1,2,35-37} With an experimental design researchers from the RIVM want to investigate what the effects are of communicating about accepting (i.e. the recommended health option), refusing (the unrecommended health option), and partially accepting (i.e. the next to best health option) versus solely communicating about accepting childhood vaccination, on two primary outcomes: decisional conflict³⁸ related to the decision about childhood vaccination and intention towards childhood vaccination. The results of this study will inform policy makers about further steps needed in communication strategies.

Considerations for policy makers and health professionals

The results of this thesis and the experimental study may prove useful for policy makers. Policy makers may have different goals with providing information with regard to various health behaviors.³⁹ If policy makers opt for providing scientific information without steering, they may want to facilitate informed decision-making, which may lead to more people choosing the unrecommended health option. On the other hand, if policy makers and health professionals do not include information about alternative health options – and thus neglect other options that may be considered – and only inform the public about the recommended health option, the public may search for information about alternative health options on informal channels. Not providing information about unrecommended or next to best health options, may thus facilitate biased information processing among the public and decrease trust in public health experts due to a lack of transparency. The experimental study may thus generate insight for policy makers. For example, if experienced conflict is reduced and the intention to accept the recommended health option remains the same or increases, then communicating about all three health options does not harm public health, then supporting decision-making may be a possible goal of communication. However, if intention to accept the recommended health option is reduced due to communicating about all three health options, then communicating about all three health options may not be desired and persuasion may be a goal of communication.

The results of this thesis may furthermore prove useful for health professionals. Health professionals, such as GPs and general practice-based nurse specialists,

may be able to play an important role in the decision-making process about switching from cigarettes to e-cigarettes. Similarly, Child Vaccine Providers (CVPs) at the Child Welfare Centers (CWCs) may be important to assist in decision-making about childhood vaccination. With insight into factors that can support the decision-making process, health professionals may be able to exchange evidence-based information, address misperceptions and doubts, strengthen positive attitudes, answer questions, and discuss the various choice options.

Dissemination of results

This thesis resulted in several publications in scientific journals. These describe decision-making factors with regard to two relevant public health behaviors and provide implications for health communication. Our results about e-cigarette use and childhood vaccination generated media attention. For example, several news items were published by the RIVM, and a major Dutch newspaper. We discussed our findings at international and national conferences, and we were invited to speak at Yale University, the Virginia Commonwealth University at Richmond, and the Gillings School of Global Public Health in Chapel Hill. Policy makers, including the Dutch Secretary of Health, showed great interest in our results during multiple meetings. For example, policy makers were advised about a survey related to the attractiveness of e-cigarettes and we spoke about the decision-making of parents who refuse or partially accept childhood vaccination with the Dutch Secretary of Health. In addition, our results about the attractiveness of e-cigarettes were used by the Dutch secretary of health to strengthen his argument to ban the sales of non-tobacco e-liquid flavors and expand existing smoking bans to include e-cigarette use.⁴⁰ These measures are part of the national prevention agreement that aims to achieve a smoke free generation in 2040.⁴⁰ Results of our studies were also used in the yearly surveillance report of the Dutch National Immunization program, this led to multiple publications.^{1,12} Every year, surveillance and scientific developments are presented in a report of the National Immunization Program, in 2018 and 2019 our results were used to describe the scientific developments related to decision-making about childhood vaccination.

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Summary

Summary

Health-related decisions often involve a variety of options. Public health professionals often inform the public about an option they recommend based on scientific evidence. However, this healthiest, recommended option might not be suitable for everyone due to their personal values, priorities with regards to health, previous experiences, opinions, and the norms of their social environment. Consequently, in these cases people may choose options that match their individual values and goals but are considered by public health professionals as, for example, '*next to best*'. Next to best health options are – from a public health and scientific point of view – less harmful or less healthy than the unrecommended health option, but not less harmful or less healthy compared to the recommended health option. Another option people may choose is the unrecommended option, which is considered as unhealthy by public health experts and science.

In this thesis we explored two examples of decisions in which an increase in the next to best health decision (i.e. e-cigarette use and partially accepting childhood vaccinations) was observed. To expand our understanding of these next to best health decisions, the aim of this thesis was twofold. The two aims were related to improving our understanding of the next to best health decisions in the context of smoking behavior and childhood vaccination. First, this thesis aimed to explore which socio-cognitive factors, such as perceived susceptibility and severity, trust, anticipated regret, social support, and self-efficacy, are related to the decisions regarding smoking behavior and childhood vaccination. With this in mind, we conducted qualitative and quantitative studies to explore and determine socio-cognitive factors related to the decisions regarding e-cigarette use among never-users, smokers, dual users, and exclusive e-cigarette users, as well as decisions concerning childhood vaccination among parents who choose to accept, refuse or partially vaccinate their child. Second, this thesis investigated whether the decisions with regard to smoking behavior and childhood vaccinations adhered to the criteria of informed decision-making. To this end, we explored differences in knowledge, attitude, and deliberation, as well as decisional conflict of those who opted for the recommended, the unrecommended, and the next to best health options. It is important to investigate the criteria for informed decision-making because supporting informed decision-making may reduce decisional conflict and support decision-making in general.

Part I Exploring factors related to decision-making about smoking behavior

In the first part of the thesis, *Chapters 2 – 5* focus on smoking behavior. *Chapter 2* describes a narrative systematic review of perceptions and reasons for e-cigarette use. Results indicate that e-cigarette users perceive e-cigarettes as being less harmful than cigarettes. In addition, reasons for and benefits of

e-cigarette use reported by never-users were the novelty of the product and that it can aid concentration. Smokers mentioned that it mimics the smoking routine, whereas dual users reported benefits of avoiding smoking restrictions and the practicality of e-cigarettes. E-cigarette users reported benefits of increased athletic performance and that e-cigarettes can be used discretely.

Chapter 3 presents results from a qualitative focus group study into factors that play a role in the decision regarding e-cigarette use. Socio-cognitive factors, such as knowledge, perceived risks of e-cigarettes compared to cigarettes, trust in information, attitudes, and social norms about e-cigarette use, and deliberation were reported to be of influence in decisions related to smoking behavior and e-cigarette use.

Chapters 4 and 5 describe the results of a quantitative questionnaire into product characteristics of e-cigarettes and socio-cognitive factors related to the decision concerning smoking behavior. Results indicate that of all product characteristics investigated in *chapter 4* (e.g. amendable nicotine levels or adjustable settings of e-cigarettes), e-liquid flavors were reported to be the most attractive aspect of e-cigarettes by all user groups. For example, menthol/mint and sweet e-liquid flavors were preferred by never-users, tobacco and menthol/mint e-liquid flavors were preferred by smokers and dual users, and sweet and fruit flavors were preferred by e-cigarette users compared to other flavor categories. In addition, dual users – dual use of tobacco cigarettes and e-cigarettes – and exclusive e-cigarette users – exclusive use of e-cigarettes – are two distinct e-cigarette user groups.

Chapter 5 presents our quantitative exploration of distinguishing features between these groups, and results indicate that seven features are important to distinguish a dual user from an exclusive e-cigarette user with 86% certainty: (1) compared to exclusive e-cigarette users, dual users felt more connected to other smokers; (2) the quantity of tobacco cigarettes smoked in the past was higher among exclusive e-cigarette users than the quantity smoked currently by dual users; (3) self-efficacy to quit vaping and smoking was lower among dual users; (4) e-cigarette users found the cigarette unattractive more often than dual users did; (5) e-cigarette users had more positive attitudes towards vaping than dual users; (6) dual users perceived more barriers to accessing e-cigarettes; and (7) dual users had a stronger intention to quit vaping than e-cigarette users (*chapter 5*). The findings from part I expand our knowledge of factors related to the decision about the next to best health decision: e-cigarette use.

Part II Exploring factors related to decision-making about childhood vaccination

In part II, *chapters 6 – 7* focus on childhood vaccination. *Chapter 6* presents results from a qualitative focus group study into factors that play a role in the

decision regarding childhood vaccination. Results indicate that several socio-cognitive factors play a role in the decision to either accept, refuse, or partially accept childhood vaccinations, such as knowledge, perceived susceptibility and severity, trust in information, attitudes, anticipated regret, social norms, and deliberation.

Chapter 6 shows that partial acceptors perceived fewer risks of vaccine-preventable diseases (VPDs), more risks of side-effects of vaccines, less social support from their environment, and less trust in child welfare centers (CWCs) and information provided by the CWCs than acceptors. Partial acceptors reported having made a deliberate decision, and described this process of deliberation as elaborate, time-consuming, and difficult. Acceptors and refusers indicated that they had not given much thought to partially accepting childhood vaccination, (chapters 6 and 7).

Chapter 7 presents the results of a quantitative survey investigating factors related to the decision concerning childhood vaccination. Results demonstrate that acceptors perceived the susceptibility of side-effects of vaccines as lower compared to the susceptibility of VPDs if (some) vaccines are refused. Refusers and partial acceptors perceived the susceptibility of side-effects of vaccines to be higher compared to that of the VPDs. While anticipated regret towards negative consequences of VPDs was high among acceptors when considering refusing childhood vaccinations, anticipated regret among refusers and partial acceptors with regard to potential side-effects for the child was high when considering accepting vaccines. All parents reported a social norm favoring accepting childhood vaccinations. Trust in the National Immunization Program (NIP) was high among acceptors but moderate among refusers and partial acceptors. Partial acceptors experienced more barriers with regard to vaccination than refusers and acceptors. With regard to decisional conflict, on the decisional conflict scale, acceptors scored highest on uninformed, refusers scored highest on unsupported, and partial acceptors scored highest on uncertainty. The findings of part II expand our knowledge of factors related to the decision about the next to best health decision: partially accepted childhood vaccinations.

Part III Decision-making

In part III, *chapter 8* presents the results of two quantitative surveys investigating smoking behavior and childhood vaccination. The aim of these studies was to investigate whether the decisions about smoking behavior and childhood vaccination adhered to criteria – knowledge, attitudes, and deliberation – of informed decision-making. The results indicate that overall, decisions about smoking behavior and childhood vaccination did not adhere to at least one of the criteria of informed decision-making. Those who opted for the recommended health option (i.e. never-users and acceptors) had relatively low levels of deliberation about their decision or the alternative health options. In addition, cognitive beliefs of smokers, e-cigarette users, refusers, and partial

acceptors did not correspond with scientific evidence. Those who chose the next to best health option reported levels of knowledge, attitudes, and deliberation in-between those who chose the recommended and unrecommended health option. Whereas vaccine refusers had deliberated their decision thoroughly, smokers were found to report low levels of deliberation and were negative with regard to their own behavior. Those who chose for the next to best health decision were not outspokenly negative towards the recommended health option but e-cigarette users were outspokenly negative towards smoking.

In the general discussion in *chapter 9*, it is observed that further research is needed to investigate how to communicate about next to best health options, such as e-cigarette use and partially accepting childhood vaccination. Although not smoking or not using e-cigarettes and accepting childhood vaccinations can be considered as most beneficial for public health, e-cigarette use or partially accepting childhood vaccination has potential individual and public health benefits compared to smoking or refusing all vaccines. However, e-cigarette use and partially accepting childhood vaccinations are not beneficial for individual health or without risks. Consequently, these options are not recommended from a public health perspective. Based on our results, we would recommend further research to investigate the effects of communicating about the recommended health options (e.g. not smoking or not using e-cigarettes, and accepting childhood vaccinations), the unrecommended option (e.g. smoking or refusing childhood vaccinations), and the next to best health options (e.g. e-cigarette use and partially accepting childhood vaccination). Such research could test the effect, appreciation, and acceptability of providing information on all health options on decision-making and intention to accept the recommended option in comparison to standard information. With regard to communicating about best and other options, it is important to articulate clearly which particular goals public health experts want to achieve. They may consider it their goal to provide scientific information without providing advice or decisional support. Another goal may be to facilitate informed decision-making even though the consequence of this may be that more people will choose the unrecommended or next to best option rather than the recommended option, thereby increasing public health risks. Alternatively, public health experts may choose to take a more directive approach to get as many people as possible to choose the recommended health option to increase public health gain. With this aim, several motivational techniques can be applied to steer the public in the desired and recommended direction. Rigorous testing of possible decisional effects of providing information on all options will allow public health experts and policy makers to make an informed decision on possible adaptation of current communication efforts.

Samenvatting

Samenvatting

Keuzes met betrekking tot gezondheid omvatten vaak verschillende opties. Vanuit het perspectief van volksgezondheid wordt het publiek geïnformeerd door experts over een optie die wordt aanbevolen op basis van wetenschappelijk bewijs. De gezondste, aanbevolen optie is mogelijk niet voor iedereen geschikt bijvoorbeeld vanwege persoonlijke waarden of prioriteiten met betrekking tot gezondheid. Ook kunnen eerdere ervaringen, meningen en de sociale omgeving een rol spelen. Daardoor kunnen mensen in deze gevallen opties kiezen die beter passen bij hun individuele waarden en doelen, maar die vanuit volksgezondheid worden beschouwd als een één na beste keuze. Één na beste keuzes zijn – vanuit het oogpunt van volksgezondheid en wetenschap – minder schadelijk of minder ongezond dan de niet-aanbevolen optie voor gezondheid, maar schadelijker of minder gezond vergeleken met de aanbevolen gezondheidsoptie. Een andere optie die mensen kunnen kiezen is de niet-aanbevolen optie, die door deskundigen op het gebied van de volksgezondheid en de wetenschap als ongezond wordt beschouwd.

In dit proefschrift heb ik twee voorbeelden onderzocht van gezondheid gerelateerde keuzes waarbij in de laatste jaren een toename van de één na beste keuze (dat wil zeggen het gebruik van e-sigaretten (ook wel dampen genoemd) en het gedeeltelijk accepteren van vaccinaties voor kinderen) werd waargenomen in Nederland. Om ons begrip over de één na beste keuzes te vergroten is dit proefschrift geschreven. Het doel beschreven in dit proefschrift is daarbij tweeledig. Ten eerste was het doel te onderzoeken welke sociaal-cognitieve factoren verband houden met de keuze rondom rookgedrag en vaccineren van kinderen. Denk hierbij aan de perceptie met betrekking tot de kans en ernst van bijvoorbeeld infectieziekten, het vertrouwen in informatie over de e-sigaret, verwachte spijt over het weigeren van vaccinaties, sociale steun en zelfeffectiviteit. Met dit in gedachten hebben wij kwalitatieve en kwantitatieve onderzoeken uitgevoerd om sociaal-cognitieve factoren te onderzoeken en te bepalen of deze factoren een rol spelen bij de keuzes over het gebruik van e-sigaretten bij niet-gebruikers, rokers, exclusieve e-sigaretgebruikers, en 'dual users' (dit zijn gebruikers die zowel tabakssigaretten als e-sigaretten gebruiken) en exclusieve e-sigaretgebruikers. Een vergelijkbaar onderzoek heb ik uitgevoerd met betrekking tot keuzes over vaccinatie van kinderen onder ouders die het Rijksvaccinatieprogramma volgen, die alle vaccinaties weigeren of die gedeeltelijk vaccineren. Ten tweede onderzochten wij in dit proefschrift of de keuzes rondom rookgedrag en vaccinaties voor kinderen voldeden aan de criteria van geïnformeerde besluitvorming. Daartoe heb ik de verschillen in kennis, houding en deliberatie onderzocht, evenals twijfels onder ouders die het Rijksvaccinatieprogramma volgen, die alle vaccinaties weigeren of die gedeeltelijk vaccineren. Het is belangrijk om de criteria voor geïnformeerde besluitvorming te onderzoeken omdat het ondersteunen van geïnformeerde besluitvorming twijfels kan verminderen en de kwaliteit van besluitvorming kan verbeteren.

Deel I Onderzoek naar factoren gerelateerd aan de keuze rondom rookgedrag

In het eerste deel van dit proefschrift gaan de *hoofdstukken 2–5* in op rookgedrag. *Hoofdstuk 2* beschrijft een systematische review van percepties ten opzichte van de e-sigaret en redenen voor het gebruik van e-sigaretten. De resultaten geven aan dat e-sigaretgebruikers de e-sigaret als minder schadelijk beschouwden dan sigaretten. Niet-gebruikers gaven aan dat ‘de nieuwigheid van het product’ en ‘de verwachting dat het de concentratie kan bevorderen’ voordelen zijn van het gebruik van e-sigaretten. Rokers gaven aan dat de e-sigaret de rookroutine nabootst, terwijl ‘dual users’ voordelen rapporteerden zoals het vermijden van rookbeperkingen en het gemak van e-sigaretten. E-sigaretgebruikers meldden voordelen van verbeterde atletische prestaties en dat e-sigaretten discreet kunnen worden gebruikt.

Hoofdstuk 3 presenteert resultaten van een kwalitatieve focusgroep studie naar factoren die een rol kunnen spelen bij de beslissing over het gebruik van e-sigaretten. De resultaten laten zien dat sociaal cognitieve factoren van invloed zijn bij keuzes rondom rookgedrag en het gebruik van e-sigaretten. Hierbij valt te denken aan kennis, de perceptie van de kans en ernst van e-sigaretten in vergelijking met sigaretten, vertrouwen in informatie over de e-sigaret, houding en sociale normen over het gebruik van e-sigaretten, en deliberatie.

Hoofdstukken 4 en 5 beschrijven de resultaten van een kwantitatieve vragenlijst naar productkenmerken van e-sigaretten en sociaal cognitieve factoren gerelateerd aan de keuzes rondom rookgedrag. De resultaten geven aan dat van alle productkenmerken die in hoofdstuk 4 zijn onderzocht (bijvoorbeeld het kunnen aanpassen van nicotinegehalten of aanpasbare instellingen van e-sigaretten), de variatie aan smaken van e-vloeistoffen voor de e-sigaret door zowel niet-gebruikers als gebruikers als het meest aantrekkelijke aspect van e-sigaretten werd bevonden. Zo gaven niet-gebruikers de voorkeur aan menthol/munt en zoete e-vloeistof smaken in vergelijking met andere smaakcategorieën. Rokers en ‘dual users’ gaven de voorkeur aan tabak en menthol/munt e-vloeistof smaken in vergelijking met andere smaakcategorieën. E-sigaretgebruikers gaven de voorkeur aan zoete smaken en fruitsmaken in vergelijking met andere smaakcategorieën. Bovendien laten de resultaten zien dat dual- en exclusieve e-sigaretgebruikers verschillende smaakvoorkeuren hadden met betrekking tot e-vloeistoffen terwijl beide gebruikersgroepen van e-sigaretten zijn.

Hoofdstuk 5 presenteert de kwantitatieve verkenning van onderscheidende kenmerken tussen de twee e-sigaretgebruikersgroepen. De resultaten geven aan dat zeven kenmerken belangrijk zijn om met 86% zekerheid een ‘dual user’ te onderscheiden van een exclusieve e-sigaretgebruiker:

- 1) Vergeleken met exclusieve e-sigaretgebruikers, voelden ‘dual users’ zich meer *verbonden* met andere rokers;

- 2) De *hoeveelheid tabak sigaretten* die in het verleden werd gerookt is hoger onder exclusieve e-sigaretgebruikers dan de hoeveelheid die momenteel werd gerookt door 'dual users';
- 3) De *eigen-effectiviteit* om te stoppen met 'dampen' en roken was lager bij 'dual users';
- 4) Exclusieve e-sigaretgebruikers vonden de sigaret vaker *onaantrekkelijk* dan 'dual users';
- 5) E-sigaretgebruikers hadden een positievere *houding* ten opzichte van 'dampen' dan 'dual users';
- 6) 'Dual users' zagen meer belemmeringen rondom de *verkrijgbaarheid* van e-sigaretten;
- 7) 'Dual users' hadden een sterkere *intentie om te stoppen met 'dampen'* dan exclusieve e-sigaretgebruikers (*hoofdstuk 5*).

De bevindingen van *deel I* vergroten de kennis over factoren die een mogelijke rol spelen bij de keuze rondom een één na beste keuze: het gebruik van de e-sigaret.

Deel II Onderzoek naar factoren gerelateerd aan de keuze rondom vaccinaties voor kinderen

In deel II gaan de *hoofdstukken 6 – 7* in op de keuze van ouders rondom vaccinaties van kinderen. *Hoofdstuk 6* presenteert resultaten van een kwalitatieve focusgroep studie naar factoren die een rol spelen bij de keuze rondom vaccinatie voor kinderen. De resultaten geven aan dat verschillende sociaal-cognitieve factoren mogelijk een rol spelen bij de keuze om vaccinaties voor kinderen al dan niet te accepteren, te weigeren of gedeeltelijk te accepteren. Het gaat daarbij om de aspecten kennis, de perceptie van de kans en ernst van infectieziekten en bijwerkingen, vertrouwen in informatie, houding, verwachte spijt, sociale normen en deliberatie.

Hoofdstuk 6 laat zien dat ouders die hun kind gedeeltelijk vaccineren een lage perceptie hebben van de risico's rondom de infectieziekten en een hoge perceptie van de risico's rondom de bijwerkingen van vaccins. Ook ervaren zij weinig sociale steun vanuit hun omgeving met betrekking tot de keuze over vaccineren en rapporteren zij weinig vertrouwen te hebben in de (informatie van de) consultatiebureaus. Ouders die hun kind gedeeltelijk vaccineren meldden een weloverwogen keuze te hebben genomen en beschreven het deliberatieproces als uitgebreid, tijdrovend en moeilijk. Ouders die het Rijksvaccinatieprogramma wel of helemaal niet volgen gaven aan niet veel aandacht te hebben besteed aan de optie om hun kind gedeeltelijk te vaccineren van kinderen (*hoofdstukken 6 en 7*).

Hoofdstuk 7 presenteert de resultaten van een kwantitatieve studie naar factoren die verband houden met de keuze rondom vaccinatie voor kinderen.

De resultaten tonen aan dat ouders die het Rijksvaccinatieprogramma volgen de kans op bijwerkingen van vaccins als lager inschatten dan de kans op het krijgen van een infectieziekte als zij (sommige) vaccins zouden weigeren. Ouders die vaccins weigeren of sommige vaccins accepteren gaven aan dat de kans op bijwerkingen door een vaccinatie hoger is dan de kans voor het kind om een infectieziekte op te lopen. Ouders die het Rijksvaccinatieprogramma volgen verwachtten een hogere mate van spijt met betrekking tot de negatieve *gevolgen van infectieziekten* als gevolg van het weigeren van vaccinaties. Ter vergelijking, ouders die alle vaccinaties weigeren of ouders die gedeeltelijk vaccineren verwachten een hogere mate van spijt met betrekking tot de mogelijke *bijwerkingen* voor het kind van vaccins als gevolg van het volgen van het Rijksvaccinatieprogramma. Alle ouders rapporteerden een positieve sociale norm die uitgaat van het zijn van een voorstander inzake het accepteren van vaccinaties voor kinderen. Het vertrouwen in het Rijksvaccinatieprogramma was hoog bij ouders die dit programma volgen, maar matig bij ouders die alle vaccinaties weigeren of gedeeltelijk vaccineren. Ouders die gedeeltelijk vaccineren ondervonden meer belemmeringen op het gebied van het maken van een keuze rondom vaccineren dan ouders die alle vaccinaties weigeren of accepteren. Wat betreft twijfels met betrekking tot de keuze, rapporteerden ouders die alle vaccinaties accepteren zich niet geïnformeerd te voelen. Ouders die alle vaccinaties weigeren gaven aan onvoldoende ondersteuning te ontvangen van hun omgeving. Ouders die gedeeltelijk vaccineren gaven aan onzeker te zijn over de keuze. De bevindingen van deel II geven inzicht in de factoren die verband houden met de één na beste keuze: het gedeeltelijk (laten) vaccineren van kinderen.

Deel III Besluitvorming

In deel III – *hoofdstuk 8* – worden de resultaten gepresenteerd van twee kwantitatieve studies naar rookgedrag en vaccinatie voor kinderen. Het doel van deze studies is om te onderzoeken of de keuzes rondom rookgedrag en vaccinatie voor kinderen voldoen aan criteria (voldoende kennis en deliberatie en een positieve houding t.a.v. het eigen gedrag) van geïnformeerde besluitvorming. De resultaten laten zien dat beslissingen over rookgedrag en vaccinatie bij kinderen in het algemeen niet voldeden aan ten minste één van de criteria voor geïnformeerde besluitvorming.

Participanten die kozen voor de aanbevolen gezondheidsoptie (dat wil zeggen niet-gebruikers en ouders die het Rijksvaccinatieprogramma volgen) rapporteerden relatief weinig deliberatie rondom de gemaakte keuze en/of de alternatieve keuzeopties.

De overtuigingen van participanten die gekozen hebben voor de niet aanbevolen en één na beste keuze kwamen niet overeen met het wetenschappelijk bewijs (*hoofdstuk 3, 6 en 8*). Deze overtuigingen zijn een mogelijke verklaring waarom

deze participanten niet voldeden aan het criterium van 'voldoende kennis'. Participanten die voor de één na beste keuze optie kozen rapporteerden niveaus van kennis, houding en deliberatie die vallen tussen participanten die voor de aanbevolen en de niet-aanbevolen gezondheidsoptie kozen. Terwijl vaccinweigeraars hun keuze grondig hebben overwogen en positief waren over de gemaakte keuze, rapporteerden rokers een lage deliberatie en waren rokers negatief over hun eigen gedrag. Participanten die kozen voor de één na beste keuze waren niet uitgesproken negatief tegenover de aanbevolen gezondheidsoptie, maar opvallend was dat de e-sigaretgebruikers uitgesproken negatief waren over roken (dat wil zeggen de niet-aanbevolen optie).

Met betrekking tot participanten die voor de niet-aanbevolen optie gekozen hebben laten de resultaten zien dat vaccinweigeraars hun keuze grondig hadden overwogen en positief waren over de gemaakte keuze, terwijl rokers een lage deliberatie blijken te melden en dat rokers negatief waren over hun eigen gedrag.

Algemene discussie

In de algemene discussie in *hoofdstuk 9* wordt opgemerkt dat verder onderzoek nodig is om te onderzoeken hoe men het beste kan communiceren over 'één na beste keuzes', zoals e-sigarettengebruik en gedeeltelijk vaccineren. Hoewel niet roken of niet 'dampen' en het volgen van het Rijksvaccinatieprogramma als het meest gunstig voor de volksgezondheid kan worden beschouwd, heeft e-sigaretgebruik of gedeeltelijk vaccineren potentiële individuele en volksgezondheidsvoordelen in vergelijking met traditioneel roken of het weigeren van alle vaccins. E-sigaretgebruik en gedeeltelijk vaccineren zijn niet per se gunstig voor de individuele gezondheid of zonder risico. Daarom worden deze één na beste keuzes niet aanbevolen vanuit het perspectief van de volksgezondheid. Dergelijk onderzoek zou het effect, de waardering en de aanvaardbaarheid kunnen testen van het verstrekken van informatie over alle gezondheidsopties rondom de besluitvorming. Ook is het dan mogelijk om de intentie om de aanbevolen optie te accepteren of te weigeren te testen bij het communiceren over alle drie de opties in vergelijking met de intentie om de aanbevolen optie te accepteren of te weigeren bij standaardinformatie.

Wat betreft het communiceren over de aanbevolen en andere opties, is het belangrijk om duidelijk te verwoorden welke specifieke doelen volksgezondheidsdeskundigen willen bereiken. Zij kunnen het als hun doel beschouwen om wetenschappelijke informatie te verstrekken zonder advies of beslissingsondersteuning. Een ander doel kan zijn om geïnformeerde besluitvorming te ondersteunen, hoewel het gevolg hiervan kan zijn dat meer mensen de niet-aanbevolen of één na beste keuze optie zullen kiezen in plaats van de aanbevolen optie, waardoor de risico's voor de volksgezondheid toenemen. Als alternatief kunnen deskundigen kiezen om een meer sturende benadering te

volgen om zoveel mogelijk mensen de aanbevolen gezondheidsoptie te laten kiezen en de winst voor de volksgezondheid te vergroten. Met dit doel kunnen verschillende motivatietechnieken (persuasieve technieken) worden toegepast om het publiek in de gewenste richting te sturen. Volksgezondheidsdeskundigen en beleidsmakers kunnen op basis van de doorslaggegeven effecten van communiceren over alle drie de opties, een weloverwogen keuze maken over het aanpassen en het doel van de huidige communicatiestrategieën.

Curriculum Vitae

Curriculum Vitae

Kim Romijnders was born on January 14, 1992 in Nijmegen, the Netherlands. After graduating high school (A-level, focus on science, health, technology, and Latin) in 2010, she started with the bachelor European Public Health at Maastricht University in Maastricht. After receiving her bachelor's degree, Kim continued with her masters Global Health and Health Education and Promotion in 2013.

During the period of 2013 – 2015, Kim worked as a research assistant at the University of Texas at Houston, USA. Here she was responsible for research and the project administration of two projects and, one quantitative survey and one qualitative program evaluation. She investigated the mental health of LGBTQ youth and the sexual health of men who have sex with men. Upon her return, she started an elective of human rights and trade at Thammasat University in Bangkok, Thailand. She finished both masters in 2015.

In the beginning of 2016, Kim started with her PhD project titled: risk communication about alternative health strategies at the Department of Health Education and Health Promotion at the Faculty of Health, Medicine and Life Sciences of Maastricht University (UM), and the Centre of Health Protection, at the Dutch National Institute for Public Health and the Environment (RIVM) in the Netherlands. She completed her PhD project under the supervision of Dr. Ir. Liesbeth Mollema (RIVM), Dr. Liesbeth van Osch (UM), Dr. Reinskje Talhout (RIVM), and Prof. Dr. Hein de Vries (UM). During her PhD project, she carried out several studies investigating the decisions about smoking behavior and childhood vaccinations. The results of these studies are described in this thesis. Currently, she researches the impact on daily life of a hypothetical HIV cure among people living with HIV and people at risk for HIV at the University Medical Center in Utrecht.

Publication list

Publications in this thesis

- Romijnders KAGJ**, van Osch L, de Vries H, Talhout R. Perceptions and Reasons Regarding E-Cigarette Use among Users and Never-users: A Narrative Literature Review. *Int J Environ Res Public Health*. 2018;15(6).
- Romijnders KAGJ**, van Osch L, de Vries H, Talhout R. A Deliberate Choice? Exploring the Decision to Switch from Cigarettes to E-Cigarettes. *Int J Environ Res Public Health*. 2019;16(4).
- Romijnders KAGJ**, van Seventer SL, Scheltema M, van Osch L, de Vries H, Mollema L. A deliberate choice? Exploring factors related to informed decision-making about childhood vaccination among acceptors, refusers, and partial acceptors. *Vaccine*. 2019;37:5637-44.
- Romijnders KAGJ**, Pennings JLA, van Osch L, de Vries H, Talhout R. A Combination of Factors Related to Smoking Behavior, Attractive Product Characteristics, and Socio-Cognitive Factors are Important to Distinguish a Dual User from an Exclusive E-Cigarette User. *Int J Environ Res Public Health*. 2019;16(21).
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- Romijnders KAGJ**, Timmermans, D, Pennings, JLA, de Vries, H, van Osch, L, Talhout, R, and Mollema, L. Exploring differences in knowledge, attitude, and deliberation of the healthiest, unhealthiest, and alternative options: an illustration based on childhood vaccination and (non) smoking or vaping (Submitted, 2020).
- Romijnders KAGJ**, Osch, L, de Vries, H, and Mollema, L. Deciding on childhood vaccination: differences in decisional conflict and socio-cognitive factors between parents who accepted, refused, and partially accepted childhood vaccination. (Submitted, 2020)

Additional Publications

Romijnders KAGJ, Nyoni JE, Ross MW, et al. Lubricant use and condom use during anal sex in men who have sex with men in Tanzania. *Int J STD AIDS*. 2016;27(14):1289-1302.

Romijnders KAGJ, Wilkerson JM, Crutzen R, et al. Strengthening Social Ties to Increase Confidence and Self-Esteem Among Sexual and Gender Minority Youth. *Health Promot Pract*. 2017;18(3):341-347.

Wilkerson JM, Schick VR, Romijnders KAGJ, et al. Social Support, Depression, Self-Esteem, and Coping Among LGBTQ Adolescents Participating in Hatch Youth. *Health Promot Pract*. 2017;18(3):358-365.

Wilkerson JM, Lawler SM, Romijnders KAGJ, et al. Exploratory Analyses of Risk Behaviors Among GLBT Youth Attending a Drop-In Center. *Health Educ Behav*. 2018;45(2):217-228.

King, B, Morphet, K, O'Connor, R, Fielding, K, Gartner, C, Romijnders, KAGJ, Talhout R, and Borland R. "it's all the other stuff!" How smokers understand "chemicals" in cigarettes and cigarette smoke. (submitted, 2019).

The background of the page is a complex, abstract geometric pattern. It consists of a dense network of thin, white lines that intersect to form a variety of irregular polygons, primarily triangles and quadrilaterals. The lines are distributed across the entire page, creating a sense of depth and connectivity. The background color is a light gray gradient, which is slightly darker at the bottom and lighter at the top, providing a subtle contrast to the white lines.

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And now, the end is near...

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Dankjewel
Kim

Appendices

Appendix 1 Search Strategy for OvidMedline®

Chapter 2

Perceptions and Reasons Regarding E-Cigarette Use among Users and Non-Users: A Narrative Literature Review

Data Source	Provider/Interface	Ovid
	Database	Medline®
	Date searched	09-02-2016
	Database update	09-02-2017
	Search developer(s)	Wim ten Have & Kim Romijnders
Limiters & other information	English only? (default is "y")	y
	Date restrictions	1950–present

Note: an asterisk is used as a wildcard symbol to broad the search by including words that start with the letters before the asterisk.

Search Strategy

- 1 (electr* adj (cigar* or nicotine)).tw. (803)
- 2 ((electronic or electrically) adj3 (cigar* or nicotine)).tw. (852)
- 3 (e-cig* or ecig* or e-cigarette* or ecigarette* or e-nicotine* or enicotine*).tw. (846)
- 4 electronic cigarettes/(439)
- 5 1 or 2 or 3 or 4 (1316)
- 6 (initiation or motivation* or motives or reason* or attitude* or belief* or expectan* or understanding or knowledge or reactions or awareness or perception* or opinion or views or debate* or discussion* or image or popularity or desirab* or demand).ti. (409599)
- 7 ((frequency adj5 ("use" or usage)) or (real-world adj5 ("use" or usage))).tw. (12469)
- 8 (("use" or usage) and (frequency or prevalence or among or change* or emerg* or factors or associations or trends or traditional or conventional or locations)).ti. (31844)
- 9 motivation/or perception/or awareness/or attitude/or attitude to health/or public opinion/or consensus/or focus groups/or social desirability/or consumer behavior/ (252874)
- 10 (internet or social media or Facebook or Twitter or YouTube).ti. or internet/ or social media/(59745)
- 11 5 and (6 or 7 or 8 or 9 or 10) (300)
- 12 (vaping or behavio?*).ti. or (smoking sensation or smoking characteristics or sensation seeking).tw. or sensation/ or smoking/px or electronic cigarettes/px (247982)
- 13 5 and 12 (135)

table continues

Search Strategy

- 14 harm reduction.ti. or harm reduction.ot. or harm reduction/ (2185)
 - 15 5 and 14 (68)
 - 16 (relative harm or product harm or cessation).ti. or (relative harm or product harm or cessation).ot. (11395)
 - 17 smoking cessation/ or "tobacco use cessation" / or health behavior/ or risk reduction behavior/ or treatment outcome/ (768920)
 - 18 (effect or effects or efficacy or effectiv* or benefit or evidence* or consequences or impact or success* or public support or comparison or compared or control policies or strateg* or cochrane or foundation).ti. (2501872)
 - 19 5 and (16 or 17) and 18 (58)
 - 20 (marketing or advertis* or commercials or communicating or communicat*).ti. (60382)
 - 21 marketing/ or commerce/ or communication/ or exp advertising as topic/ or advertisements.pt. (102541)
 - 22 5 and (20 or 21) (131)
 - 23 (policy or policies or strateg* or public health or legislat* or regulat* or guideline* or government* or ban or bans or taxes or tax or taxation*).ti. (635686)
 - 24 health policy/ or public policy/ or public health/ or social control policies/ or social control, formal/ or government regulation/ or legislation, medical/ or smoke-free policy/ or air pollution, indoor/lj or workplace/lj or restaurants/lj or smoking/lj or taxes/ or health promotion/ (235485)
 - 25 (guideline or legislation).pt. (15644)
 - 26 5 and (23 or 24 or 25) (274)
 - 27 (effect or effects or efficacy or effectiv* or benefit or evidence* or consequences or impact or success* or public support or comparison).ti. (2373199)
 - 28 26 and 27 (24)
 - 29 (tobacco product*.ti. or tobacco products/) and (harm*.ti. or harm*.ot. or harm reduction/) (72)
 - 30 11 or 13 or 15 or 19 or 22 or 28 or 29 (605)
 - 31 (english or dutch).lg. (20815326)
 - 32 30 and 31 (591)
 - 33 (letter or comment or news).pt. (1342230)
 - 34 32 not 33 (505)
 - 35 remove duplicates from 34 (498)
-

Appendix 2 Decision tree of Exclusion criteria in hierarchical order.

Chapter 2

Perceptions and Reasons Regarding E-Cigarette Use among Users and Non-Users: A Narrative Literature Review

#1 not e-cigarette

Does the article describe a subject which is not the electronic cigarette (e-cigarette), vaping/vapor? often "e-cigarette/vaping" etc. is not mentioned in the title?

Does the article describe tobacco, smoking or alternative tobacco products without mentioning the e-cigarette?

Does the article describe a subject which is Yes? EXCLUDED based on exclusion criterion, #1.

No? Move on to exclusion criterion #2.

#2 toxicology and vaping behavior

Does the article discuss the chemical composition of alternative tobacco products (e-cigarettes are thus clearly mention (otherwise excluded at #1)?

Does the article describe the physiological response to e-cigarette use?

Does the article describe toxicological effects of e-cigarette use?

Does the article describe the use of non-human subjects?

- psychopharmacological properties,
- chemical characteristics,
- also testing for toxicity or safety, toxicological properties
- pharmacological attributes of nicotine,
- components of e-liquids (Gas Chromatography-Mass Spectrometry analyses),
- mention aerosol, air quality,
- Topography,
- Effectiveness (not in relation to harm reduction) of nicotine delivery
- Safety/risks of an e-cigarette (use),
- or ingredients,
- burden of disease or
- innovations regarding e-cigarettes?
- health as an outcome,
- nicotine health risks,
- lung disease,
- cancer,
- mental illness,
- blood levels
- nicotine intake,
- cravings (not as a subjective reasons given for e-cigarette use, but tested (e.g., experimental setting)
- comorbidity/relation with disease/ mental
- dependency (i.e., drug/alcohol use in combination with e-cigarette use)

Yes? EXCLUDED based on exclusion criterion #2.

No? Move on to exclusion criterion #3.

table continues

#3 opinion article

Does the title or abstract revolve around or phrased in a way an opinion or stands with regard to the e-cigarette?	For example, feelings about the e-cigarette debate, or opinions about the e-cigarette or titles that suggests an opinion towards the e-cigarette, or analyzing debates/opinions? Usually, the title is framed as a question (e.g., "E-cigarettes: a nicotine gateway?")
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Yes? EXCLUDED based on exclusion criterion #3

No? Move on to exclusion criterion #4

#4 market or marketing

Does the article describe the market of alternative tobacco products (specifically mentioning e-cigarettes)?	Not related to participants describing awareness of e-cigarettes as a result of marketing strategies
Does the article describe marketing/ advertising of alternative tobacco products (specifically mentioning e-cigarettes)?	
Examples	<ul style="list-style-type: none">· Market trends,· Sale points of e-cigarettes,· Retail,· Types of e-cigarettes on the market,· The increase in sales of e-cigarettes· The role of advertising on use

Yes? EXCLUDED based on exclusion criterion #4.

No? move on to exclusion criterion #5.

#5 harm reduction

Is the article about harm reduction/ smoking cessation?	EXCEPTION: But Not Perceptions Of Study Participants Regarding Perceptions Of Harm Or Perceived Effectiveness As Smoking Cessation. Other than participants describing the use of an e-cigarette as a form of harm perceptions or as a reason why the use the e-cigarette?
Does the article discuss smoking cessation, with the e-cigarette as a tool	<ul style="list-style-type: none">· Measured effectiveness as smoking cessation aid· Evaluated the intention to quit smoking using e-cigarettes

Does the article discuss the public health debate surround the e-cigarette?

Yes? EXCLUDED based on exclusion criterion 5#

No? move on to exclusion criterion #6

table continues

#6 e-cigarette regulation

Does the article revolve around policy work/regulation/tobacco control/policy recommendations?	· Asking for policy change,· Describes policy change with regard to the e-cigarette,· The e-cigarette as a form of harm reduction policy (other than users describing perceptions of harm),· The e-cigarette in relation to tobacco control?

Yes? EXCLUDED based on exclusion criterion #6

No? move on to exclusion criterion #7

#7 subjective reports

Does the article describe the use of the e-cigarette by as rehabilitation?	· The use of e-cigarettes in out-patient centers,
Does the article describe the use of e-cigarettes in institutionalized participants (not stop smoking services)	· Psychiatric clinics etc.
Does the article describe patterns of awareness?	· How to use the e-cigarette?
Does the article describe patterns of use?	· Opinion on use other than users' opinions themselves
	· No subjective reports of perceptions or reasons provided
	· Only description of awareness and patterns of use.
	· Alternative use for other drugs, such as marijuana.

Yes? EXCLUDED based on exclusion criterion #7

No? move on to exclusion criterion #8

#8 gateway effect

Does the article describe the uptake of e-cigarettes or e-cigarettes as a gateway to other tobacco/drug products by individuals?	EXCEPTION: Not the perception of participants that e-cigarettes are a gateway drug
Does the article describe the risk factors leading to uptake of e-cigarettes without describing subjective reports of perceptions and reasons?	EXCEPTION: Not if risk factors are the perceptions & reasons provided by subjective reports of participants

Yes? EXCLUDED based on exclusion criterion #8

No? move on to exclusion criterion #9

#9 not an article

Is it not an article, but newspaper dissertations, narratives, commentaries, gray literature, and editorials were excluded etc.?

Yes, fill in "NO", and as exclusion criterion #9

No? move on to exclusion criterion #10

No? Fill in "MAYBE, appropriate for inclusion"
(End of exclusion criteria screening, continue for full text)

table continues

#10 conflict of interest

Is there a conflict of interest?	· Financial relationship questionable
	· Related to the tobacco industry
-

#11 age restriction apply

Does the article include samples with unclear age restrictions?	· The article mentions age restriction for grades, however, not specific for age. If the grade falls well within the age restriction of <18, that age restriction do not apply. If students can be 18 or 19. Age restriction apply
Does the article include a sample with overlap of adults and adolescents	· Age 15 to 19 years old
	· 17 to 21 years old
	· Etc.
-

Appendix 3 summary of the major relevant findings of included articles

Chapter 2 Perceptions and Reasons Regarding E-Cigarette Use among Users and Non-Users: A Narrative Literature Review				
First Author	N	Country	Brief study description	Major relevant findings
¹ Adkison, O'Connor, Bansal-Travers, et al. ¹	US (n=1,520), UK (n=1,325), Canada (n=1,581), Australia (n=1,513); total n=5,939	US, UK, Canada, Australia	International Tobacco Control (four-country) survey). Cross-sectional data from the US (n=1,520), UK (n=1,325), Canada (n=1,581), Australia (n=1,513) total n=5,939. Types of user as defined by authors: 'Current smoker; smoked at least 100 cigarettes in their lifetime and at least 1 cigarette in the past 30 days. 18 years or older current (at least 100 cigarettes lifetime and 1 cigarette past 30 days) and former smokers.'	PERCEPTIONS less harmful than traditional cigarettes: all: 70.3%; Canada: 63.9%; U.S.: 65.9%; UK: 82.2%; Australia: 71.0%. Perception of harm was higher in the US than UK (i.e. e-cigs are legal), and higher in Canada than Australia (i.e. e-cigs are banned). 79.8% using e-cigs because considered less harmful than traditional cigarettes; 75.4% used e-cigs to help reduce smoking; 85.1% using e-cigs to help quit smoking. Those who reported that e-cigs were less harmful than traditional cigarettes had nearly four times greater odds of trying e-cigs. (e-cigs users were more likely to have reduced their cigarettes per day between waves than non-users).
² Amato, Boyle, Levy ²	N=9304	US	The 2014 Minnesota Adult Tobacco Survey; a cross-sectional sample of Minnesotan adults aged 18 years or older. Types of user as defined by authors: 'Past users 0 days in past. Infrequent users 1–5 days in past. Intermediate users 6–29 days in past. Daily users; Every day in past.'	REASONS Goal oriented: To quit other tobacco products, to cut down, less harmful, to use them in places where other tobacco is not allowed, affordable. Non-goal oriented: curiosity, menthol flavor, other flavors.
³ Ambrose, Rostrom, Johnson, et al. ³	n=24,658	US	National Youth Tobacco Survey (N=24,658); cross-sectional. Types of user as defined by authors: 'Current smokers: individuals who reported smoking on. At least one of the past 30 days. Ever smokers: those who reported ever having tried cigarette smoking but not smoking within the past month. Dual use: any reported past 30 days use of e-cigarettes among current cigarette smokers. 11–18 years old; non-users, smokers and e-cigarette users current; (1 in past 30 days) ever and never cigarette smokers.'	PERCEPTIONS 30.6% overall believed e-cigarettes to be less harmful than regular cigarettes, 25.0% of never smokers, 41.3% of ever smokers, and 54.2% of current smokers 64.2% perceived harmfulness cigarettes dose-dependent.

First Author	N	Country	Brief study description	Major relevant findings
⁴ Anand, McGinty, O'Brien, et al. ⁴	N=2769	US	Cross-sectional data from the US (n=2,769) among youth. Types of user as defined by authors: 'Current use: past 30 day use. Ever use: lifetime use.' 14-18 years old; e-cigarette users, smokers and other tobacco product users	PERCEPTIONS 60% minor health hazard. Healthier (7.5%), safer (6.9%), can be used anywhere (5.4%), do not have harmful chemicals (3.4%), mimic tobacco smoking (6.0%), trendier (3.5%), easier to get (2.0%), and more affordable (1.2%) safer (6.9%), no harmful chemicals (3.4%). REASONS helped to smoking cessation (31.0%) 51% of e-cigarette users and 28% of non-cigarette users, accessibility (2.0%); (most accessible from friends (35.9%)), health benefits (7.5%), avoid smoking restriction (5.4%), mimic smoking (6.0%), trends (3.5%), costs (1.2%). E-cigarettes most accessible from friends (35.9%) tobacco stores (23.5%), gas stations (17.2%), and family (13.2%). REASONS Smoking cessation, cut back on smoking, alternative way of tobacco consumption, costs, health benefit, withdrawal symptoms, satisfaction
⁵	N=12	Malaysia	Qualitative research (interviews) with 21 – 40 year old e-cigarette users. Types of user as defined by authors: 'Past and current users (have been using for <1 year, > 1 year, more than 2 year), of e-cigarettes). Past users are not specified.'	
⁶ Bauhoff, Montero, Scharf ⁶	N=796	US	Cross-sectional survey using an online platform (n=796). Types of user as defined by authors: 'Participants were never smokers (56%) or ever smokers (44%). 72% never tried e-cigarettes. 18 to 64 years old. Those who were aware of e-cigarettes were asked if they had "ever used" e-cigarettes and how often they used e-cigarettes in the last 30 days.'	PERCEPTIONS believe that e-cigarettes can help smokers quit smoking (58%), less harmful than smoking (64%); not less addictive than smoking (27%). current smokers more likely that e-cigarettes could help smokers quit (64%) ever smokers more likely than never smokers to believe that e-cigarettes are cheaper than regular cigarettes. REASONS top reasons: to reduce or quit smoking (58%), curiosity (19%), less smelly than cigarettes (19%). Perceived healthier (13%) can replace smoking cessation products (13%).

table continues

First Author	N	Country	Brief study description	Mayor relevant findings
⁷ Baweja, Curci, Yingst, et al. ⁷	n=200	US	Mixed methods, self-report with open-ended questions (n=200). Types of user as defined by authors: 'Current adult e-cig users (current user is not specified).' All adult (18 years or older) e-cigarette users, median age 40.5 years.	<p>PERCEPTIONS perceived as less harmful than smoking (36.5%). Safe way to use nicotine</p> <p>REASONS health benefit (36.5%), smoking cessation (25%), vape quality (94%), battery life (82%) and liquids (59%). Starting e-cig use to quit tobacco soon (73.5%), e-cigs help quit smoking (93.5%). Pleasurable, improve sense of smell and taste, costs, routine maintenance, no odors, social environment. Device characteristics (design; ability to control voltage, simple to operate and maintain, durability, consistent performance of e-cig device and experience, taste and variety of flavors; throat hit, compatibilities of variety of e-cig components, machine quality, cost of e-cigarette device, battery life, tank size, safety features, easy availability of e-cigs, and the ability to customize liquids and coils), smoking cessation and reduced cigarette consumption, unexpected health effects; improved breathing; decreased cough, fewer sore throats; pleasure & smoking-related actions; less toxic than smoking tobacco; sense of smell and taste; less expensive than cigarettes; feasibility to use e-cigs; similar gestures or action of smoking cigarette; no unpleasant odors; taste and variety of flavors; safe for others or bystander with no second hand smoke; cravings; dental health.</p>
⁸ Berg ⁸	n=1,567	US	Cross-sectional (n=1,567) Types of user as defined by authors: 'Current smoker; smoked in the past 30 days. Former smoker; smoked more than 100 cigarettes in their lifetime but did not smoke in the past 30 days.' 18-34 years old; REASONS for use among current e-cigarette users	<p>PERCEPTIONS electronic cigarettes were perceived as one of the least harmful (41%), addictive and most socially acceptable.</p> <p>REASONS less harmful than cigarettes (77%), do not smell (77%), smoking cessation (66%), costs (62%), weight management (6.6%) avoid smoking restrictions (25.2%), socially acceptable (48.7%), flavors (60.2%).</p>

First Author	N	Country	Brief study description	Major relevant findings
⁹ Biener, Hargraves ⁹	n=695	US	Mixed methods, self-report (n=1,374) and interviews (n=695) Types of user as defined by authors: 'Level 3 = intensive users: used daily for at least 1 month. Level 2 = intermittent users: used more than once or twice but not daily for a month or more. Level 1 = non-users or at most once or twice.' Adult smokers (18 - 65 years old); motivation among e-cigarette users	REASONS to smoking cessation 52.6%, avoid smoking restriction 5.6%, social environment (16.1%), Cut back 4.5%, health benefit 8%. PERCEPTIONS e-cig healthier than regular cigarettes (16.1%).
¹⁰ Biener, Song, Sutfin, Spangler, Wolfson ¹⁰	n=4,740	US	Self-report (n=4740) Types of user as defined by authors: 'Current smokers: those who had at least smoked 100 cigarettes and either smoked every day or some days. Former smokers: those who had at least smoked 100 cigarettes but now smoked not at all. Never smokers: those who denied having smoked 100 cigarettes in their lifetime or never used any tobacco products.' 18-35 years old; motivation asked among smokers	REASONS Curious 61.2% Current smokers; 59.1% former smokers; 77.3% Never smokers; Better for health than cigs 55.1% Current smokers; 42.7% Former smokers; 17.2% Never smokers; Friends use it 30.9% Current smokers; 28.1% Former smokers; 46.0% Never smokers; Can use in no-smoking areas 43.1% Current smokers; 33.8% Former smokers; Help to quit smoking 35.9% Current smokers; 40.1% Former smokers ; Cut down on smoking 41.1% Current smokers; 18.5% Former smokers; Doesn't smell bad 42.7% Current smokers; 37.8% Former smokers; 25.9% Never smokers.
¹¹ Bold, Kong, Cavallo, Camenga, Krishnan-Sarin ¹¹	N=340	US	Longitudinal survey ever users, age 14 – 17. Types of user as defined by authors: 'Students were selected as ever e-cigarette users if they responded "yes" to the question "have you ever tried an e-cigarette".'	REASONS Interest: Curiosity, It is cool. Desirable attributes: Good flavors, Does not smell bad, and Hide from adults; Low cost. Social norms: Friends use, Parents/family use. Can use anywhere. Goal-directed: To quit smoking cigarettes, Healthier than cigarettes.
¹² Brose, Brown, Hitchman, McNeill ¹²	2012 n=4,553, 2013 n=1,588, 2014 n=1,204	UK	UK cohort study (n=4,553 in 2012, n=1,588 in 2013 & n=1,204 in 2014). Types of user as defined by authors: 'Current use: used e-cigarette daily, less than daily but at least once a week, less than weekly but at least once a month and less than monthly. Current smoker: Smoke cigarettes every day, not every day, or smoke tobacco of some kind. Ex-smoker: stopped smoking in the past year or more than a year ago.' smokers and former smokers 18 years or older	PERCEPTIONS E-cigarettes perceived as less harmful than combustible cigarettes, but changed overtime (66.6%: 2012; 66.5%: 2013; 60.4%: 2014)

table continues

First Author	N	Country	Brief study description	Mayor relevant findings
¹³ Brown, West, Beard, et al. ¹³	n=4,117	UK	Cross-sectional (n=4,117) Types of user as defined by authors: 'Current smokers: smoke every day, not every day or smoke tobacco of some kind but not cigarettes. Recent ex-smokers: stopped smoking completely in the last year.' 18 years or older Current smokers and recent ex-smokers	PERCEPTIONS Perceived as less harmful Current smokers 67.6% believe less harmful; ex-smokers 63.2% less harmful REASONS Health benefit, cutting down & quitting (current uses), taste (ex-smokers) Among Current users of e-cigarettes: health benefit: 82.6% current smokers, 83.5% recent ex-smokers; taste: 24.4% current smokers, 39.4% recent ex-smokers; cutting down: 83.0% current smokers, 78.9% recent ex-smokers; temporary abstinence: 70.2% current smokers; 47.7% recent ex-smokers; quitting: 82.8% current smokers, 84.4% recent ex-smokers
¹⁴ Chaffee, Gansky, Halpern-Felsher, et al. ¹⁴	n=104	US	Cross-sectional (n=104) Types of user as defined by authors: 'Current use: participants who had use e-cigarettes on one or more days in the past 30 days Ever use: participants who had hear of electronic cigarettes and ever used e-cigarettes, even once or twice.' All male 13-18 years old; e-cigarette users and non-users	PERCEPTIONS Believed to be likely (40% - 75%): decreased athletic performance, trouble breathing, coughing, lung cancer, heart attack mouth cancer, mouth sores. Believed to be likely (40% - 80%): upset your family, get into trouble, upset friends, bad breath, addictive, dental issues, harmful for others. Believed to be beneficial (15% - 60%): relaxed, cool, fit in more, feel alert, and increased performance. Decreased athletic performance 57.3% never users, 28.0% ever users; Trouble catching your breath 54.7% never users, 19.2% ever users; Bad cough 53.2% never users, 23.9% ever users; Lung cancer 52.2% never users, 21.8% ever users; Heart attack 48.7% never users, 16.8% ever users; Mouth sores 45.5% never users, 20.8% ever users; Upset your family 68.2% never users, 38.2% ever users; Get into trouble 56.8% never users, 54.0% ever users; Upset your friends 50.2% never users, 18.4 % ever users; Bad breath 49.9% never users, 23.8% ever users; Become addicted 49.7% never users, 37.6% ever users; Brown teeth 41.5% never users, 17.2% ever users; Harm someone nearby 38.7 never users, 19.7% ever users.

First Author	N	Country	Brief study description	Major relevant findings
				<p>REASONS Feel more relaxed 44.6% never users, 50.2% ever users; Look cool 39.2 % never users, 45.8 % ever users; Fit in more 33.2% never users, 36.4% ever users; Feel more alert 27.7% never users, 26.4% ever users; Increased athletic performance 18.0% never users, 19.2% ever users;</p> <p>REASONS Young adults: to continue e-cigarette use was that it kept them from smoking, to help them cope with stress, rewarding feelings of hand-to-mouth motions, form of entertainment, immediate health benefits, not smelling like smoke. Flavors filled a positive role as they were often a way to connect with other e-cigarette users, and a reason for continuing to use e-cigarettes, always many more to try, flavor made e-cig use more attractive than smoking. Dual use: help to cope with stress when exclusive use is not enough, bond with other smokers, convenience in a particular situation, influence young adult smokers with positive comments about e-cigs, family members introduced young adults to e-cigarettes, family member influence decision to start e-cigarette use, friends played a supportive role in initiation of e-cig use and continuation. It is perceived as socially acceptable behavior.</p>
¹⁵ Cheney, Gowin, Wann	N=30	US	Qualitative interviews (n= 30) in the US. Aged 19 -24 years old. Types of user as defined by authors: 'E-cigarette and dual users. (2) current use (within the past week) of e-cigarettes.'	
¹⁶ Coleman, Johnson, Tessman, et al.	n=116	US	Qualitative research (focus groups n=116). Types of user as defined by authors: 'Current use: use of an e-cigarette product in the past 30 days.' 18-30 years old; current e-cig users	<p>PERCEPTIONS Persisted that e-cigarettes are less harmful. E-cigarettes a method to reduce or quit smoking, where smoking is not permitted, the perception of e-cigarettes as more socially acceptable, and the availability of a variety of flavors. Lack of knowledge about e-cigarettes ingredients affect in general and on health. Most tried e-cigarettes for the first time with friends, and overall, friends are positive.</p> <p>REASONS Ability to use as a smoking cessation method, avoid smoking restriction, socially acceptable, health benefit. However, not mimic smoking.</p>

table continues

First Author	N	Country	Brief study description	Mayor relevant findings
¹⁷ Dockrell, Morrison, Bauld, McNeill	Structured interview, n=1,380 & self-report, n=25,029 (2010 n=12,587; 2012 n=12,432)	UK	Mixed methods (structured interview, n=1,380 & self-report, n=25,029) Types of user as defined by authors: 'smoking status: never-smoking, ex-smoking, occasional, and daily smoking. 18 years or older; both smokers (smokers' survey) and general population (population survey).'	PERCEPTIONS Believed to aid smoking cessation efforts: 60% satisfy the desire to smoke, 55% Cut back on e-cigarettes, 53% believed it expensive. 51% help quit entirely, 39% believed it might not satisfy the desire to smoke, 71% perceived e-cigarettes as less harmful than combustible cigarettes. 28% considered them less harmful than Nicotine Replacement Therapy (NRT). REASONS Avoid smoking restrictions (43%), 35% to smoking cessation, 31% cut back on smoking.
¹⁸ Dutra, Glantz	2011 n=17,353, 2012 n=22,529	US	National Youth Tobacco Survey (n=17,353 in 2011 & n=22,529 in 2012): Types of user as defined by authors: 'Experimenters; Have you ever tried cigarette smoking, even one or two puffs? 'Yes.' Ever smoker: 100 or more cigarettes (5 or more packs) of lifetime smoking. Current smoker; had smoked at least 100 cigarettes and smoked in the past 30 days. Ever e-cigarette users: adolescents who responded 'electronic cigarettes or e-cigarettes, such as Rayan or NJOY' to the question 'which of the following tobacco products have you ever tried, even just 1 time?' Current e-cigarette users: those who responded 'e-cigarettes' to the question 'during the past 30 days, which of the following tobacco products did you use on at least 1 day?' Dual ever use: who have ever used e-cigarettes and ever smoked conventional cigarettes. Dual current use: who are currently using e-cigarettes and conventional cigarettes? 11-18 years old; Ever and current e-cigarette users.'	REASONS Among current smokers, motives for ever e-cigarette use was related to quitting combustible tobacco use. smoking cessation
¹⁹ Eastwood, Dockrell, Arnott, et al.	2013 n=2,062, 2014 n=1,952	UK	11-18 years old. Types of user as defined by authors: population not stratified. never smokers, former smokers, current smokers	PERCEPTIONS Some perceived e-cigarettes to be less harmful to the user decreased significantly, from 73.4% in 2013 to 66.9% in 2014. Considered e-cigarettes to cause about the same level of harm to the user increased from 11.8% in 2013 to 18.2% in 2014. Believing them to be less harmful decreased from 78.5% in 2013 to 73.1% in 2014, and similar levels of harm increased from 8.0% to 12.0%.

First Author	N	Country	Brief study description	Major relevant findings
²⁰ Etter	n=81	France, Canada, Belgium & Switzerland	Self-report (n=81) Types of user as defined by authors: 'daily user, non-daily user, former user, never used. Smoking status: daily, non-daily, former smoker, never smoker.' 19-65 years old; Ever e-cigarette users	REASONS To quit smoking, for health benefits (e-cigarettes were perceived to be less toxic than tobacco), less expensive than regular cigarettes, can be smoked everywhere (including smoke-free places), to avoid disturbing other people, or producing environmental tobacco smoke or the smell of stale smoke, for the pleasure of smoking (including the pleasure of inhaling and smoking related actions), to reduce cigarette consumption, curious to test a new product, e-cigarettes taste and smell good, previously failed quit attempts, to get nicotine, unexpected health effects.
²¹ Etter, Bullen	n=3,587	62% US, 14% France, 6% UK, 4% Switzerland, 3% Canada, 11% other countries	Self-report (n=3,587) Types of user as defined by authors: 'Daily users, occasional users (not daily), past users (used e-cigarettes in the past), and never users (never used e-cigarettes). 18 years or older e-cigarette users, smokers and non-smokers.'	PERCEPTIONS Less harmful than tobacco 83.5% REASONS Smoking cessation (76.8%), deal with cravings (79%), withdrawal symptoms (67%), costs (57.3%), avoid smoking restrictions (34%) (avoid going outside is 34.4%, avoid situations where you cannot smoke is 39.4%, social environment (to avoid bothering other people with tobacco smoke (44%)), avoid smoking restrictions (39%), cut down tobacco 28%), unable to stop using it (4%). Current smokers: helped them to reduce their smoking (92%). Former smokers: (96%) said that it helped them to quit smoking. Ever users: (89%) said that it was easy to abstain from smoking while using the e-cigarette
²² Falletau, Glover, Nosa, Pienaar	n=20	New-Zealand, Auckland	Qualitative Research (Focus groups n=20) Types of user as defined by authors: Children aged 6-10 years; non-users	PERCEPTIONS Children thought it looked cool, viewed as an imitation cigarette, viewed as smoking.

table continues

First Author	N	Country	Brief study description	Mayor relevant findings
²³ Ford, Mackintosh, Bauld, Moodie, Hastings ²³	n=20	New-Zealand, Auckland	Youth Tobacco Policy Survey (n=1205); cross-sectional Types of user as defined by authors: 'Regular smokers: at least one cigarette a week. Occasional smoker's less than one cigarette a week. Never smokers: those who had never tried smoking, not even a puff or two. Ever smokers: regular smokers, occasional smokers, those who used to smoke and those who had tried smoking only once. 11-16 years old; ever (at least one cigarette a week), occasional smokers (less than one a week), those who used to smoke and those who had tried smoking only once, and never smokers.'	PERCEPTIONS Perceived harm differed for flavors, with candy and fruit flavors considered less harmful than tobacco flavors. Perception of flavor matching goal of using e-cigarettes (e.g., adult smoker giving up smoking would favor tobacco flavors).
²⁴ Gowin, Cheney, Wann ²⁴	N=30	US	Qualitative research (semi-structured individual interviews n=30) with current e-cigarette users. Types of user as defined by authors: 'Current use of e-cigarettes (at least once per week). Young adults (19-31) who go straight to work (STW) from high school.'	PERCEPTIONS E-cigarettes are healthier and a safer, e-cigarettes are cheaper, e-cigs are healthier and safer from themselves, it is a safer option than smoking, it is healthier and safer for others, no secondhand smoke, nice smell, less harmful, environmental friendlier and reduces less waste. REASONS Healthier, safer, cheaper, safer for self and other, environmental friendlier than smoking
²⁵ Hess, Antin, Annechino, Hunt ²⁵	N=46	US	Qualitative research (focus groups n=46). Age 18 – 25 years old. Types of user as defined by authors: No type of user or frequency specified.	PERCEPTIONS Utilitarian function and a social function. Social identity of e-cigarettes is described as different form the participants, described with an "us versus" them attitude. Utilitarian function neither as smoking reduction or cessation nor to minimize craving when smoking is prohibited.
²⁶ Hilton, Weishaar, Sweeting, Trevisan, Katikireddi ²⁶	N=86	UK	Qualitative research (focus groups n=86). Age 14 – 17 years old. Types of user as defined by authors: 'Smoking status: do you smoke cigarettes at all nowadays? And which statement describes you best: never tried, not even a puff or two; once had a puff or two, but never smoke now; do you sometimes smoke? E-cigarette use: do you use e-cigarettes at all nowadays? And which statement describes you best: never tried, not even a puff or two; once had a puff or two, but never use e-cigarettes now; do you sometimes use e-cigarettes?'	PERCEPTIONS Potential health harms and unknown harmful ingredients. Unsure whether e-cigarettes are more or less addictive than conventional cigarettes. REASONS Great flavor, colors, fun tricks, fitting in, looking cool.

First Author	N	Country	Brief study description	Major relevant findings
²⁷ Huerta, Walker, Mullen, Johnson, Ford ²⁷	N= 3630 in 2012 N= 3185 in 2013 N= 3677 in 2014 Pooled n= 10,273	US	Health Information National Trends Survey (HINTS) 2012 -2014. Types of user as defined by authors: 'Smoking status was defined in the same manner for this study and the original study, defining non-smokers as those who have smoked <100 cigarettes during their lifetime, current smokers as those who have smoked >100 cigarettes and are still smoking every day or most days, and former smokers as those who have smoked >100 cigarettes in their lifetime and are not smoking now. US adults (18>) smokers, former smokers and non-users.'	PERCEPTIONS Perceived harm declined slightly from 2012 to 2014 (50.7% to 43.1%). Current and former smokers had higher odds of perceiving e-cigarettes as less harmful.
²⁸ Kahr, Padgett, Shope, et al. ²⁸	N=87	US	Qualitative research (focus group n=87); Types of user as defined by authors: 'pregnant women's beliefs of e-cigarette users during pregnancy; use not specified.' adult pregnant women; non-users.	PERCEPTIONS Compared to combustible cigarettes, e-cigarettes were perceived as less harmful. However, e-cigarettes were not perceived safe during a pregnancy, damaging to baby, not safe during pregnancy, may be a smoking cessation tool, better alternative than regular cigarettes. Smoking causes health problems during pregnancy, smoking is selfish and irresponsible. Smoking is perceived as not acceptable during pregnancy; not as strong for e-cigarettes. Still risks and not taking care of her baby's health if used.
²⁹ Khoury, Manlhiot, Fan, et al. ²⁹	N=3312	Canada	Self-report (cross-sectional survey n=3312) with n=238 adolescents who tried e-cigarettes at least once. (Age 14-15 years old). Types of user as defined by authors: 'E-cigarette use status: "Have you ever taken at least one puff from an electronic cigarette?" and "If yes, why did you try an e-cigarette?"' (options: "a. It's cool/fun/something new; b. For the buzz; c. To help me quit smoking; d. To help me smoke less; e. To help me when I'm not allowed to smoke"). Smoking status: "Do you smoke now?" and "Think about the last 30 days. Did you smoke a cigarette, even a puff?"	REASONS (among 238 adolescents ever users) cool/fun/new, for the buzz, helps to quit smoking, helps to smoke less, helps when not allowed to smoke.

table continues

First Author	N	Country	Brief study description	Major relevant findings
³⁰ Kim, Davis, Dohack, Clark ³⁰	N=35	US	Qualitative research (focus groups, n= 35). Types of user as defined by authors: 'with adult e-cigarette users (18 – 65 years old) using e-cigarettes for at least two month prior to the study. (1)those who were current users of both e-cigarettes and combustible cigarettes; (2) those who were former combustible cigarette users;'	PERCEPTIONS Perceived as healthier; safer, and cleaner alternative compared to smoking. Respondents feel better; have more energy; breathe easier; cough less since using e-cigarettes.
³¹ Kinnunen, Ollila, Lindfors, Rimpela ³¹	N=10,233	Finland	The 2013 and 2015 Adolescent Health and Lifestyle Survey, which is a cross-sectional postal survey. Types of user as defined by authors: 'Self-report (survey n= 10,233) among Finnish adolescents (12-, 14-, 16- and 18-year-olds obtained from the population register center). Tried e-cigarettes at least once. E-cigarette use: "Have you ever tried electronic cigarettes? How many times altogether?" The options were: "I do not know what they are", "No", "I have tried once or twice", "I have tried 20 times or less" and "I have tried more than 20 times". Frequency was estimated in 2015: "Which one of the following alternatives best describes your current use of e-cigarettes?" with the options "I do not use e-cigarettes", "I use e-cigarettes less than once a week", "I use e-cigarettes once a week or more often, but not daily" and "I use e-cigarettes once a day or more often".	REASONS To try something new, to quit smoking, friends use them, something new to try.
³² Kistler, Crutchfield, Sutfin, et al. ³²	N=34	US	Qualitative research (n=34). Age 18 – 64 years old. Types of user as defined by authors: 'Used e-cigarettes at least once.'	REASONS Reasons included: User Experience (The odor, feel, texture, appearance, taste, cloud chasing, and novelty); Social Acceptability (encouragement or acceptability to use e-cigs and to connect with others who vape vice versa when there is stigmatization or no acceptability to use e-cigs); Cost; Health Risks/ Benefits (health issues or benefits); Ease of Use (The difficulty or ease to manipulate or use an e-cig, availability of products, and setting in which it can be used); Flavor (type of flavors, the mixing of flavors, the smell of flavors); Smoking Cessation Aid; Nicotine Content & the ability to control it; Modifiability; e-cigs Regulation; Dual use; Hobby use.

First Author	N	Country	Brief study description	Major relevant findings
³³ Lee, Lee, Cho	N=6655	Korea	2015 Korean Youth Risk Behavior Web-based Survey (n=6655) age 13 – 18 years old ever e-cigarette users. Types of user as defined by authors: 'Ever conventional cigarette smokers "yes" to the question: "Have you ever tried a cigarette, even one puff, in your life?" Among ever-smokers, current conventional smokers: those who replied from "1 and 2 days" to "every day" for the question, "During the past 30 days, how many days did you smoke cigarettes, even one cigarette?" Ever e-cigarette use: "yes" answer to the following question: "Have you ever tried e-cigarettes?" Current e-cigarette use: those who replied from "1 and 2 days" to "every day" to the question, "During the past 30 days, how many days did you use e-cigarettes?" The number of days that used e-cigarette was re-grouped into 0–2 days/month, 3–9 days/month, and 10 days/month.'	REASONS Among ever e-cigarette users: curiosity (22.9%), belief that they were less harmful than conventional cigarettes (18.9%), to quit smoking (13.1%), to smoke indoors (10.7%). For infrequent e-cigarette users (<3 per month), curiosity was the most frequent reason for e-cigarette use (28.8%). For more frequent e-cigarette users (>10 per month), to quit smoking (21.0%) and indoor use (19.5%) were the most frequent reasons for e-cigarette use. The belief that e-cigarettes are less harmful was a common reason for use among both less (<3 per month) and more (>10 per month) frequent users of e-cigarettes (19.3% and 17.9%, respectively).
³⁴ LeVault, Mueller-Luckey, Waters, et al.	N=309	US	Based on the Minnesota Adult Tobacco Survey (2010) and the Brief Smoking consequences Questionnaire –Adult. Types of user as defined by authors: 'N=309; there were 235 current cigarette smokers consisting of 79 who smoked only cigarettes (smokers); 122 who used both cigarettes and e-cigarettes (dual users); and 34 former e-cigarette users. Only smokers and dual users were included in this analysis. 18 years or older.'	REASONS Reasons for dual use were to reduce or to quit smoking (79.5%).
³⁵ Li, Bullen, Newcombe, Walker, Walton	n=840	New-Zealand	The New Zealand Smoking Monitor (n=840) Types of user as defined by authors: 'Sample of current smokers: who smoked at least one cigarette a month and who had not made a quit attempt lasting 24 hours or more in the past three months, and those who have made a quit attempt lasting 24 hours or longer in the past three months which may or may not have been sustained. Use of e-cigarettes not specified.' Current smokers and recent quitters 18 years or older	PERCEPTIONS One-third agreed that e-cigarettes were safer than tobacco cigarettes (n=158) and agreed e-cigarettes could help people quit smoking (n=162)

table continues

First Author	N	Country	Brief study description	Major relevant findings
³⁶ Li, Newcombe, Walton	(n=2594)	New-Zealand	The New Zealand Smoking Monitor (n=2594) Types of user as defined by authors: 'Ever use: Have you ever tried an electronic cigarette? Current use: which best describes how often you use an electronic cigarette now? At least once a day/at least once a week/at least once a month. Current smoker's non-attempter: smoked at least one cigarette a month and who had not made a quit attempt lasting 24 hours or more in the past three months. Recent quit attempters: those who have made a quit attempt lasting 24 hours or longer in the past three months which may or may not have been sustained.' Current smokers and recent quitters 18 years or older.	REASONS 57.1% curiosity, 31.3% wanted to quit, 8.4% alternative for tobacco cigarettes, 2.8% due to a recommendation, 2.5% safer, 2.4% avoid smoking restrictions, 1.2% costs (among ever users). 15.4% curiosity, 50.9% wanted to quit, 21.7% alternative for tobacco cigarettes, 0.8% due to a recommendation, 4.9% safer, 10.3% avoid smoking restrictions, 6.1% costs (among current users).
³⁷ Lotrean	N=480	ROMANIA	Cross-sectional data from Romania (n=480) among students Types of user as defined by authors: 'Smokers: individuals who had smoked in the past month. Ex-smokers: those who had smoked in their lifetime but not in the past month. Non-smoker: those who had not smoked traditional cigarettes. Ever e-cigarette use: had tried at least once in lifetime. Students aged 19–24. 53.3% of the smokers, 25% of the ex-smokers and 5.5% of the non-smokers had tried e-cigarettes. Definition of use is not provided.'	PERCEPTIONS E-cigarettes are less dangerous; overall 55.9%. Ever users; 62.3% smokers; 33.3% former smokers; 58.7% non-smokers; E-cigarettes can help smokers to quit; overall 66.4%. Ever users; 46.1% smokers; 70.8% former smokers; 79.4% non-smokers; E-cigarettes are used only by smokers; 48.9% overall; 51.3% smokers; 50.0% former smokers; 46.8% non-smokers. REASONS E-cigarettes are less dangerous 8% overall; 0% smokers; 50% former smokers; 0% non-smokers; To quit smoking 23.2% overall; 31.7% smokers; Curiosity 62.5% ever users; 65.9% smokers; 50.0% former smokers; 58.3% non-smokers; Other friends also tried e-cigarettes 23.2% overall; 25.6% smokers; 0% former smokers; 41.7% non-smokers.
³⁸ Majeed, Stanton, Dube, et al.	N=14	US	Qualitative research (focus groups (n= 14)). Types of user as defined by authors: 'Current cigarette users (adults: 18 years or older) who ever used e-cigarettes. (self-identified as current smokers; had used e-cigarettes, even once).'	REASONS for experimentation: Curiosity, cravings, coolness, convenience, persuasive persons. Reasons for regular use: cravings, sensory experience, coolness, perceived reduced harm, convenience.

First Author	N	Country	Brief study description	Mayor relevant findings
³⁹ Majeed, Weaver, Gregory, et al. ³⁹	A total of 4,170; 5,717; and 6,051 respondents completed the 2012, 2014, and 2015	US	Tobacco Products and Risk PERCEPTIONS Surveys, cross-sectional, with US adults (18>). Types of user as defined by authors: 'Non-users, smokers, and former smokers. Current smokers were defined as adults who had smoked at least 100 cigarettes during their lifetime and reported currently smoking every day or some days. Former smokers were defined as adults who had smoked at least 100 cigarettes and responded not at all to the question about current smoking. Those who had not smoked at least 100 cigarettes in their lifetime were defined as never smokers.'	PERCEPTIONS There is an increase perception that e-cigarettes are "about the same level of harm" as or to be "more harmful" than cigarettes. Uncertain about harm: decreased (47.8%) in 2012 to 29.5% in 2015.
⁴⁰ Mark, Farquhar, Chisolm, Coleman-Cowger, Terplan ⁴⁰	n=316	US, University of Maryland Women's Health Center	Self-report (n=316) among pregnant women Types of user as defined by authors: 'Current use: past 30 days. Current smokers: smoked within the past 30 days. Pregnant women (66.1 % reported having ever heard of e-cigarettes, 13% reported having any prior or current use of e-cigarettes (ever users), with 0.6% reporting current daily use); 18 years or older.'	PERCEPTIONS Less harmful for baby 43%, less harmful to self (45%), cheaper (31%), fashionable (18%), contain nicotine (57%), addictive (61%), contains tobacco (31%), not as bad for health (74%), taste better (54%), cut down (72%), avoid smoking restrictions (55%), smoking cessation tool (73%).
⁴¹ McKeganey, Dickson ⁴¹	N=650	UK	Self-report (survey n= 650) among smokers. 18 years or older; Types of user as defined by authors: '336 participants reported having tried/used e-cigarettes. No clear definitions provided.	REASONS To avoid smoking bans, flavors available, cheaper than cigarettes, less harmful than cigarettes, attractiveness of the device settings and specifications. Among smokers: switching to e-cig use was more enjoyable than smoking. If this expectation was not met, it led to continued smoking. Also, it was important how the technology worked, how it looked when using e-cigs, how people reacted to them vaping, whether it was a poor substitute for smoking, if they felt embarrassed.
⁴² McQueen, Tower, Sumner ⁴²	n=15	US	Qualitative research (interviews n=15) Types of user as defined by authors: 'past year users, e-cigarette users who started using in the past year. 20-60 years old; e-cigarette users'	REASONS Alternative way of tobacco consumption, smoking cessation, costs, maintain weight, sense of taste, smell, ability to be physically active, health benefit (unexpected and experienced), Cut back on nicotine fix, not smelling of cigarette smoke, immediate effects outweigh potential long-term harm

table continues

First Author	N	Country	Brief study description	Mayor relevant findings
⁴³ Patel, Davis, Cox, et al. ⁴³	N=13,304	US	Internet surveys of U.S. adult conventional cigarette smokers and nonsmokers. N= 10,181 current cigarette smokers; N=3123 nonsmokers aged 18 or older. Types of user as defined by authors: 'Current cigarette smokers = persons who had smoked at least 100 conventional cigarettes in their lifetime and currently smoked either "some days" or "every day" at the time of the survey. Non-smokers were defined as persons who reported smoking "not at all" at the time of the survey, regardless of lifetime number of conventional cigarettes smoked. Current e-cigarette users were defined as those who responded "every day" or "some days" to the question, "Do you now use e-cigarettes every day, some days, or not at all?"	REASONS Among current users: cessation/health (84.5%) (less harmful, reduce number of cigarettes, other friends use them too); consideration of others (less harmful, don't smell); convenience (to avoid smoking bans), curiosity, flavors, costs, simulation of cigarettes. Non-smokers: curiosity, tank users mentioned costs, cessation, and simulation of cigarette sensation.
⁴⁴ Pearson, Richardson, Niaura, Vallone, Abrams ⁴⁴	n=2,649 (online study) & n=3,658 (cohort)	US	Legacy Longitudinal Smoker Cohort (LLSC) (n=3,658) and national cohort (n=2,649) Types of user as defined by authors: 'in both surveys: Never smokers: having never smoked up to 100 cigarettes in their lives. Former smokers: having smoked 100 cigarettes or more in their lives but currently smoking not at all. Current smokers: having smoked in excess of 100 cigarettes in their lives and currently smoking every day or smoke days. 18-49 years old recent quitters and current smokers (n=3,658) and 18 years or older never, former, and current smokers (n=2,649).'	PERCEPTIONS 70.6% of those aware in the online survey and 84.7% in the LLSC believed e-cigs are less harmful than combustible cigarettes.
⁴⁵ Pepper, Emery, Ribisi, Rini, Brewer ⁴⁵	n=6,607	US	Tobacco Control in a Rapidly Changing Media Environment (TCME) (n=6,607 current smokers) Types of user as defined by authors: 'Current use of e-cigarette: using them every day or some days. Ever use: tried e-cigarettes, even just one puff. Adult smokers; 18 years or older (mean age 44.2 years old'	PERCEPTIONS Participants perceived e-cigarettes less likely to cause lung cancer, heart disease, and oral cancer compared to regular cigarettes.

First Author	N	Country	Brief study description	Major relevant findings
⁴⁶ Pepper, Ribisl, Brewer	N=1125	US	Self-report (survey n=1125) age 13 – 17 years old Types of user as defined by authors: 'never smokers/e-cigarette users (89%), 4% current smokers and 5% current e-cigarette users. 3 categories of e-cigarette users: never users, ever users (used ≥ 1 time but not in the past 30 days), and current users (used ≥ 1 time in the past 30 days).'	PERCEPTIONS Perceived fruit-flavored to be less harmful, and were more likely to try menthol, candy or fruit flavored e-cigarettes.
⁴⁷ Pepper, Ribisl, Emery, Brewer	n=3,878	US	Self-report (n=3,878) Types of user as defined by authors: 'Current use: using e-cigarettes either every day or some days. Ever use: trying or starting, even one puff. Adults (18 years or older) who ever tried e-cigarettes.'	PERCEPTIONS Perceived as less harmful (29%) and less harmful to others (23%) REASONS Curiosity (53%), social environment (34%), to quit or cut back (30%), avoid smoking restriction (26%), unexpected benefits (42%), cravings (38%), affordable (28%), flavors (30%), routine maintenance (36%).
⁴⁸ Peters, Meshack, Lin, Hill, Abughosh	N=47	US	Qualitative research (focus groups n=47) Types of user as defined by authors: age 15 – 17 years old male adolescent current e-cigarette users in Texas, US.	REASONS Aesthetics, accessibility, healthier than Cigarettes, Odorless, High Social Approval, Expeditious Consumption and Concealment, Safe High.
⁴⁹ Pineiro, Correa, Simmons, et al.	N=1815	US	Self-report (n=1,815) Types of user as defined by authors: 'Dual users: participants reporting using tobacco cigarettes in the past 30 days, that is, users of both tobacco cigarettes and e-cigarettes. E-cigarettes users: reported smoking no tobacco cigarettes in the past month.' 18 years or older; E-cigarette users	PERCEPTIONS Taste, social environment, throat hit, weight control, addiction. REASONS Smoking cessation tool, health benefit, curiosity, due to family/friends, Cut back smoking, enjoy taste, deal with stress. Self-regulation.
⁵⁰ Pokhrel, Herzog, Muranaka, Fagan	n=62	US, Hawaii	Qualitative research (focus groups n=62) Types of user as defined by authors: 'All participants' current daily e-cigarette users.' 18 - 35 years old; Current daily e-cigarette users and dual users	REASONS Smoking cessation, health benefit, satisfaction, mimic smoking, cut back, avoid smoking restrictions, discreet (hiding use), hobby, social environment, costs

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First Author	N	Country	Brief study description	Major relevant findings
⁵¹ Pokhrel, Herzog, Muranaka, Regmi, Fagan	n=62	US, Hawaii	Qualitative research (focus groups n=62): Types of user as defined by authors: 'All participants' current daily e-cigarette users. Former smokers: reported having smoked more than 100 cigarettes in the lifetime and non in the past 30 days. Current non-smokers: never smoked cigarettes or were former cigarette smokers. 18 - 35 years old; Current daily e-cigarette users and current dual users.' Dual users, 18 years or older	REASONS Dual use: to help with cravings, situational use, places, when other substances are used, need of an e-cigarette substitute. Activities (working, before work out), places/situations (home, inside a vehicle, when you don't want to smell), to avoid smoking restrictions
⁵² Rass, Pacek, Johnson, Johnson	n=350	US	Cross-sectional (n=350) Types of user as defined by authors: 'all participants were dual users of e-cigarettes and tobacco cigarettes.' Dual users, 18 years or older	PERCEPTIONS Less harmful (57% much less, 30% some less), less harmful to others, less enjoyable than cigarettes, additive, NRT perceived as equally harmful as e-cigarettes (59%). 30% not at all addictive, unsure about the dangers of e-cigarettes (22%), unsure about the dangers 22.0% REASONS Less harmful 64%; To cut down smoking tobacco 40%; Avoid smoking restrictions 45%; To quit smoking 34%; cravings 57%; less harmful to others 52%; experienced health benefits 30%; costs 27%; taste 22%; Other (e.g., prefer the smell, reduce stress) 3%; withdrawal 35%; focus 8%; I can't stop using it 1%; With an e-cigarette, it is easier to just smoke one or a few puffs at a time rather than a whole cigarette 45%.
⁵³ Richardson, Pearson, Xiao, Stalgaitis, Vallone	n=1,487	US	Legacy Longitudinal Smoker Cohort (n=1,487) Types of user as defined by authors: 'Current smoker: those who reported smoking 'every day' or 'some days'. Former smoker: those who reported smoking 'not at all'. Current and former smokers '18-49 years old'	PERCEPTIONS Perceived as less harmful than combustible cigarettes overall (61.6% among smokers; 79.2% among ever users, and 65.4 % among aware but non-users). REASONS 55.3% cut back or smoking cessation, 38.1%, avoid smoking restrictions, feels like smoking (62.8%), with former smokers more likely than current smokers (35.5% vs. 16.8%). cost (59.6%), social environment (69.6%), no lingering odor (61.7%), avoid smoking bans (69.0%), with former smokers more likely than current smokers to cite this as a reason for use (92.6% vs. 65.4%).

First Author	N	Country	Brief study description	Major relevant findings
⁵⁴ Rutten, Blake, Agunwamba, et al. ⁵⁴	n=2,254	US	Cross-sectional (n=2,254) Types of user as defined by authors: 'Current smokers: had smoked 100 or more cigarettes during their life and smoke cigarettes currently. E-cigarette users: use e-cig on some days or every day. 18 years or older; Current smokers'	REASONS Reduce health risks 51.9%; Quit smoking 58.4%; Reduce smoking 57.9%; Appealing flavor 14.7%; Not as strong, lighter 15.9%; Addicted to e-cigarettes 7.099%; Curious 16.0%; Stress reduction 11.9%; Cost less 24.5%; Can smoke indoors 46.8%; Less harmful to others 32.9%; PERCEPTIONS Less toxic (46.5%)
⁵⁵ Saddleison, Kozlowski, Giovino, et al. ⁵⁵	(n=429)	US	Cross-sectional (n=1,437) subsample (n=429) Types of user as defined by authors: 'current use: past 30 days divided in current daily (all 30 days) and current non-daily (1 to 29 days of the previous 30 days) users. Discontinued e-cigarette user: ever used, but not in the previous 20 days. Never smokers: never tried a tobacco cigarette, not even a puff. Experimenters: have smoked less than 100 cigarettes in lifetime, and did not smoke any cigarettes in the past 30 days. Discontinued smokers: smoked 100 or more cigarettes in lifetime, but did not smoke any cigarettes in the past 30 days. Current smokers: have smoked at least 1 day out of the past 30 days. 18-23 years old, 29.8% e-cig ever users.'	REASONS Pleasure/enjoying use 57.9%, social environment (20.4%), alternative way of tobacco consumption (18.5%), smoking cessation (14.1%), cravings (13.6%), do not smell like smoke (39.2%), costs (24.9%), to try something new (71.6%), to try something new and to help control appetite (9.1%), I am addicted to the e-cig and because all other smoking cessation methods had failed (5.3%). PERCEPTIONS E-cigarettes are less harmful than tobacco cigarettes: ever e-cig users (32.8%), current (16.3%), never (42.4%).
⁵⁶ Saddleison, Kozlowski, Giovino, et al. ⁵⁶	n=1,437	US	Self-report (n=1,437) Types of user as defined by authors: 'Current use: use on one or more days the past 30 days. Ever use: Have you ever tried or experimented with an e-cigarette, even one or two puffs? Never smoker: never tried a tobacco cigarette. Former smokers: smoked 100 or more cigarettes in lifetime, and have smoked 0 out of past 30 days. Experimenters: have ever tried a cigarette, have smoked less than 100 cigarettes in lifetime and have smoked 0 of the past 30 days. Current smoker: have smoked at least 1 day out of the past 30. 18-23 years old; general population; reports dual use for smokers'	

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First Author	N	Country	Brief study description	Mayor relevant findings
⁵⁷ Schmidt, Reidmohr, Harwell, Helgerson	N=5,067	US	Adult Tobacco Survey (self-report) cross sectional data of noninstitutionalized Montana adults. Types of user as defined by authors: ' "Have you ever used an electronic cigarette, even just one time in your entire life?" ? ever use "Do you now use electronic cigarettes every day, some days ? current e-cigarette users. Adult (18+) ever users of e-cigarettes (who answered the questions regarding REASONS)?	REASONS Curiosity, to quit, less harmful, less disturbing, to avoid smoking bans, taste, costs.
⁵⁸ Sherratt, Marcus, Robinson, Newson, Field	n=319	UK	Cross-sectional (n=319) Types of user as defined by authors: 'Current smokers: smoked one or more cigarettes within the past week. Recent former smokers: did not smoke one or more cigarettes within the past week. Ever e-cigarette use: have ever used an electronic cigarette. Current e-cigarette use: having used an e-cigarette within the past month. Former e-cig user: used within the past 1-6 months or more than 6 months ago. current smokers: Stop smoking service, 18-60 years old'	PERCEPTIONS 48.2% perceived e-cig as less harmful than tobacco. 38.8% felt uncertain about e-cig safer than tobacco. Current users viewed e-cig as less harmful than former or never users.
⁵⁹ Sherratt, Newson, Marcus, Field, Robinson	N=20	UK	Qualitative interviews (n=20). Types of user as defined by authors: 'With participants of Stop Smoking Services in north-west England. Both individuals who had tried e-cigarettes (n = 6) and those who had not (n = 14). Median age was 51.5 years (range 25–59). Recent former smokers: they had not smoked within at least the last 7 days'	PERCEPTIONS E-cigarette users perceive e-cigarettes as safer than smokers. E-cigarettes were perceived as an effective smoking cessation aid. Reduce cravings and helps to sustain abstinence from tobacco.
⁶⁰ Simmons, Quinn, Harrell, et al.	N=31	US	Qualitative research (focus groups n=31). With e-cigarette users. Types of user as defined by authors: '(1) ≥ 18 years old; (2) had smoked cigarettes daily for at least 1 year; and (3) had used e-cigarettes in the past 30 days.'	PERCEPTIONS Perceived health benefits REASONS to quit smoking initially. Interest and satisfaction from experimenting with several aspects of e-cigarette devices.
⁶¹ Soule, Rosas, Nasim	N=108	US	Concept mapping (CM) to characterize and describe adults' REASONS for using ECIGs. Types of user as defined by authors: 'A total of 108 adults completed a multi-module online CM study that consisted of brainstorming statements. E-cigarette use was described as past 30-day use. 18 years or older and used e-cigarettes in the past month.'	REASONS Cessation Methods, perceived health benefits, private regard, convenience, conscientiousness, and pleasurable effects, perceived agency, therapeutic, hobby, and social impacts.

First Author	N	Country	Brief study description	Major relevant findings
⁶² Suris, Berchtold, Akre ⁶²	N= 621 (248 e-cigarette users)	Switzerland	Longitudinal research (self-report (n=621) Types of user as defined by authors: 'Current smoker: smoking at least weekly. Experimenters: only used once. Adolescent (14- 16 years old). Users (experimenters and regular users) were asked about REASONS'	REASONS Curiosity 93.1% (experimenters) - 76.8% (users); avoid smoking restrictions 3.2% (experimenters) - 14.4% (users); To reduce smoking 3.6% (experimenters) - 10.4% (users); To do like my friends 5.1% (experimenters) - 6.0% (users); To smoking cessation 0.0% (experimenters) - 3.3% (users).
⁶³ Tan, Bigman ⁶³	n=3,630	US	Health Information National Trends Survey (n=3,630); cross-sectional Types of user as defined by authors: 'Non-smoker: respondents who have never smoked up to 100 cigarettes in their lives. Former smokers: Those who smoked at least 100 cigarettes in their lives but were currently not smoking at all. Current smokers: those who smoked at least 100 cigarettes in their lives and were smoking daily or on some days. 18 years or older; general population'	PERCEPTIONS Decline in harm perception among current: believed e-cigarettes are less harmful than smoking (84.7% in 2010 to 65.0% in 2014). Believe e-cigarette as less harmful 49.5%former smokers, 45.9 % non-smokers, and 65.0% current smokers.
⁶⁴ Tan, Lee, Bigman ⁶⁴	n=527	US	Self-report (n=527) Types of user as defined by authors: 'Ever users: comprising those tried but not in the past 30 days, and those used in the past 30 days, even just one time.' 18- 87 years old; general population.	PERCEPTIONS Harmful to others 42.8% Non-users; 26.2% ever-users; addictive 52.5% Non-users; 40.9% ever-users; Gateway effect 55.1% Non-users; 43.1% ever-users; Socially acceptable 61.6% Non-users; 38.5% ever-users; Less harmful than smoking 32.4% Non-users; 56.9% ever-users; Smoking cessation 31.9% Non-users; 52.3% ever-users; Less harmful to others 38.9% Non-users; 57.6% ever-users; make smoking look acceptable to youth never smokers;35.7%, former smokers 46.7%, current smokers 36.1%
⁶⁵ Trumbo, Harper ⁶⁵	n=244	New-Zealand	Cross-sectional (n=244) Types of user as defined by authors: Ever tried and regular use not specified; 19-22 years old; not specified	PERCEPTIONS Students found it socially acceptable to use e-cigarettes in public places. Overall negative attitude, pressure to use an e-cigarette
⁶⁶	N= 3241	US	Longitudinal research (survey 7-month follow-up). Types of user as defined by authors: 'Ever use of e-cigarettes (n=2476 are included in the analysis). "Have you ever used e-cigarettes, electronic, or vapor cigarettes?" adult ever users of e-cigarettes (18 +)'	REASONS To quit, to replace tobacco cigarettes, to cut down, to avoid smoking bans, curiosity, deal with cravings, less harmful, recommendation, costs

table continues

First Author	N	Country	Brief study description	Mayor relevant findings
⁶⁷ Wackowski, Bover Manderski, Delnevo ⁶⁷	n=519	US	Cross-sectional (n=519) Types of user as defined by authors: 'current smokers: have ever smoked 100 cigarettes and now smoke some days or every day. Current e-cigarette users: those who had used e-cigarettes in the past 30 days. Former e-cigarette users/riers: those who had ever tried e-cigarettes but not used them in the past 30 days. Current Cigarette smokers 18 years or older.'	PERCEPTIONS 59.9% of smokers believed e-cigarettes are less harmful. More prevalent among current e-cig users (82.8%) than former (63.9%) or never (48.6%)
⁶⁸ Wackowski, Bover Manderski, Delnevo, Giovenco, Lewis ⁶⁸	N=509	US	Self-report (survey n=509) among adult (18 years or older) Types of user as defined by authors: 'current smokers defined as having ever smoked 100 cigarettes and now smoking "some days" or "everyday" in the US. Those smokers who had also used e-cigarettes in the past 30 days as "current e-cigarette users/riers". Those who had ever tried e-cigarettes but not used them in the past 30 days as "former e-cigarette users/riers".'	REASONS Believed it was less harmful than regular cigarettes (77.2%), out of curiosity (76.5%), as a way to cut down on smoking (72.7%), cigarette smoking cessation (64.9%), to use in places where they can't smoke (66.7%). Current e-cigarette users/riers reported more often cutting down on smoking, saving money and consideration for others as REASONS for trying e-cigarettes. Curiosity was the main reason for trying e-cigarettes among former users/riers (77.1%).
⁶⁹ Wang, Li, Jiang, et al. ⁶⁹	n=1,307	Hong Kong	Cross-sectional (n=1307) Types of user as defined by authors: 'Daily smokers; 4 ppm or above exhaled carbon monoxide. Ever use: ever used, even a single puff, age 18 years or older. 18 years or older; daily smokers'	PERCEPTIONS 11.0% perceived is as an effective smoking cessation tool. 74.1% (users) and 91.2% (non-users) did not think of them as effective for smoking cessation.
⁷⁰ White, Li, Newcombe, Walton ⁷⁰	2012 n=3,127, 2014 n=2,919	New-Zealand	Youth Insights Survey (2012: n=3,127; 2014: n=2,919); cohort Types of user as defined by authors: 'Current smokers; smoked at least once a month or more often. Infrequent smokers; less often than once a month. Ex-smokers; had smoked a cigarette, but no longer smoke. Ever use: have ever tried electronic cigarettes. 14-15 years old; not stratified (ever users are asked reasons why)'	REASONS Curiosity (64.5%), recommended by someone (24.2%), safer than tobacco (27.8%), avoid smoking restrictions (16.3%), cut back on cigarettes (18.4%), smoking cessation (16.6%), costs (not specified). Curiosity: infrequent smokers (67.1%) and ex-smokers (62.4%). Harm reduction: 42.5% infrequent smokers having first tried e-cigarettes for this reason.
⁷¹ Yong, Borland, Balmford, et al. ⁷¹	N=2105	Australia & UK	International tobacco control four country ITC project, Australia & UK 2013 (n=2105). Longitudinal data. Types of user as defined by authors: 'E-cigarette use: "Have you ever tried an electronic cigarette?" Those who had tried: "How often, if at all, do you currently use an electronic cigarette?" with the response options "Daily, Less than daily, Less than weekly, Less than monthly or Not at all".'	PERCEPTIONS Australia: a lot less harmful compared to conventional cigarettes 36% of the smokers. UK: a lot less harmful compared to conventional cigarettes 57.6% of the smokers.

First Author	N	Country	Brief study description	Major relevant findings
⁷² Zhu, Gamst, Lee, et al. ⁷²	n=10,041	US	Cross-sectional n=10,041 Types of user as defined by authors: 'Current smoker; had at least smoked 100 cigarettes in their lifetime and answered the question 'Do you currently smoke cigarettes every day, some days, or not at all?' with every day or some days. Former smokers; those who smoked at least 100 cigarettes in their lifetime and answered 'not at all'. Non-smoker: those who had not smoked 100 cigarettes in their lifetime. Ever use: those who have ever tried an e-cigarette. Current user: those who had used e-cigarettes in the last 30 days. 18 years or older; general sample, reasons among e-cig users'	REASONS Safer than cigarettes 49.9%; Cheaper than cigarettes 30.3%; Easy to use when I can't smoke 44.8%; To try to quit smoking cigarettes 54.9%; Just because 68.3%

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Appendix 4 Participants characteristics and alias

Alias for e-cigarette users	Age	Gender	Education level	Alias for never-users	Age	Gender	Education level	Alias for smokers	Age	Gender	Education level
1_E-cigarette user	46	female	Low	1_Never-user	13	female	High	1_Smoker	20	male	High
2_E-cigarette user	37	male	Low	2_Never-user	15	female	High	2_Smoker	18	female	Middle
3_E-cigarette user	22	male	Low	3_Never-user	17	female	Middle	3_Smoker	19	female	Low
4_E-cigarette user	18	male	Middle	4_Never-user	14	male	High	4_Smoker	29	male	High
5_E-cigarette user	30	male	Low	5_Never-user	16	female	Low	5_Smoker	20	female	Low
6_E-cigarette user	50	male	Middle	6_Never-user	16	male	Low	6_Smoker	23	female	Middle
7_E-cigarette user	42	male	High	7_Never-user	15	female	Low	7_Smoker	18	male	Middle
8_E-cigarette user	40	male	Low	8_Never-user	15	female	Low	8_Smoker	24	female	Middle
9_E-cigarette user	51	male	Middle	9_Never-user	16	female	Low	9_Smoker	18	male	High
10_E-cigarette user	43	male	Middle	10_Never-user	16	female	Middle	10_Smoker	19	male	High
11_E-cigarette user	20	female	Middle	11_Never-user	15	female	Middle	11_Smoker	19	female	High
12_E-cigarette user	24	male	Middle	12_Never-user	16	male	Middle	12_Smoker	18	female	High
13_E-cigarette user	24	male	Low	13_Never-user	16	male	Low	13_Smoker	19	male	Middle
14_E-cigarette user	27	male	Middle	14_Never-user	16	female	Low	14_Smoker	19	male	Low
15_E-cigarette user	48	female	Middle	15_Never-user	14	female	Middle	15_Smoker	18	female	Middle
16_E-cigarette user	34	male	Middle	16_Never-user	15	female	Low	16_Smoker	18	male	Low
17_E-cigarette user	31	female	Low	17_Never-user	16	male	Low	17_Smoker	18	female	High
18_E-cigarette user	31	female	Middle	18_Never-user	14	male	High				
19_E-cigarette user	32	male	High	19_Never-user	14	female	Middle				
20_E-cigarette user	48	male	Middle	20_Never-user	13	female	middle				
21_E-cigarette user	55	male	Middle	21_Never-user	16	male	Middle				

table continues

Alias for e-cigarette users	Age	Gender	Education level	Alias for never-users	Age	Gender	Education level	Alias for smokers	Age	Gender	Education level
22_E-cigarette user	58	female	Middle	22_Never-user	17	female	High				
23_E-cigarette user	43	female	Low	23_Never-user	16	male	Low				
24_E-cigarette user	49	male	Middle								
25_E-cigarette user	55	male	Middle								
26_E-cigarette user	22	male	Low								

Note the alias reflects the user group of the participant

Appendix 5 Topic guide: exploring decision making process of e-cigarette use initiation

Chapter 3

A Deliberate Choice? Exploring the Decision to Switch from Cigarettes to E-Cigarettes

Note: All participants have to sign an informed consent before the start of the introduction.

Introduction by interviewer

Welcome! My name is ... and this is ..., who will be helping me with the discussion today. I work for ... and I my research is about....

Today we are discussing e-cigarettes. Your opinion as user/smoker/non-user is very important. We would like to talk to you about e-cigarettes and this discussion will take approximately two hours, with a break. At the end of our discussion we have time for general questions about e-cigarettes.

We would like to stress that there are no correct or wrong answers. Today is all about your experiences and your ideas. We will be hearing a lot of different ideas and experiences, so I would like to ask you to respect each other. Please listen carefully to each other and please let each other finish speaking.

This group discussion will be audio recorded. – *Turn on audio recording*— All personal information will be made anonymous, and please remember that your participation is voluntary. This means that you can leave at all times, you do not have to explain yourself.

Are there any remaining questions before we start?

Introduction participants

Please introduce yourself shortly. Do you use e-cigarettes exclusively? Or do you also use cigarettes or something else? What do you enjoy doing?

- Make name tags
-

General prompts

- What do you mean?
 - Can you tell me more about that?
 - What comes to mind?
 - Can you explain that to me?
 - Is there anything else that you can think of?
-

table continues

Topic guide: exploring decision making process of e-cigarette use initiation

Knowledge about e-cigarettes

What do you know about e-cigarettes?

Prompts

Risks, batteries, taxes, different e-cigarettes, costs, health benefits

Attitude

What did you think when you used it?

What do you think of e-cigarettes?

Prompts

How does it feel? Do you compare it to cigarette smoking? What do you think of the action of using e-cigarettes?

Deliberation

Did you ever try an e-cigarette?

When did you try an e-cigarette?

How did you consider e-cigarette use?

Who played a role in your decision?

What played a role in your decision?

How difficult was it to make a decision?

Prompts

Did you consider using something else, like an NRT? Did you ask for advice? Did you go to a shop? Are you happy with your decision? Would you do it differently? What would have made it easier for you to make a decision about e-cigarette use?

[use these prompts to link to next topic]

Information need

What information is important to make a decision about e-cigarette use?

Where did you look for information about e-cigarettes?

Prompts

Which information was important to you? Which source was important to you? How do you know how to trust information? Which information do you still miss?

Closing

Is there anything we did not cover today that you find important related to e-cigarettes?

Do you have any questions left?

Note: due to the semi-structured protocol these questions are examples and may vary slightly in each focus group in both style and order.

Appendix 6 survey used to investigate smoking behavior

Chapter 4, chapter 5, and chapter 8				
Concept	Item	Answer option	Explanation of the concept	Reference
Demographics	How old are you?	Open question		Centraal Bureau voor Statistiek (CBS) ¹
	What is your gender?	Male-female		
	What is your level of education?	Did not finish school <ul style="list-style-type: none"> Primary school to 8th grade Some high school, did not graduate High school graduate, diploma or the equivalent (for example: GED) Some college credit, no degree Trade/technical/vocational training Associate degree Bachelor's degree Master's degree Professional degree Doctorate degree 	Low level of education: answer options 1, 2, 3 Middle level of education: answer options 4, 5 Higher level of education: answer options 6, 7	
Concept	Item	Answer options	Explanation and formation of the concept	Reference
Type of user	A. I smoke or vape	1. Both cigarettes and E-cigarettes 2. Only cigarettes 3. Only E-cigarettes 4. I do not smoke or vape 5. I have smoked in the past 6. I have vaped in the past 7. I have smoked both cigarettes and vaped in the past	<ul style="list-style-type: none"> Response options A.4 formed the group non-users. Response options A.2 & B.1 OR B.2 formed smokers. Response options A.1 & (B.1 OR B.2) & C1.OR C2) formed dual users. Response options A.3 & C.1 OR C.2 formed E-cigarette users. 	Pearson, Hitchman, Brose, et al. ² Amato, Boyle, Levy ³ International Tobacco Control Policy Evaluation Project ⁴

table continues

Concept	Item	Answer options	Explanation and formation of the concept	Reference
	B. How often do you smoke?	1. Every day 2. Not every day, but at least once a week 3. Not every week, but at least once a month 4. Less than monthly		
	C. How often do you vape?	1. Every day 2. Not every day, but at least once a week 3. Not every week, but at least once a month 4. Less than monthly 5. I have never vaped regularly, I only tried it once or twice.		
Smoking behavior	How many cigarettes have you smoked in your life?	: Fewer than 100 cigarettes in my life : 100 or more cigarettes in my life	Single item	Pearson, Hitchman, Brose, et al. ² Amato, Boyle, Levy ³ International Tobacco Control Policy Evaluation Project ⁴ Heatherton, Kozlowski, Frecker, Fagerstrom ⁵
	How long have you been smoking?	: 1 – 6 months : Between 6 – 12 months : Between 1 – 5 years : More than 5 years	Single item	
	How often have you tried to quit smoking?	: Never : 1 – 3 times : More than 3 times : Don't know	Single item	
	I smoked... (number of cigarettes)	: 5 – 10 (less than half a package) : 10 – 13 (a bit more than half a package) : 16 – 19 (about three quarters of a package) : 1 package : 19 – 25 (a bit more than a package) : I never smoked regularly I only tried it once or twice.	Single item	

table continues

Concept	Item	Answer options	Explanation and formation of the concept	Reference
Vaping behavior	How long have you been vaping?	<ul style="list-style-type: none"> 1 – 6 months Between 6 – 12 months Between 1 – 5 years More than 5 years 	Single item	Pearson, Hitchman, Brose, et al. ² Amato, Boyle, Levy ³ International Tobacco Control Policy Evaluation Project ⁴
	How often have you tried to quit vaping?	<ul style="list-style-type: none"> Never 1 – 3 times More than 3 times Unknown 		
	I have vaped different flavors in different situations	1 = totally disagree to 7 = totally agree	Single item	
	How much nicotine does your current e-liquid contain?	<ul style="list-style-type: none"> I vape without nicotine 1– 8 mg/ml 9 – 14 mg/ml 15 – 24 mg/ml > 25 mg/ml > 36 mg/ml Don't know Not applicable 	Single item	
	How much nicotine did the first E-liquid you used contain?	<ul style="list-style-type: none"> I vape without nicotine 1– 8 mg/ml 9 – 14 mg/ml 15 – 24 mg/ml > 25 mg/ml > 36 mg/ml Don't know Not applicable 	Single item	NA
	How likely is it that you will start using E-cigarettes / vapers in the future?	very likely --- very unlikely (1-7)	Single item	
	If you have the opportunity, how likely is it that you will use E-cigarettes/ vapers without nicotine in the future?		Single item	

table continues

Concept	Item	Answer options	Explanation and formation of the concept	Reference
	How many E-cigarettes/vapers are you currently using?	<ul style="list-style-type: none"> Zero Two Three or more 	Single item	
	How did you get to know about the E-cigarette?	<ul style="list-style-type: none"> Via my family doctor/ practice nurse Internet Adverts on TV Via acquaintances/friends/family who use E-cigarettes. Advertisements 	Single item	Romijnders, van Osch, de Vries, Talhout ⁶ Romijnders, van Osch, de Vries, Talhout ⁷
	<i>Sometimes you can have an unpleasant taste experience while vaping; this can be caused by vaping without E-fluid, for example. This is called a dry hit.</i>			
Concept	Item	Answer options	Explanation and formation of the concept	Reference
	Do you or did you often have a problem with a dry hit?	<ul style="list-style-type: none"> I don't know Yes, very often Yes, often Yes, sometimes Now and again No 	Single item	Romijnders, van Osch, de Vries, Talhout ⁶ Romijnders, van Osch, de Vries, Talhout ⁷
Flavor preference of non-users and smokers	If you were to start using an E-cigarette, which flavor would you like to try? (check all that apply)	<ul style="list-style-type: none"> Tobacco. Menthol/mint Nuts Herbs, spices Coffee/tea Cocktails Alcohol, other Sodas Sweet, chocolate Sweet, vanilla Sweets, other Fruit Sweet, desserts Milk products 	<p>If participants selected 'I do not want to try a flavor', no other flavor could then be selected simultaneously.</p> <p>The closed answer options that were used to assess flavor preference were recoded in accordance with the thirteen main categories of the recently published E-liquid flavor wheel ⁸, with the exception of "I don't want to try a flavor". Recoding reported flavor preferences</p>	Yingst, Veldheer, Hammett, Hrabovsky, Foulds ⁹

table continues

Concept	Item	Answer options	Explanation and formation of the concept	Reference
		<ul style="list-style-type: none"> · Candy · Floral · Unflavored · I do not want to try a flavor 	<p>resulted in the following thirteen main categories: tobacco (survey item: tobacco), menthol/mint (survey item: menthol/mint), nuts (survey item: nuts), spices (survey items: herbs, spices), coffee/tea (survey items: coffee; tea), alcohol (survey items: alcohol, cocktail; alcohol, other), other beverages (survey items: soda; sweet, other), fruit (survey item: fruit), dessert (survey items: sweet, dessert; milk product), other sweets (survey items: sweet, chocolate; sweet, vanilla), candy (survey items: sweet, candy), other flavors (survey items: floral; other) and unflavored (survey item: non-user or smoker reported an interest in the survey items "sweet, candy" and "alcohol, cocktail", their answers were recoded as a preference for the categories candy and alcohol, respectively. Open answers from dual and E-cigarette users were assessed for recoding of their closed answers in accordance with the categories of the e-liquid flavor wheel ⁸.</p>	
Flavor preference of dual users and e-cigarette users	Which e-liquid flavor did you try first?			

table continues

Concept	Item	Answer options	Explanation and formation of the concept	Reference
Smoking cessation information	Which e-liquid flavor do you currently use most?			
	By means of the following questions we would like to form an impression of the way you may potentially quit smoking. These questions only concern stopping smoking cigarettes.			
	How many times have you tried to stop smoking?	<ul style="list-style-type: none"> · Never · Once · Twice · Three times · More than three times · I don't know 	Single item	International Tobacco Control Policy Evaluation Project ⁴
Vaping cessation information	Have you had anything to help you stop smoking? (more than one answer is possible)	<ul style="list-style-type: none"> · No, I haven't used an aid · I have used the electronic cigarette as an aid · Medicines · Nicotine replacement therapy · Self-help program · Discussed stopping smoking with the family doctor · Behavioral support programs · Stop smoking course or group therapy · Other therapies or aids · Other aids or methods 	Single item	
	By means of the following questions, we would like to form an impression of the way you may potentially quit smoking. These questions only concern vapers/ E-cigarettes.			

table continues

Concept	Item	Answer options	Explanation and formation of the concept	Reference
	How often have you tried to stop vaping? <i>Choose the option or options that are applicable to you (more than one answer possible).</i>	<ul style="list-style-type: none"> Never Once Twice Three times More than three times I don't know 	Single item	International Tobacco Control Policy Evaluation Project ⁴
	Since I have been vaping E-cigarettes cigarettes...	<ul style="list-style-type: none"> ... I am smoking fewer tobacco cigarettes ... I smoke just as many cigarettes as I used to ... I no longer smoke any cigarettes at all ... I smoke more/for longer in comparison with cigarettes ... I feel physically more healthy ... I have more of a craving to use nicotine ... I feel mentally more healthy 	Single item	International Tobacco Control Policy Evaluation Project ⁴
Reasons for tobacco product use or e-cigarette use	Which of the following statements applies to you? I smoke/smoked/used e-cigarettes/vapers: (more than one answer possible)	Because E-cigarettes/vapers are easy to get. Because they are easy to use. Due to the cost: less expensive than cigarettes/affordable For their health advantages: effects on health, fewer ingredients than a cigarette.	Single item	Romijnders, van Osch, de Vries, Talhout ⁶ Romijnders, van Osch, de Vries, Talhout ⁷

table continues

Concept	Item	Answer options	Explanation and formation of the concept	Reference
		As an aid to smoking fewer cigarettes or giving them up completely: a method of stopping smoking, to prevent me going back to cigarettes.		
		Because it is less addictive than cigarettes, variation in nicotine level is possible.		
		To cope with cravings and to prevent/cope with withdrawal symptoms		
		As an alternative to cigarettes: it is like the smoking or because of the throat hit (add info-button).		
		To get around the smoking ban (to be able to vape in places where smoking is normally forbidden).		
		To help me to focus and improve my performance, to reduce stress or to prevent weight gain.		
		Due to improved sense of taste and smell: because it tastes better than cigarettes, and to be discreet (you can hide the fact that you smoke, no unpleasant smells).		
		This is a real experience, one that can only be experienced by doing it.		
		To try something new: out of curiosity about new products, different flavors, different apparatus/designs, for pleasure, as a hobby, or because it is cool/trendy/classy.		
		For social reasons: because it was recommended by friends or family, due to pressure from the people around me, to extend my social network or because it is socially acceptable.		

table continues

Concept	Item	Answer options	Explanation and formation of the concept	Reference
	Which of the following statements is applicable to you? I do not/ no longer vape/use E-cigarettes/vapers: (more than one answer possible)	<p>Because it is addictive.</p> <p>Because of the disadvantages to health: Unsafe during pregnancy, injurious, injurious to other people, effects on health, another step towards smoking cigarettes, the ingredients in E-liquid, increase in weight.</p> <p>Because of the cost: costs too much or more expensive than cigarettes.</p> <p>Due to practical failings: difficult to use, difficult to obtain, too different from smoking a cigarette, changing to other NRTs does not help to stop smoking or cravings, technical aspect (poor quality product), no throat hit.</p> <p>Because it isn't cool</p> <p>Because my friends don't do it either</p> <p>Not interested, not curious</p>	Single item	Romijnders, van Osch, de Vries, Talhout ⁶ Romijnders, van Osch, de Vries, Talhout ⁷
	Which of the following statements applies to you? I smoke/I used to smoke: (more than one answer possible)	<p>Because cigarettes are easy to obtain.</p> <p>Because they are easy to use.</p> <p>To help me to focus and improve my performance, to reduce stress or to prevent weight gain.</p> <p>This is a real experience, one that can only be experienced by doing it.</p> <p>For social reasons: because it was recommended by friends and family, due to pressure from the people around me, to extend my social network or because it is socially acceptable.</p>	Single item	Romijnders, van Osch, de Vries, Talhout ⁶ Romijnders, van Osch, de Vries, Talhout ⁷

table continues

Concept	Item	Answer options	Explanation and formation of the concept	Reference
	<i>Which of the following statements applies to you? I do not smoke / I no longer smoke: (more than one answer possible)</i>	To have a moment for myself: a break from working or studying, just to do something completely different etc.	Single item	Romijnders, van Osch, de Vries, Talhout ⁶ Romijnders, van Osch, de Vries, Talhout ⁷
		Because a cigarette tastes so good.		
		Due to stress: at work or at home, for example.		
		Because it gives me a good feeling.		
		Smoking is no more risky than a lot of other things that people do.		
		Due to the situation: After a meal, with a cup of coffee, with alcohol, on social occasions.		
		Because it damages the health of the people around me.		
		Because it is unhealthy.		
		Because it costs me a lot of money.		
		Because I am ashamed of smoking.		
Attractiveness of tobacco products and e-cigarettes	<i>The E-cigarette/vaper is attractive because (more than one answer possible)</i>	Because it takes a lot of my time.	Single item	Romijnders, van Osch, de Vries, Talhout ⁶ Romijnders, van Osch, de Vries, Talhout ⁷
		Because it is addictive.		
		The product looks nice		
		Due to all the different flavors		
		Because it is possible to alter the setting of the E-cigarette to my wishes		
		Due to its varying designs		
		Due to the price of the product		
		Due to the price of the E-liquids		
		Because the nicotine level can be varied		
		Because you can blow nice smoke clouds with it		

table continues

Concept	Item	Answer options	Explanation and formation of the concept	Reference
		Not applicable, I do not find the E-cigarette/vaper attractive		
	The E-cigarette/vaper is unattractive because (more than one answer possible).	<div>The appearance of the E-cigarette</div> <div>Its many flavors</div> <div>The price of the product</div> <div>The price of the E-liquids</div> <div>The weight of the E-cigarette (the apparatus)</div> <div>The shape of the E-cigarette</div> <div>How the product feels in my hand, it is different to a cigarette</div> <div>Not applicable, I do not find the E-cigarette/vaper attractive</div>	Single item	Romijnders, van Osch, de Vries, Talhout ⁶ Romijnders, van Osch, de Vries, Talhout ⁷
	I think the cigarette is attractive because... (more than one answer possible).	<div>The product looks nice</div> <div>Due to all the different flavors</div> <div>Because you can smoke different brands</div> <div>Due to the price of the product</div> <div>Because smoking looks cool and classy</div> <div>Because it looks cool when other people smoke</div> <div>Because you can blow nice smoke clouds with it</div> <div>Not applicable, I do not find the cigarette attractive</div>	Single item	Romijnders, van Osch, de Vries, Talhout ⁶ Romijnders, van Osch, de Vries, Talhout ⁷

table continues

Concept	Item	Answer options	Explanation and formation of the concept	Reference
	The cigarette is unattractive because... (more than one answer possible).	The appearance of the cigarette	Single item	Romijnders, van Osch, de Vries, Talhout ⁶ Romijnders, van Osch, de Vries, Talhout ⁷
		Its many flavors		
		The price of the product		
		The many brands		
		The smell of cigarettes		
		Packaging of cigarettes		
		Because you stink after you have smoked a cigarette		
		Not applicable, I find the cigarette attractive		

Concept	Item	Answer option	Explanation of the scale	Formation of the concept	Cronbach's alpha (α)	Reference
Knowledge about tobacco product use and e-cigarette use	1. The E-cigarette/vaper is 95% less damaging than a cigarette.	0 = incorrect and 1 = correct NA = don't know	0 = no correct answers to all statements were answered correctly	<ul style="list-style-type: none"> - 0 = no correct answers to 12 = all statements were answered correctly. - The scores were summed to come to a final score of possible correct answers out of 12. - I don't know was categorized as incorrect. - The coding of correct and incorrect answers was based on scientific consensus. - The statements assessing knowledge were based on previously conducted a focus group study. 	NA	Romijnders, van Osch, de Vries, Talhout ⁷

table continues

Concept	Item	Answer option	Explanation of the scale	Formation of the concept	Cronbach's alpha (α)	Reference
Attitude towards E-cigarettes	2. Only water vapor comes out of an E-cigarette/vaper.					
	3. E-cigarettes/vapers are the same thing.					
	4. E-cigarette use can lead to irritation and damage of the airways, palpitations and an increased risk of cancer.					
	5. The E-cigarette/vaper is a scientifically proved means of stopping smoking.					
	6. There are just as many harmful substances in the E-cigarette liquid as in a cigarette.					
	7. Smoking increase the risk of developing various diseases, including lung cancer and various other types of cancer, cardiovascular disease and COPD.					
	8. Additives (substances added to the tobacco in a cigarette) cannot make cigarette smoke any more addictive.					
	9. Smoking is the main cause of premature death.					
	10. It is always good to stop smoking, even for a short time.					
	11. Passive smoking is also damaging.					
	12. Getting enough exercise compensates for the risks to health from smoking.					
	<i>I think vaping is...</i>	Really bad (1) – Really good (7)	1 = very negative towards E-cigarette use and 7 = very positive towards E-cigarette use.	The four items were summed and averaged to compute one score of the concept attitude towards E-cigarettes.	0.927	Lehmann, de Melker, Timmermans, Mollema ¹⁰

table continues

Concept	Item	Answer option	Explanation of the scale	Formation of the concept	Cronbach's alpha (α)	Reference
		Really gross (1) – Really nice (7)				
		Really socially unacceptable behavior (1) – Really socially acceptable behavior (7)				
Attitude towards smoking	<i>I think smoking</i>	Really bad (1) – Really good (7)	1 = very negative towards smoking and 7 = very positive towards smoking.	The four items were summed and averaged to compute one score of the concept attitude towards smoking.	0.889	Lehmann, de Melker, Timmermans, Mollema ¹⁰ Montano, Kasprzyk ¹¹
		Really harmful (1) – Really safe (7)				
		Really gross (1) – Really nice (7)				
		Really socially unacceptable behavior (1) – Really socially acceptable behavior (7)				

table continues

Concept	Item	Answer option	Explanation of the scale	Formation of the concept	Cronbach's alpha (α)	Reference
Attitude towards not using E-cigarettes and cigarettes	<i>I think not using E-cigarettes or cigarettes is...</i>		1 = very negative towards E-cigarettes and cigarettes and 7 = very positive towards not using E-cigarettes and cigarettes.	- The four items were added together and averaged to compute one score of the concept attitude towards not using E-cigarettes and cigarettes.	0.940	Lehmann, de Melker, Timmermans, Mollema ¹⁰
		Really bad (1) – Really good (7)				
		Really harmful (1) – Really safe (7)				
		Really gross (1) – Really nice (7)				
Deliberation about the pros and cons of tobacco product use		Really socially unacceptable behavior (1) – Really socially acceptable behavior (7)		The nine items were summed and averaged to compute one score of the concept Deliberation of the pros and cons of tobacco product use	0.864	Lehmann, de Melker, Timmermans, Mollema ¹⁰
Deliberation on the pros and cons of E-cigarette use	<i>Please keep your own decision in mind, but have you considered the option of using E-cigarettes?</i>	I have visualized how it would feel not to smoke and not to vape.	1 = no deliberation about E-cigarette use to 7 = very extensive deliberation about E-cigarette use	- The three items were summed and averaged to compute one score of the concept Deliberation on the pros and cons of e-cigarette use .	0.656	Lehmann, de Melker, Timmermans, Mollema ¹⁰
		I have visualized how it would feel to smoke.	1 = I have not considered the consequences 7 = I have considered the consequences			

table continues

Concept	Item	Answer option	Explanation of the scale	Formation of the concept	Cronbach's alpha (a)	Reference
Deliberation of the pros and cons of smoking.	I have visualized how it would feel to vape.	1 = no conscious list of the pros and cons 7 = a very conscious list of pros and cons				
	<i>Please keep your own decision in mind, but have you considered smoking?</i>		1 = no deliberation of the about smoking to 7 = very extensive deliberation about smoking.	- The three items were summed and averaged to compute one score of the concept Deliberation of the pros and cons of smoking	0.579	Lehmann, de Melker, Timmermans, Mollema ¹⁰
	1. I have tried to consider the consequences of not smoking or vaping.	1 = I have not visualized how I would feel to 7 = I have visualized how I would feel				
	2. I have tried to visualize the consequences of smoking.	1 = I have not considered the consequences to 7 = I have considered the consequences				
	3. I have tried to visualize the consequences of vaping.	1 = no conscious list of the pros and cons to 7 = a very conscious list of pros and cons				
Deliberation about not using E-cigarettes or cigarettes	<i>Please keep your own decision in mind, but have you considered the option of not using E-cigarettes?</i>		1 = no deliberation about not using E-cigarettes or cigarettes to 7 = very extensive deliberation about not using E-cigarettes or cigarettes.	- The three items were summed and averaged to compute one score of the concept Deliberation on not using e-cigarettes and cigarettes.	0.666	Lehmann, de Melker, Timmermans, Mollema ¹⁰
	I have made/thought about a list of the pros and cons of not smoking or vaping.	1 = I have not visualized how I would feel about not using tobacco product and e-cigarettes 7 = I have visualized how I would feel				
	I have made/thought about a list of the pros and cons of not smoking.	1 = I have not considered the consequences 7 = I have considered the consequences				
	I have made a list of the pros and cons of not vaping.	1 = no conscious list of the pros and cons 7 = a very conscious list of pros and cons				
						table continues

Concept	Item	Answer option	Explanation of the scale	Formation of the concept	Cronbach's alpha (α)	Reference
Risk perception about e-cigarette use (cognitive)	A. If I vape, then my risk of developing some form of cancer during my lifetime is...	very small -- very big (1--7)	1 = low to 7 = perception of cognitive risk of susceptibility to health risks related to e-cigarette use	Answer options were recoded to make sure 7 is positive and 1 is negative. Cognitive susceptibility and severity items on side-effects could not be summed [6] because Cronbach's alpha was below .6. A concept could not be created so the individual item was used.	NA	Janssen [7] de Vries, van Osch, Eijmael, Smerecnik and Candel [6]
	B. I think that if I vape, my risk of developing some form of cancer during my lifetime:					
Risk perception of e-cigarette use (affective)	A. My feeling is that if I vape, the risk of developing some form of cancer during my lifetime:	very small -- very big (1--7)	1 = low to 7 = affective risk perception for susceptibility to health risks related to E-cigarette use.	Answer options were recoded to make sure 7 is positive and 1 is negative.	NA	Janssen [7] de Vries, van Osch, Eijmael, Smerecnik and Candel [6]
Risk perception of smoking (cognitive)	A. If I smoke, then my risk of developing some form of cancer during my lifetime is...	very small -- very big (1--7)	1 = low to 7 = cognitive risk perception for susceptibility to health risks related to smoking.	Answer options were recoded to make sure 7 is positive and 1 is negative. Cognitive susceptibility and severity items on side-effects could not be summed [6] because Cronbach's alpha was below .6. A concept could not be created so the individual item was used.	NA	Janssen [7] de Vries, van Osch, Eijmael, Smerecnik and Candel [6]
	B. I think that if I smoke, my risk of developing some form of cancer during my lifetime:					
Risk perception of smoking (affective)	A. A. My feeling is that if I smoke, the risk of developing some form of cancer during my lifetime:	very small -- very big (1--7)	1 = low to 7 = affective risk perception for susceptibility to health risks related to smoking.	Answer options were recoded to make sure 7 is positive and 1 is negative.	NA	Janssen [7] de Vries, van Osch, Eijmael, Smerecnik and Candel [6]

table continues

Concept	Item	Answer option	Explanation of the scale	Formation of the concept	Cronbach's alpha (a)	Reference
Risk perception of not using E-cigarettes or cigarettes (cognitive)	A. How big a risk do you think you have of developing some form of cancer during your lifetime?	very small -- very big (1--7)	1 = low to 7 = cognitive risk perception for susceptibility to health risks related to no use.	Answer options were recoded to make sure 7 is positive and 1 is negative.	NA	Janssen [7] de Vries, van Osch, Eijmael, Smerecnik and Candel [6]
	B. If I don't smoke or vape, then the risk that I will develop some form of cancer during my lifetime is...			Cognitive susceptibility and severity items on side-effects could not be summed [6] because Cronbach's alpha was below .6. A concept could not be created so the individual item was used.		
	C. I think that my risk of developing some form of cancer during my lifetime:					
Risk perception of not using E-cigarettes or cigarettes (affective)	A. My feeling is that the risk of developing some form of cancer during my lifetime:	very small -- very big (1--7)	1 = low to 7 = affective risk perception for susceptibility to health risks related to no use.	Answer options were recoded to make sure 7 is positive and 1 is negative.	NA	Janssen [7] de Vries, van Osch, Eijmael, Smerecnik and Candel [6]
	B. My feeling is that if don't smoke or vape, then the risk of developing some form of cancer during my lifetime			Affective susceptibility and severity items on side-effects could not be summed [6] because Cronbach's alpha was below .6. A concept could not be created so the individual item was used.		
Information seeking behavior	Independency of information I think that scientific research into E-cigarettes/vapers, is independent ... (more than one answer possible).		Check all that apply	Frequencies were used to determine what participants thought about independent scientific research.	NA	Romijnders, van Osch, de Vries, Talhout ⁷
	Only if researchers have influence on how the research is carried out.			The most-reported response option was used as the definition of independent.		
	Only if researchers have influence on how the research results are interpreted.					

table continues

Concept	Item	Answer option	Explanation of the scale	Formation of the concept	Cronbach's alpha ^(a)	Reference
Information seeking behavior	Only if researchers have influence on how the research results are communicated.					
	If all the research results are made known and not just the desired results.					
	If the researchers themselves have no vested interests in the results.					
	If the research is not financed by the tobacco industry.					
	If the research is under the auspices of the national government, if there is a governmental logo.					
	Reliability of information I think that scientific research into E-cigarettes/vapers is reliable ... (more than one answer possible).		Check all that apply	Frequencies were used to determine what participants thought about independent scientific research.	NA	
	Only if researchers have influence on how the research is carried out			The most-reported response option was used as the definition of independent.		
	Only if researchers have influence on how the research results are interpreted					
	Only if researchers have influence on how the research results are communicated					
	If all the research results are made known and not just the desired results					
	If the research is not financed by the tobacco industry					
	If the research is under the auspices of the national government, if there is a governmental logo					

table continues

Concept	Item	Answer option	Explanation of the scale	Formation of the concept	Cronbach's alpha (4)	Reference
Information seeking behavior	Information source I think the most important source of information about the E-cigarette/vapers is:		Maximum of 3 answers possible	Frequencies were used to determine which sources were used.	NA	Romijnders, van Osch, de Vries, Talhout ⁷
	Television					Sandefer,
	Newspaper					Westra, Khairat,
	Radio					Pieczkiewicz, ¹²
	Advertising (signs, shop displays, advertising folders, pop-ups, YouTube advertisements, advertising banners)					Speedie
	Internet					
	Dutch National Institute for Public Health and the Environment (RIVM)					
	Facebook or Twitter					
	Dutch Vape forum or Acvoda (Active for vaping)					
	Friends, family, acquaintances or colleagues					
Information seeking behavior	Health care professionals, such as my family doctor or practice nurse					
	Not applicable. I never look for information about the E-cigarette/vapers					
	Information need I would like to receive more information about:...		Check all that apply	Frequencies were used to determine what participants wanted to know about e-cigarettes.	NA	Romijnders, van Osch, de Vries, Talhout ⁷
	a: The harmfulness of e-cigarettes					
	b: Where you can buy e-cigarettes					
	c: E-liquids					
	d: The different types of e-cigarettes available					

table continues

Concept	Item	Answer option	Explanation of the scale	Formation of the concept	Cronbach's alpha ⁽⁴⁾	Reference
Attitude towards information about e-cigarettes	e: How an e-cigarette works					
	f: Whether the e-cigarette is an effective smoking cessation tool					
	g: How much e-liquid do you use on average with an e-cigarette					
	h: What settings to use with an e-cigarette					
	i: How often on a day you should use e-cigarettes					
	j: About the e-liquids available					
	All the above					
	I do not want additional information about the e-cigarette					
	In my opinion, the information about the E-cigarette/vaper is:		Very negative indeed – very positive indeed (1-7)	Single item		
	In my opinion, the information about the E-cigarette/vaper is:		Not at all useful - very useful indeed (1--7)			
Trust	I think RIVM is trustworthy. I think RIVM is independent.	completely agree -- completely disagree (1-7)	1 low to 7 = high level of trust in information provided by the Dutch National Institute of Public Health and the Environment.	The two items were summed and averaged to compute one score of the concept Trust.	0.915	Siegrist, Earle, Gutscher ¹³

table continues

Concept	Item	Answer option	Explanation of the scale	Formation of the concept	Cronbach's alpha (α)	Reference
Social Ties: e-cigarette users	How often does it happen that...?		1 low to 7 high		0.900	Thoits ¹⁴
	A vaper greets me even though I don't know him/her?	Not at all often (1) – very often (7)	level of social ties with other vapers			
	People try to point out the advantages of vaping?					
	Non-vapers come to stand with you when you are using an E-cigarette/vaping?					
	People ask you what your vaper is?					
	People respond negatively to vaping?					
	To what extent do you agree with the following comments?					
	I feel a bond with E-cigarette users.	completely agree – completely disagree				
	I feel I am an E-cigarette user.					
	How often does it happen that...?					
Social Ties: smokers	A smoker greets me even though I don't know him/her?	Not at all often – very often			0.868	Thoits ¹⁴
	Non-smokers come to stand with you when you are smoking?					
	People ask you what brand of cigarette you are smoking?					

table continues

Concept	Item	Answer option	Explanation of the scale	Formation of the concept	Cronbach's alpha ⁽¹⁾	Reference
	People respond negatively to smoking?					
	To what extent do you agree with the following comments?					
	I feel a bond with smokers.	completely agree -- completely disagree				
Social influence	I feel I am a smoker.					
	A: Society thinks that you should not smoke E-cigarettes.	completely agree (1) – (7) completely disagree		Single item	NA	Montano, Kasprzyk ¹¹
	B: Society thinks that you should not smoke.	completely agree (1) – (7) completely disagree				
	C: My partner uses E-cigarettes/vapers.	Yes (1), No (0)				
	D: My partner smokes.	Yes (1), No (0)				
	E: How many of your family, friends or colleagues use E-cigarettes/vapers?	· (almost) All of them · More than half · Half · Less than half · (almost+) No-one · Not applicable				

table continues

Concept	Item	Answer option	Explanation of the scale	Formation of the concept	Cronbach's alpha ⁽⁴⁾	Reference
	If I didn't smoke or vape (E-cigarette/vaper) then I am sure that I would be able not vape.					
Barrier: accessibility of e-cigarettes	E-cigarettes are easy to obtain.	1 = totally disagree to 7 = totally agree	1 = low perception of accessibility to e-cigarettes to 7 = high perception of accessibility to e-cigarettes	The tree items were summed and averaged to create a final score for the scale Accessibility.	0.882	Romijnders, van Osch, de Vries, Talhout ⁷
	E-liquids are easy to obtain.					
	Vapors* are easy to obtain.		* in the Netherlands a specific type of e-cigarette is marketed as a separate product without nicotine and in many fruit flavors. This device is very similar in looks to the first generation e-cigarette and is not refillable. This specific type of e-cigarette is very popular among non-using adolescents.			
Intention to quit	A. Please indicate on a scale from 1 to 7 your intent to quit vaping in the next 6 months.	(1) I do not intend to quit vaping to (7) I intent to quit vaping.	1 = low intention to quit vaping to 7 = high intention to quit vaping	Single item	NA	Montano, Kasprzyk ¹¹
	B. Please indicate which of the statements indicates your intention best	(1) I do not intend to quit vaping to (7) I really intent to quit vaping	1 = low intention to quit vaping to 7 = high intention to quit vaping	Single item	NA	Montano, Kasprzyk ¹¹

table continues

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Appendix 7 differences between dual users and exclusive e-cigarette users

Chapter 5

A Combination of Factors Related to Smoking Behavior, Attractive Product Characteristics, and Socio-Cognitive Factors are Important to Distinguish a Dual User from an Exclusive E-Cigarette User

Scale and items	Dual users (n)	Dual users (mean/percentage)	Dual users (SD)	E-cigarette users (n)	E-cigarette users (mean/percentage)	E-cigarette users (SD)	p-value
Participant Characteristics							
Age	80	47.8	13.40	36	51.9	9.80	0.10
Gender	80			36			0.31
<i>male</i>		46.3%			36.1%		
<i>female</i>		53.8%			63.9%		
Education	80			36			0.70
<i>low</i>		30.0%			19.4%		
<i>middle</i>		40.0%			55.6%		
<i>high</i>		30.0%			25.0%		
Differences in past and current smoking and vaping behavior							
lifetime status of tobacco smoking (Fagerstrom index)	80			36			0.02
< 100 cigarettes in life		6.30%			0.00%		
> 100 cigarettes in life		93.70%			100.00%		
onset of tobacco smoking	80			36			0.06
< 6 months		1.3%			2.8%		
6-12 months		1.3%			0.0%		
1-5 years		8.8%			0.0%		
5-10 years		11.3%			0.0%		
> 10 years		77.5%			97.2%		
quantity of tobacco cigarettes smoked in their past (e-cigarette users) or current (dual users) smoking behavior	80			36			0.00
< ½ package/day		16.3%			2.8%		
½-1 package/day		63.7%			36.1%		
1 package/day		13.8%			22.2%		
> 1 package/day		6.3%			38.9%		

table continues

Scale and items	Dual users (n)	Dual users (mean/percentage)	Dual users (SD)	E-cigarette users (n)	E-cigarette users (mean/percentage)	E-cigarette users (SD)	p-value
onset of vaping	80			36			0.01
< 6 months		35.0%			13.9%		
6-12 months		20.0%			16.7%		
1-5 years		41.3%			61.1%		
5-10 years		3.8%			8.3%		
vaping status ml	80	18.35	18.99	36	16.78	18.92	0.68
vaping status liquid	80			36			0.75
less than half a container		67.5%			77.8%		
a little bit more than half a container		15.0%			2.8%		
about three quarters of a container		7.5%			11.1%		
a little bit less than a container		2.5%			2.8%		
a container at max		2.5%			0.0%		
little more than one container		1.3%			0.0%		
Differences in product characteristics used							
Flavors situation	80	3.6	2.08	36	3.14	2.45	0.29
nicotine current				36			0.96
None		17.5%			8.30%		
1-8 mg/mL		27.5%			41.70%		
9-14 mg/mL		18.8%			16.70%		
15-24 mg/mL		25.0%			25.00%		
> 25 mg/mL		2.5%			0		
> 36 mg/mL		1.3%			2.80%		
nicotine first	80			36			0.48
None		13.8%			8.3%		
1-8 mg/mL		17.5%			13.9%		
9-14 mg/mL		25.0%			25.0%		
15-24 mg/mL		26.3%			41.7%		
> 25 mg/mL		3.8%			2.8%		
> 36 mg/mL		1.3%			1.6%		
future intention e-cigarette use	80	4.75	1.89	36	5.25	1.95	0.20
future intention e-cigarette nicotine content	80	4.24	1.94	36	4.33	1.80	0.80
quantity e-cigarettes used	80			36			0.32

table continues

Scale and items	Dual users (n)	Dual users (mean/percentage)	Dual users (SD)	E-cigarette users (n)	E-cigarette users (mean/percentage)	E-cigarette users (SD)	p-value
<i>I don't own my own e-cigarette</i>		2.5%			5.6%		
1		68.8%			52.8%		
2		22.5%			30.6%		
more than 3		6.3%			11.1%		
type e-cigarette used	80			36			0.80
<i>Disposable e-cigarettes</i>		58.8%			58.3%		
<i>Refillable and chargeable e-cigarettes</i>		18.8%			13.9%		
<i>Mods</i>		8.8%			13.9%		
<i>other</i>		13.8%			13.9%		
AWARENESS FIRST	80			36			0.88
GP		0.0%			2.8%		
Internet		32.5%			30.6%		
Commercials on tv		7.5%			0.0%		
Through my social network		47.5%			55.6%		
Advertisements		6.3%			2.8%		
Other		6.3%			8.3%		
DRYHIT	80			61			0.13
very often		2.5%			5.6%		
often		8.8%			16.7%		
sometimes		17.5%			25.0%		
rarely		20.0%			47.2%		
never		40.0%			36.1%		
unknown		11.3%			5.6%		
Current e-liquid flavors used (% of flavor category used)							
FLAVOR TOBACCO	79	55.7%		35	54.3%		0.89
FLAVOR MENTHOL	79	24.1%		35	11.4%		0.09
FLAVOR NUTS	79	0.0%		35	0.0%		NA
FLAVOR SPICES	79	0.0%		35	0.0%		NA
FLAVOR COFFEE or TEA	79	3.8%		35	2.9%		0.79
FLAVOR ALCOHOL	79	0.0%		35	0.0%		NA
FLAVOR OTHER BEVERAGES	79	0.0%		35	0.0%		NA
FLAVOR FRUIT	79	8.9%		35	11.4%		0.69

table continues

Scale and items	Dual users (n)	Dual users (mean/percentage)	Dual users (SD)	E-cigarette users (n)	E-cigarette users (mean/percentage)	E-cigarette users (SD)	p-value
FLAVOR DESSERT	79	1.3%		35	2.9%		0.61
FLAVOR CANDY	79	0.0%		35	5.7%		0.16
FLAVOR OTHER SWEETS	79	6.3%		35	5.7%		0.90
FLAVOR UNFLAVORED	79	0.0%		35	2.9%		0.32
FLAVOR OTHER FLAVOR	79	0.0%		35	2.9%		0.32
First e-liquid flavors used (% of flavor category used)							
FLAVOR TOBACCO	79	62.0%		35	74.3%		0.19
FLAVOR MENTHOL	79	19.0%		35	17.1%		0.81
FLAVOR NUTS	79	0.0%		35	0.0%		NA
FLAVOR SPICES	79	0.0%		35	0.0%		NA
FLAVOR COFFEE or TEA	79	2.5%		35	2.9%		0.92
FLAVOR ALCOHOL	79	1.3%		35	0.0%		0.32
FLAVOR OTHER BEVERAGES	79	0.0%		35	0.0%		NA
FLAVOR FRUIT	79	6.3%		35	2.9%		0.38
FLAVOR DESSERT	79	0.0%		35	0.0%		NA
FLAVOR CANDY	79	1.3%		35	0.0%		0.32
FLAVOR OTHER SWEETS	79	7.6%		35	0.0%		0.01
FLAVOR OTHER FLAVOR	79	0.0%		35	2.9%		0.32
FLAVOR UNFLAVORED	79	0.0%		35	0.0%		NA
FLAVOR UNFLAVORED	79	0.0%		35	0.0%		NA
Differences in attractiveness and reasons related to cigarettes and e-cigarettes							
Attractiveness of e-cigarettes							
The product looks nice	80	18.8%		36	5.6%		0.03
Due to all the different flavors	80	46.3%		36	25.0%		0.02
Because it is possible to alter the setting of the E-cigarette to my wishes	80	20.0%		36	38.9%		0.05
Due to its varying designs	80	10.0%		36	2.8%		0.10

table continues

Scale and items	Dual users (n)	Dual users (mean/percentage)	Dual users (SD)	E-cigarette users (n)	E-cigarette users (mean/percentage)	E-cigarette users (SD)	p-value
Due to the price of the product	80	22.5%		36	13.9%		0.25
Due to the price of the E-liquids	80	28.8%		36	36.1%		0.45
Because the nicotine level can be varied	80	45.0%		36	66.7%		0.03
Because you can blow nice smoke clouds with it	80	2.5%		36	0.0%		0.16
Not applicable, I do not find the E-cigarette/vaper attractive	80	8.8%		36	0.0%		0.01
Unattractiveness of e-cigarettes							
The appearance of the E-cigarette	80	17.5%		36	22.2%		0.57
Its many flavors	80	15.0%		36	11.1%		0.56
The price of the product	80	22.5%		36	13.9%		0.25
The price of the E-liquids	80	15.0%		36	16.7%		0.82
The weight of the E-cigarette (the apparatus)	80	17.5%		36	8.3%		0.15
The shape of the E-cigarette	80	8.8%		36	11.1%		0.70
How the product feels in my hand, it is different to a cigarette	80	20.0%		36	19.4%		0.95
Not applicable, I do not find the E-cigarette/vaper attractive	80	27.5%		36	36.1%		0.37
Attractiveness of cigarettes							
The product looks nice	80	7.5%		36	0.0%		0.01
Due to all the different flavors	80	30.0%		36	11.1%		0.01
Because you can smoke different brands	80	26.3%		36	5.6%		0.00
Due to the price of the product	80	7.5%		36	2.8%		0.25
Because smoking looks cool and classy	80	6.3%		36	2.8%		0.37

table continues

Scale and items	Dual users (n)	Dual users (mean/percentage)	Dual users (SD)	E-cigarette users (n)	E-cigarette users (mean/percentage)	E-cigarette users (SD)	p-value
Because it looks cool when other people smoke	80	3.8%		36	0.0%		0.08
Because you can blow nice smoke clouds with it	80	1.3%		36	2.8%		0.62
Not applicable, I do not find the cigarette attractive	80	28.8%		36	72.2%		0.00
Unattractiveness of cigarettes							
The appearance of the cigarette	80	5.0%		36	2.8%		0.55
Its many flavors	80	8.8%		36	11.1%		0.70
The price of the product	80	35.0%		36	58.3%		0.02
The many brands	80	8.8%		36	2.8%		0.16
The smell of cigarettes	80	31.3%		36	38.9%		0.44
Packaging of cigarettes	80	10.0%		36	5.6%		0.39
Because you stink after you have smoked a cigarette	80	43.8%		36	66.7%		0.02
Not applicable, I find the cigarette attractive	80	13.8%		36	5.6%		0.14
Reasons for e-cigarette use							
Because E-cigarettes/vapers are easy to get.	80.00	5.0%		36.00	11.1%		0.30
Because they are easy to use.	80.00	27.5%		36.00	19.4%		0.34
Due to the cost: less expensive than cigarettes/affordable	80.00	41.3%		36.00	52.8%		0.26
For their health advantages: effects on health, fewer ingredients than a cigarette.	80.00	42.5%		36.00	72.2%		0.00
As an aid to smoking fewer cigarettes or giving them up completely: a method of stopping smoking, to prevent me going back to cigarettes.	80.00	42.5%		36.00	61.1%		0.07

table continues

Scale and items	Dual users (n)	Dual users (mean/percentage)	Dual users (SD)	E-cigarette users (n)	E-cigarette users (mean/percentage)	E-cigarette users (SD)	p-value
Because it is less addictive than cigarettes, variation in nicotine level is possible.	80.00	28.8%		36.00	36.1%		0.45
To cope with cravings and to prevent/cope with withdrawal symptoms	80.00	11.3%		36.00	13.9%		0.70
As an alternative to cigarettes: it is like the smoking or because of the throat hit (add info-button).	80.00	28.8%		36.00	50.0%		0.04
To get around the smoking ban (to be able to vape in places where smoking is normally forbidden).	80.00	22.5%		36.00	5.6%		0.01
To help me to focus and improve my performance, to reduce stress or to prevent weight gain.	80.00	7.5%		36.00	5.6%		0.69
Due to improved sense of taste and smell: because it tastes better than cigarettes, and to be discreet (you can hide the fact that you smoke, no unpleasant smells).	80.00	13.8%		36.00	22.2%		0.30
This is a real experience, one that can only be experienced by doing it.	80.00	1.3%		36.00	5.6%		0.30
To try something new: out of curiosity about new products, different flavors, different apparatus/designs, for pleasure, as a hobby, or because it is cool/trendy/classy.	80.00	11.3%		36.00	0.0%		0.00

table continues

Scale and items	Dual users (n)	Dual users (mean/percentage)	Dual users (SD)	E-cigarette users (n)	E-cigarette users (mean/percentage)	E-cigarette users (SD)	p-value
For social reasons: because it was recommended by friends or family, due to pressure from the people around met, to extend my social network or because it is socially acceptable.	80.00	10.0%		36.00	5.6%		0.39
NA	80.00	2.5%		36.00	0.0%		0.16
Differences in socio-cognitive factors							
Socio-cognitive factors							
Attitude never use	80	5.15	1.23	36	5.34	1.14	0.43
Attitude smoking	80	3.28	1.11	36	2.69	1.17	0.01
Attitude vaping	80	4.50	0.75	36	5.03	0.82	0.00
Barrier: accessibility of e-cigarettes	80	5.17	1.13	36	4.84	1.52	0.25
Deliberation about not using E-cigarettes or cigarettes	80	4.48	1.42	36	3.92	1.28	0.04
Deliberation about the pros and cons of tobacco product use	80	4.43	1.24	36	4.02	1.29	0.11
Deliberation of the pros and cons of smoking.	80	4.50	1.30	36	4.07	1.56	0.16
Deliberation on the pros and cons of E-cigarette use	80	4.32	1.31	36	4.07	1.33	0.37
Intention to quit vaping A. Please indicate on a scale from 1 to 7 your intent to quit vaping in the next 6 months.	80	3.76	2.00	36	2.86	1.82	0.02
Intention to quit vaping B. Please indicate which of the statements indicates your intention best	80	3.56	2.38	36	2.25	1.81	0.00
Knowledge	80	8.54	1.92	36	8.61	1.40	0.82

table continues

Scale and items	Dual users (n)	Dual users (mean/percentage)	Dual users (SD)	E-cigarette users (n)	E-cigarette users (mean/percentage)	E-cigarette users (SD)	p-value
Risk perception about <u>e-cigarette use</u> (cognitive): A. If I vape, then my risk of developing some form of cancer during my lifetime is...	80	4.29	1.17	36	4.25	1.02	0.86
Risk perception about <u>e-cigarette use</u> (cognitive): B. I think that if I vape, my risk of developing some form of cancer during my lifetime:	80	4.30	1.32	36	4.28	1.34	0.93
Risk perception of <u>e-cigarette use</u> (affective): A. My feeling is that if I vape, the risk of developing some form of cancer during my lifetime:	80	4.34	1.30	36	4.22	0.99	0.60
Risk perception of <u>not</u> using E-cigarettes or cigarettes (affective) A. My feeling is that the risk of developing some form of cancer during my lifetime:	80	4.44	1.29	36	4.36	1.13	0.75
Risk perception of not using E-cigarettes or cigarettes (affective): A. My feeling is that if don't smoke or vape, then the risk of developing some form of cancer during my lifetime	80	4.13	1.19	36	4.19	1.28	0.78
Risk perception of <u>not</u> using E-cigarettes or cigarettes (cognitive): A. How big a risk do you think you have of developing some form of cancer during your lifetime?	80	4.54	1.26	36	4.83	1.21	0.23

table continues

Scale and items	Dual users (n)	Dual users (mean/percentage)	Dual users (SD)	E-cigarette users (n)	E-cigarette users (mean/percentage)	E-cigarette users (SD)	p-value
Risk perception of <u>not</u> using E-cigarettes or cigarettes (cognitive): B. If I don't smoke or vape, then the risk that I will develop some form of cancer during my lifetime is...	80	3.93	1.24	36	4.08	1.11	0.49
Risk perception of <u>not</u> using E-cigarettes or cigarettes (cognitive): C. I think that my risk of developing some form of cancer during my lifetime:	80	4.29	1.32	36	4.36	1.05	0.75
Risk perception of <u>smoking</u> (cognitive): A. If I smoke, then my risk of developing some form of cancer during my lifetime is...	80	5.08	1.29	36	5.22	1.31	0.58
Risk perception <u>smoking</u> (affective): My feeling is that if I smoke, the risk of developing some form of cancer during my lifetime:	80	4.71	1.34	36	5.11	1.30	0.14
Risk perception <u>smoking</u> (cognitive): B. I think that if I smoke, my risk of developing some form of cancer during my lifetime:	80	4.73	1.28	36	5.31	1.06	0.01
Self-efficacy: e-cigarette use	80	3.89	1.21	36	4.84	1.02	0.00
Self-efficacy: not using tobacco products or e-cigarettes	80	3.37	1.34	36	3.77	1.26	0.12
Self-efficacy: smoking	80	3.88	1.18	36	3.57	1.37	0.23
Social Influence A: Society thinks that you should not vape E-cigarettes.	80	4.21	1.68	36	3.22	1.57	0.00

table continues

Scale and items	Dual users (n)	Dual users (mean/percentage)	Dual users (SD)	E-cigarette users (n)	E-cigarette users (mean/percentage)	E-cigarette users (SD)	p-value
Social Influence B: Society thinks that you should not smoke.	80	5.56	1.52	36	5.31	2.05	0.50
Social Influence C: Vaping status partner (% of yes): My partner uses E-cigarettes/ vapers.	80			36			0.14
Social influence D: smoking status partner (% of yes): My partner smokes.	80	33.8%		36	13.9%		0.01
social influence E: How many of your family, friends or colleagues use E-cigarettes/ vapers?	80	4.41	0.98	36	4.61	0.93	0.30
social influence F: How many of your family, friends or colleagues use cigarettes?	80	3.59	1.13	36	4.06	1.12	0.04
SOCIAL TIES with other smokers	79	3.34	1.09	36	2.32	1.22	0.00
SOCIAL TIES with other vapers	80	3.00	1.24	36	3.09	0.99	0.68
TRUST in the National Institute of Public Health and the Environment	73	4.95	1.25	34	4.43	1.61	0.10
Information seeking behavior							
Source of information used a: Television	80.00	13.8%		36.00	8.3%		0.37
Source of information used b: Newspaper	80.00	8.8%		36.00	8.3%		0.94
Source of information used c: Radio	80.00	1.3%		36.00	2.8%		0.62
Source of information used d: Advertising (signs, shop displays, advertising folders, pop-ups, YouTube advertisements, advertising banners)	80.00	6.3%		36.00	2.8%		0.37

table continues

Scale and items	Dual users (n)	Dual users (mean/percentage)	Dual users (SD)	E-cigarette users (n)	E-cigarette users (mean/percentage)	E-cigarette users (SD)	p-value
Source of information used e: Internet	80.00	67.5%		36.00	80.6%		0.13
Source of information used f: Dutch National Institute for Public Health and the Environment (RIVM)	80.00	5.0%		36.00	2.8%		0.55
Source of information used g: Facebook or Twitter	80.00	1.3%		36.00	0.0%		0.32
Source of information used h: Dutch Vape forum or Acvoda (Active for vaping)	80.00	6.3%		36.00	22.2%		0.04
Source of information used i: Friends, family, acquaintances or colleagues	80.00	30.0%		36.00	33.3%		0.73
Source of information used j: Health care professionals, such as my family doctor or practice nurse	80.00	5.0%		36.00	11.1%		0.30
Source of information used k: Not applicable. I never look for information about the E-cigarette/ vapers	80.00	6.3%		36.00	0.0%		0.02
Need of information a: The harmfulness of e-cigarettes	76.00	38.2%		36.00	47.2%		0.37
Need of information b: Where you can buy e-cigarettes	76.00	11.8%		36.00	19.4%		0.33
Need of information c: E-liquids	76.00	13.2%		36.00	8.3%		0.43
Need of information d: The different types of e-cigarettes available	76.00	9.2%		36.00	11.1%		0.76

table continues

Scale and items	Dual users (n)	Dual users (mean/percentage)	Dual users (SD)	E-cigarette users (n)	E-cigarette users (mean/percentage)	E-cigarette users (SD)	p-value
Need of information e: How an e-cigarette works	76.00	10.5%		36.00	8.3%		0.71
Need of information f: Whether the e-cigarette is an effective smoking cessation tool	76.00	21.1%		36.00	27.8%		0.45
Need of information g: How much e-liquid do you use on average with an e-cigarette	76.00	9.2%		36.00	8.3%		0.88
Need of information h: What settings to use with an e-cigarette	76.00	3.9%		36.00	0.0%		0.08
Need of information i: How often on a day you should use e-cigarettes	76.00	6.6%		36.00	2.8%		0.34
Need of information j: About the e-liquids available	76.00	7.9%		36.00	0.0%		0.01
Need of information all: All the above	76.00	15.8%		36.00	8.3%		0.24
Need of information none: I do not want additional information about the e-cigarette	76.00	21.1%		36.00	19.4%		0.84
Attitude towards information about e-cigarettes	76	4.54	1.11	36	4.42	1.39	0.63
Reliability of information a: Only if researchers have influence on how the research is carried out	80	32.5%		36	27.8%		0.61
Reliability of information b: Only if researchers have influence on how the research results are interpreted	80	26.3%		36	22.2%		0.64

table continues

Scale and items	Dual users (n)	Dual users (mean/percentage)	Dual users (SD)	E-cigarette users (n)	E-cigarette users (mean/percentage)	E-cigarette users (SD)	p-value
Reliability of information c: Only if researchers have influence on how the research results are communicated	80	27.5%		36	19.4%		0.34
Reliability of information d: If all the research results are made known and not just the desired results	80	66.3%		36	75.0%		0.34
Reliability of information e: If the researchers have no conflict of interest to declare	80	51.3%		36	75.0%		0.01
Reliability of information f: If the research is not financed by the tobacco industry	80	37.5%		36	55.6%		0.08
Reliability of information g: If the research is under the auspices of the national government, if there is a governmental logo	80	16.3%		36	8.3%		0.21
Independence of information a: Only if researchers have influence on how the research is carried out.	80	35.0%		36	36.1%		0.91
Independence of information b: Only if researchers have influence on how the research results are interpreted.	80	27.5%		36	27.8%		0.98
Independence of information c: Only if researchers have influence on how the research results are communicated.	80	27.5%		36	22.2%		0.54
Independence of information d: If all the research results are made known and not just the desired results.	80	62.5%		36	72.2%		0.30

table continues

Scale and items	Dual users (n)	Dual users (mean/percentage)	Dual users (SD)	E-cigarette users (n)	E-cigarette users (mean/percentage)	E-cigarette users (SD)	p-value
Independence of information e: If the researchers themselves have no vested interests in the results.	80	50.0%		36	72.2%		0.02
Independence of information f: If the research is not financed by the tobacco industry.	80	38.8%		36	50.0%		0.27
Independence of information h: If the research is under the auspices of the national government, if there is a governmental logo.	80	18.8%		36	5.6%		0.03

Appendix 8 Participants characteristics and alias

Chapter 6

A Deliberate Choice? Exploring factors related to informed decision-making about childhood vaccination among acceptors, refusers, and partial acceptors

Alias	Gender	Country of birth	Level of education	Year of birth
1_ACCEPT	Female	the Netherlands	High	
2_ACCEPT	Female	the Netherlands	High	1974
3_ACCEPT	Female	the Netherlands	High	1977
4_ACCEPT	Female	the Netherlands	High	1973
5_ACCEPT	Female	the Netherlands	High	1986
6_ACCEPT	Female	the Netherlands	High	1975
7_REFUSE	Female	the Netherlands	High	1980
8_REFUSE	Female	the Netherlands	High	1980
9_REFUSE	Female	the Netherlands	High	1979
10_REFUSE	Female	the Netherlands	High	1979
11_REFUSE	Female	the Netherlands	High	1978
12_REFUSE	Female	the Netherlands	High	1978
13_PARTIAL	Female	the Netherlands	High	1972
14_PARTIAL	Female	the Netherlands	High	1973
15_PARTIAL	Female	the Netherlands	High	1968
16_PARTIAL	Female	the Netherlands	High	1983
17_PARTIAL	Female	the Netherlands	High	1977
18_PARTIAL	Female	the Netherlands	High	1987
19_PARTIAL	Female	the Netherlands	High	1982
20_PARTIAL	Female	the Netherlands	High	1980
21_ACCEPT	Female	the Netherlands	High	1983
22_ACCEPT	Female	Surinam	High	1985
23_ACCEPT	Female	the Netherlands	High	1982
24_ACCEPT	Female	Germany	High	1973
25_ACCEPT	Female	Canada	High	1974
26_ACCEPT	Female	the Netherlands	High	1981
27_ACCEPT	Female	the Netherlands	High	1976
28_REFUSE	Female	the Netherlands	High	1971
29_REFUSE	Female	the Netherlands	High	1980
30_PARTIAL	Female	the Netherlands	High	1959
31_PARTIAL	Female	the Netherlands	High	1990
32_PARTIAL	Female	the Netherlands	High	
33_PARTIAL	Female	Slovakia	High	1977
34_PARTIAL	Female	the Netherlands	High	1976
35_PARTIAL	Female	the Netherlands	High	1980
36_PARTIAL	Female	the Netherlands	High	1977

table continues

Alias	Gender	Country of birth	Level of education	Year of birth
37_PARTIAL	Female	the Netherlands	High	1978
38_PARTIAL	Female	the Netherlands	High	1970
39_PARTIAL	Female	the Netherlands	High	1985
40_PARTIAL	Female	Seoul	High	1977
41_PARTIAL	Female	the Netherlands	Middle	1982
42_PARTIAL	Female	the Netherlands	High	1971
43_ACCEPT	Female	the Netherlands	High	1974
44_ACCEPT	Female	the Netherlands	High	1978
45_ACCEPT	Female	the Netherlands	High	1985
46_ACCEPT	Female	the Netherlands	High	1974
47_ACCEPT	Female	the Netherlands	High	1985
48_ACCEPT	Female	the Netherlands	Low	1972
49_REFUSE	Female	the Netherlands	High	
50_REFUSE	Female	the Netherlands	High	1975
51_REFUSE	Female	the Netherlands	High	1980
52_PARTIAL	Female	the Netherlands	High	1983
53_PARTIAL	Female	the Netherlands	High	1990
54_PARTIAL	Female	the Netherlands	High	1977
55_REFUSE	Female	Australia	High	1982

Note the alias reflects the decision about childhood vaccination of participants

Appendix 9 Topic guide: exploring decision-making about childhood vaccination

Chapter 6 A Deliberate Choice? Exploring the Decision to Switch from Cigarettes to E-Cigarettes	
Note: All participants have to sign an informed consent before the start of the introduction.	
Introduction by interviewer	
Welcome! My name is ... and this is ..., who will be helping me with the discussion today. I work for ... and I my research is about....	
Today we are discussing childhood vaccination. Your opinion as a parent is very important. We would like to talk to you about childhood vaccination and this discussion will take approximately two hours, with a break. At the end of our discussion we have time for general questions about childhood vaccination.	
We would like to stress that there are no correct or wrong answers. Today is all about your experiences and your ideas. We will be hearing a lot of different ideas and experiences, so I would like to ask you to respect each other. Please listen carefully to each other and please let each other finish speaking.	
This group discussion will be audio recorded. – <i>Turn on audio recording</i> — All personal information will be made anonymous, and please remember that your participation is voluntary. This means that you can leave at all times, you do not have to explain yourself.	
Are there any remaining questions before we start?	
Introduction participants	
Please introduce yourself shortly. Please share the vaccination status of your child. What do you enjoy doing in your daily live?	
· Make name tags	
General prompts	
· What do you mean?	
· Can you tell me more about that?	
· What comes to mind?	
· Can you explain that to me?	
· Is there anything else that you can think of?	
Topic guide: exploring decision making process of childhood vaccination	
Knowledge about childhood vaccination	
What do you know about childhood vaccination? [use flip-over to collect ideas]	
Prompts	Risks, NIP, different childhood vaccination schedules, religion, herd immunity, VPDs, side-effects
Attitude	
What is your opinion about childhood vaccination?	
Prompts	How do you feel about it? What are advantages and disadvantages?

table continues

Deliberation

When did you start thinking about childhood vaccination?
How did you consider the pros and cons of childhood vaccination?
Who played a role in your decision?
What played a role in your decision?
How difficult was it to make a decision?
Did you have any doubts about your decision?

Prompts

Did you consider an alternative (schedule)? How do you deal with the risks of refusing childhood vaccinations? Is it one big decision, or several small ones? Are you happy with your decision? Would you do it differently? What would have made it easier for you to make a decision about childhood vaccination?

[use these prompts to link to next topic]

Information need

What information is important to make a decision about childhood vaccination?
Where did you look for information about childhood vaccination?
Did you understand the information provided at the CWC?

Prompts

Which information was important to you? Which source was important to you? How do you know how to trust information? Which information do you still miss? Could the CVPs answer your questions? Do you feel that the CVPs take your questions seriously?

Closing

Is there anything we did not cover today that you find important related to childhood vaccination?
Do you have any questions left?

Note: due to the semi-structured protocol these questions are examples and may slightly vary in each focus group in both style and order.

Appendix 10 survey used to investigate childhood vaccination

Chapter 7 and 8					
Concept	Item	Answer option	Explanation of the scale	Formation of the concept	Cronbach's alpha (a)
Age	What is your age?	Open answer	NA	NA	NA
Gender	What is your gender?	- Male - Female	NA	NA	NA
Education	What is your highest level of education?	1. Did not finish school 2. Primary school to 8th grade 3. Some high school, did not graduate 4. High school graduate, diploma or the equivalent (for example: GED) 5. Some college credit, no degree 6. Trade/technical/vocational training 7. Associate degree 8. Bachelor's degree 9. Master's degree 10. Professional degree 11. Doctorate degree	Low level of education: answer options 1, 2, 3, 4 Middle level of education: answer options 5, 6 Higher level of education: answer options 7 - 11	NA	NA
Country of birth	What is your country of birth?	- The Netherlands - Netherlands Antilles - Morocco - Suriname - Turkey - Other.... (open answer)	NA	NA	NA
Number of children	How many children do you have?	Open answer	NA	NA	NA
Own vaccination status	Did you, as a child, participate in the NIP?	- Yes, my parents or guardians followed the NIP completely.	NA	NA	NA

Centraal Bureau voor
Statistiek (CBS) ¹

Knowledge about childhood vaccinations	C ^a , my child, for with I received this invitation, received...	3. Not all vaccines, because I delayed some vaccines, for example, I started later than 6 to 9 weeks for the first vaccine 4. Not yet, because my child needs to receive some more vaccines 5. I delayed some vaccines, but eventually my child received all vaccines. 6. My child received all vaccines from the NIP but not from the Child Welfare Center (CWC)			
	^a D = Diphtheria, HBV = Hepatitis B, Hib = Hib disease, M = Measles, Men C = Meningococcal disease type C, B = Mumps, PCV = Pneumococcal disease, IPV = Polio, R = Rubella, T = Tetanus, aP = Whooping cough				
Knowledge about childhood vaccinations	1. The government is paying for the NIP	0 = incorrect and 1 = correct	0 = no correct answers to 9 = all statements were answered correctly	- The scores were summed to come to a final score of possible correct answers out of 9.	Lehmann, de Melker, Timmermans, Mollema ³
	2. The government makes it mandatory for me to get my child vaccinated according to the NIP.	NA = don't know		- I don't know was categorized as incorrect.	
	3. If we do not vaccinate, the infectious diseases that do not or rarely occur, could resurge.			- The coding of correct and incorrect answers was based on scientific consensus	
	4. Because of vaccination, most infectious diseases that we vaccinate against rarely occur anymore.			- The statements assessing knowledge were based on an information leaflet all parents receive with their first invitation for the first childhood vaccination	
	5. Most side effects start at the day of vaccination and are over within two days.			- The guess-corrected midpoint of the scale was used to determine sufficient or insufficient knowledge for the dichotomous measure of informed decision-making.	
	6. The simultaneous administration of two vaccinations causes less side effects than spread administration.			- To determine the guess-corrected midpoint, Abbott's blind guessing formula was used.	
	7. Children already are vaccinated at the age of 6 to 9 weeks, because the antibodies of the mother often already disappeared.			- Guess-corrected midpoint = $4.5 + (9 - 4.5)/2 \rightarrow 7$	
	8. For most infectious diseases it is important that as many as possible of the children are vaccinated to be able to fight the infectious disease.			- Abbott's blind guessing formula: $R = Rc + (T - Rc)/K$	
	9. Breastfeeding is as effective in preventing infectious diseases as completely vaccination according to the NIP.			- R = Guess-corrected midpoint - T = number of knowledge items - Rc = number of questions divided by 2 (midpoint)	

				- K = possible outcomes (2 for correct/incorrect).		
Beliefs towards the NIP	1. I think the influence of the government in the NIP is too great 2. I think the NIP feels mandatory	1 = totally disagree to 7 = totally agree A	1 = positive feelings towards the NIP to 7 = negative feelings towards the NIP	- ^A Items were recoded so the beliefs match with scientific consensus, for example, if parents answered 7 (totally agree) with I think the NIP is mandatory, this answer was recoded to 1. - The two items were summed and averaged to compute one score of the concept 'beliefs towards the NIP'.	0.688 (p)	Harmen, Lambooi, Ruiter, et al. ⁴
Beliefs towards the Effectiveness of Vaccinations	1. I think some vaccination are no longer necessary because the VPDs are no longer present in the Netherlands 2. I do not think vaccination contribute to the decrease of prevalence of VPDs in the Netherlands 3. I think vaccinations have long-term side effects for my child 4. I think it is good that there are multiple vaccines in one vaccinations 5. I think it is good that children are vaccinated at age 6 to 9 weeks 6. I think as much as possible children need to be vaccinated to have a sufficient herd immunity 7. I think breast feeding is just as effective as accepting all childhood vaccinations	1 = totally disagree to 7 = totally agree A	7 = I believe in the necessity and effectiveness of childhood vaccines, 1 = I do not believe in the childhood vaccinations.	- ^A Items were recoded so the beliefs match with scientific consensus, for example, if parents answered 7 (totally agree) with I think breast feeding is just as effective as accepting all childhood vaccinations, this answer was recoded to 1. - The seven items were summed and averaged to compute one score of the concept 'beliefs towards the effectiveness of vaccinations'.	0.903 (p)	Harmen, Lambooi, Ruiter, et al. ⁴
Attitude towards accepting Childhood Vaccination	I think accepting all childhood vaccinations is...	1 = very bad to 7 = really good 1 = very unimportant to 7 = very important 1 = very unnecessary to 7 = very necessary	1 = very negative towards accepting childhood vaccinations and 7 = very positive towards accepting	The seven items were summed and averaged to compute one score of the concept attitude towards accepting childhood vaccinations. - Midpoint of the scale = $(7 + 49) / 2 \rightarrow$ midpoint of the scale is 28.	0.983	Lehmann, de Melker, Timmermans, Mollema ³

table continues

	1 = very unacceptable to 7 = very acceptable	childhood vaccinations.	Midpoint of the scale = lowest score + highest possible score divided by 2.	
	1 = very undesirable to 7 = very desirable			
	1 = very harmful to 7 = very harmless			
	1 = very disconcerting to 7 = very comforting			
Attitude towards refusing Childhood Vaccination	<i>I think refusing all childhood vaccinations is...</i>	1 = very negative towards refusing childhood vaccinations and 7 = very positive towards refusing childhood vaccinations.	The seven items were summed and averaged to compute one score of the concept attitude towards refusing childhood vaccinations . - Midpoint of the scale = $(7 + 49) / 2 \rightarrow$ midpoint of the scale is 28. Midpoint of the scale = lowest score + highest possible score divided by 2.	Lehmann, de Melker, Timmermans, Mollema ³ Montano, Kasprzyk ⁵
	1 = very bad to 7 = really good			0.971
	1 = very unimportant to 7 = very important			
	1 = very unnecessary to 7 = very necessary			
	1 = very unacceptable to 7 = very acceptable			
	1 = very undesirable to 7 = very desirable			
	1 = very harmful to 7 = very harmless			
	1 = very disconcerting to 7 = very comforting			
Attitude towards partially Accepting Childhood Vaccination	<i>I think partially accepting childhood vaccinations is...</i>	1 = very negative towards partially accepting childhood vaccinations and 7 = very positive towards partially accepting	The seven items were summed and averaged to compute one score of the concept attitude towards partially accepting childhood vaccinations . - Midpoint of the scale = $(7 + 49) / 2 \rightarrow$ midpoint of the scale is 28.	Lehmann, de Melker, Timmermans, Mollema ³
	1 = very bad to 7 = really good			0.950
	1 = very unimportant to 7 = very important			
	1 = very unnecessary to 7 = very necessary			

	1 = very unacceptable to 7 = very acceptable 1 = very undesirable to 7 = very desirable 1 = very harmful to 7 = very harmless 1 = very disconcerting to 7 = very comforting	childhood vaccinations.	Midpoint of the scale = lowest score + highest possible score divided by 2.	
Deliberation of the pros and cons of accepting childhood vaccinations	<p>Please keep your own decision about childhood vaccination in mind, but did you consider the option to accept all childhood vaccinations?</p> <p>1. I have considered how I would feel if I were to have my child fully vaccinated.</p> <p>2. I have tried to consider the consequences of having my child fully vaccinated.</p> <p>3. I am aware of the advantages and disadvantages of having my child fully vaccinated.</p>	<p>1 = no deliberation of the decision to accept all childhood vaccinations to 7 = very extensive deliberation of the decision to accept all childhood vaccinations.</p>	<p>The three items were summed and averaged to compute one score of the concept Deliberation of the pros and cons of accepting childhood vaccinations.</p> <p>- Midpoint of the scale = (3 + 21) / 2 → midpoint of the scale is 12.</p> <p>Midpoint of the scale = lowest score + highest possible score divided by 2.</p>	Lehmann, de Melker, Timmermans, Mollema ³
	<p>Having my child fully vaccinated is something that I would automatically do. (recoded)</p> <p>I would not have to think for very long about having my child fully vaccinated.</p>	<p>1 = not considered it at all – 7 = considered it very carefully & not applicable</p> <p>1 = not considered it at all – 7 = considered it very carefully & not applicable</p>	<p>To accommodate for the large proportions of missing answers (min= 5.2%, max= 48.7%, median=35.7%), scales for deliberation of the pros and cons of accepting childhood vaccinations the concept was computed without these three items.</p>	

table continues

	I thought about it long and hard before I took the decision to have my child fully vaccinated. (recorded)	1 = not considered it at all – 7 = considered it very carefully & not applicable				Lehmann, de Melker, Timmermans, Mollema ³
Deliberation of the pros and cons of refusing all childhood vaccinations	Please keep your own decision about childhood vaccination in mind, but did you consider the option to refuse all childhood vaccinations?	1 = no deliberation of the decision to refuse all childhood vaccinations to 7 = very extensive deliberation of the decision to refuse all childhood vaccinations.	The three items were summed and averaged to compute one score of the concept	0.799		
	1. I have considered how I would feel if I were to have my child <u>not</u> vaccinated.	1 = not considered it at all – 7 = considered it very carefully	Deliberation of the pros and cons of refusing childhood vaccinations.			
	2. I have tried to consider the consequences of having my child <u>not</u> vaccinated.	1 = not considered it at all – 7 = considered it very carefully	- Midpoint of the scale = (3 + 21) / 2 → midpoint of the scale is 12.			
	3. I am aware of the advantages and disadvantages of having my child <u>not</u> vaccinated.	1 = not considered it at all – 7 = considered it very carefully	Midpoint of the scale = lowest score + highest possible score divided by 2.			
	Having my child <u>not</u> vaccinated is something that I would automatically do. (recorded)	1 = not considered it at all – 7 = considered it very carefully & not applicable	To accommodate for the large proportions of missing answers (min= 5.2%, max= 48.7%, median=35.7%), scales for deliberation of the pros and cons of refusing childhood vaccinations the concept was computed without these three items.			
	I would not have to think for very long about having my child <u>not</u> vaccinated.	1 = not considered it at all – 7 = considered it very carefully & not applicable				
	I thought about it long and hard before I took the decision to have my child <u>not</u> vaccinated. (recorded)	1 = not considered it at all – 7 = considered it very carefully & not applicable				

Deliberation of the pros and cons of partially accepting childhood vaccinations	Please keep your own decision about childhood vaccination in mind, but did you consider the option to partially accept childhood vaccinations?	1 = no deliberation of the decision to partially accept childhood vaccinations to 7 = very extensive deliberation of the decision to partially accept childhood vaccinations.	The three items were summed and averaged to compute one score of the concept Deliberation of the pros and cons of partially accepting childhood vaccinations.	0.898	Lehmann, de Melker, Timmermans, Mollema ³
	I have considered how I would feel if I were to have my child <u>partially</u> vaccinated.	1 = not considered it at all – 7 = considered it very carefully			
	I have tried to consider the consequences of having my child <u>partially</u> vaccinated.	1 = not considered it at all – 7 = considered it very carefully			
	1. I am aware of the advantages and disadvantages of having my child <u>partially</u> vaccinated.	1 = not considered it at all – 7 = considered it very carefully			
	Having my child <u>partially</u> vaccinated is something that I would automatically do. (recorded)	1 = not considered it at all – 7 = considered it very carefully & not applicable			
	I would not have to think for very long about having my child <u>partially</u> vaccinated.	1 = not considered it at all – 7 = considered it very carefully & not applicable			
	I thought about it long and hard before I took the decision to have my child <u>partially</u> vaccinated. (recorded)	1 = not considered it at all – 7 = considered it very carefully & not applicable			
	To accommodate for the large proportions of missing answers (min= 5.2%, max= 48.7%, median=35.7%), scales for deliberation of the pros and cons of partially accepting childhood vaccinations the concept was computed without these three items.				

table continues

Decisional Conflict	Considering the option you prefer about childhood vaccination, please answer the following questions:	1 = totally disagree to 7 = totally agree	1 = no decisional conflict – 100 = extremely high decisional conflict.	The decisional conflict items were recoded from 0 to 6, summed, divided by 16 (number of items), and multiplied by 100/6. Scores can range from no decisional conflict (0) to extremely high decisional conflict (100). ⁶ The subscales uncertainty, informed, value clarity, support, and effective decision were recoded from 0 to 6, summed, divided by the number of items specific to the subscale, and multiplied by 100/6. ⁶ O'Connor ⁷ states that scores on the decisional conflict scale lower than 25 out of 100 are associated with making an informed decision, while scores exceeding 37.5 are associated with decisional regret.	.914	O'Connor ⁶
Decisional conflict: informed subscale	<div>I know which options concerning the vaccination of my child are possible for me</div> <div>I know what the advantages of each option concerning the vaccination of my child are</div> <div>I know what the risks and disadvantages of each option</div>		<div>1 = feels extremely uninformed – 100 = feels extremely informed.</div>	<div>The answer options were recoded to 0-6. The three items are then summed and divided by three. The scores were multiplied by 100/6. The final score was recoded so 1 means feels extremely uninformed and 100 feels extremely informed.</div>	0.849	

concerning the vaccination of my child are	
Decisional Conflict Values Clarity	I know which advantages concerning the vaccination of my child are most important to me
	Scores range from 0 = feels extremely clear about personal values for benefits & risks/side effects to 100 = extremely unclear about personal values.
	.856
I know which risks and disadvantages concerning the vaccination of my child are most important to me	
I know what is more important to me - the benefits or the risks and disadvantages concerning the vaccination of my child	
Decisional Conflict Support	I get enough support from other people when making a choice concerning the vaccination of my child
	Scores range from 0 = feels extremely supported in decision-making to 100 = feels extremely unsupported in decision-making.
	- Answer options were recoded from zero = totally agree to six = totally disagree. - The three items were summed and averaged. - This score was then multiplied 16.667. Scores then range from 0 to 100.
	.707
I do not feel I am being put under pressure by other	

table continues

people when making a choice concerning the vaccination of my child		
I have been given enough advice to be able to make a choice concerning the vaccination of my child		
Decisional Conflict Uncertainty	<p>The best choice concerning the vaccination of my child is clear to me</p>	<p>Scores range from 0 = feels extremely certain about best choice to 100 = extremely uncertain about best choice.</p> <p>- Answer options were recoded from zero = totally agree to six = totally disagree.</p> <p>- The three items were summed and averaged.</p> <p>- This score was then multiplied 16.667.</p> <p>Scores then range from 0 to 100.</p>
I feel certain about what to choose concerning the vaccination of my child		
I find it easy to make a choice concerning the vaccination of my child		
Decisional Conflict Effective Decision	<p>I have the feeling that I have made an informed choice concerning the vaccination of my child</p>	<p>Scores range from 0 = good decision to 100 = bad decision.</p> <p>- Answer options were recoded from zero = totally agree to six = totally disagree.</p> <p>- The three items were summed and averaged.</p> <p>- This score was then multiplied 16.667.</p> <p>Scores then range from 0 to 100.</p>

I expect to stick to my choice concerning the vaccination of my child						
I am satisfied with my choice concerning the vaccination of my child						
My choice concerning the vaccination of my child shows what I think is important						
Susceptibility regarding the Vaccine Preventable Diseases (VPDs) (cognitive)						
Susceptibility regarding Factual Chance of child's susceptibility of VPDs after accepting all childhood vaccinations	If I fully vaccinate my child in accordance with the National Immunization Program, then the risk that my child will get one of these infectious diseases is	1= very small to 7 = very high	1= low to 7 = high risk perception for child's susceptibility for VPD if all childhood vaccinations are accepted	Answer options were recoded to make sure 7 is positive and 1 is negative. Susceptibility and severity items on VPDs could not be summed ⁸ because Cronbach's alpha was below .6. A concept could not be created, and thus, the individual item was used.	NA	Janssen ⁹ de Vries, van Osch, Eijmael, Smerecnik, Candel ⁸
Susceptibility regarding Factual Chance of child's susceptibility of VPDs after refusing all childhood vaccinations	If I do not vaccinate my child in accordance with the National Immunization Program, then the risk that my child will get	1= very small to 7 = very high	1= low to 7 = high risk perception for child's susceptibility for VPD if all childhood vaccinations are refused	Answer options were recoded to make sure 7 is positive and 1 is negative. Susceptibility and severity items on VPDs could not be	NA	

table continues

one of these infectious diseases is		summed ⁸ because Cronbach's alpha was below .6. A concept could not be created, and thus, the individual item was used.	NA	Janssen ⁹ de Vries, van Osch, Eijmael, Smerecnik, Candel ⁸
Susceptibility regarding Factual Chance of child's susceptibility of VPDs after partially accepting childhood vaccinations	If I partially vaccinate my child in accordance with the National Immunization Program, then the risk that my child will get one of these infectious diseases is	1 = very small to 7 = very high 1 = low to 7 = high risk perception for child's susceptibility for VPD if all childhood vaccinations are refused	Answer options were recoded to make sure 7 is positive and 1 is negative. Susceptibility and severity items on VPDs could not be summed ⁸ because Cronbach's alpha was below .6. A concept could not be created, and thus, the individual item was used.	
Susceptibility regarding the side effects of vaccines (cognitive)				
Susceptibility regarding Factual Chance of child's susceptibility of side effects after accepting all childhood vaccinations	If I fully vaccinate my child in accordance with the National Immunization Program, then the risk that my child would develop side effects is	1 = very small to 7 = very high 1 = low to 7 = high risk perception for child's susceptibility for VPD if all childhood vaccinations are accepted	Answer options were recoded to make sure 7 is positive and 1 is negative. Susceptibility and severity items on side-effects could not be summed ⁸ because Cronbach's alpha was below .6. A concept could not be created, and thus, the individual item was used.	
Susceptibility regarding Factual	If I partially vaccinate my child in	1 = low to 7 = high risk perception for child's	Answer options were recoded to make sure	NA

Chance of child's susceptibility of side effects after partially accepting childhood vaccinations	accordance with the National Immunization Program, then the risk that my child would develop side effects as a result of the vaccination(s) is	susceptibility for VPD if childhood vaccinations are accepted in part	7 is positive and 1 is negative. Susceptibility and severity items on side-effects could not be summed ⁸ because Cronbach's alpha was below .6. A concept could not be created, and thus, the individual item was used.	
Severity of VPDs and side-effects				
1. How serious would you think it would be if your child got one of the infectious diseases?	1 = not serious at all to 7 = very serious	1 = low to 7 = high perception of severity of VPDs	Answer options were recoded to make sure 7 equal a high susceptibility and severity of the risks and 1 is negative. Susceptibility and severity items on side-effects could not be summed ⁸ because Cronbach's alpha was below .6. A concept could not be created, and thus, the individual item was used.	Janssen, ⁹ de Vries, van Osch, Eijmael, Smerecnik, Candel ⁸
2. If my child got one of the infectious diseases, it could have very serious effects.	1 = totally disagree to 7 = totally agree			
3. How serious would you think it was if	1 = not serious at all to 7 = very serious ^A			

table continues

your child developed side effects as a consequence of vaccination(s) from the National Immunization Program?				
4. If my child developed side effects as a consequence of vaccination(s) from the National Immunization Program, then this could have serious consequences for my child.				
1 = totally disagree to 7 = totally agree				
Trust	Please indicate how much you trust or distrust the aspects	1 = no trust to 7 = a lot of trust	1 = no trust in the NIP to 7 = a lot of trust in the NIP	The ten items were summed and averaged to compute one score of the concept Trust.
	1. The vaccinations that are part of the National Immunization Program			0.917
	2. The National Immunization Program			Siegrist, Earle, Gutscher ¹⁰
	3. The RIVM			
	4. In the Dutch government, I have...			

<p>5. Information from the government about the National Immunization Program</p> <p>6. The pharmaceutical industry</p> <p>7. child vaccine providers at the child welfare clinic</p> <p>8. Child welfare clinic</p> <p>9. The information that you get from the Child welfare clinic</p> <p>10. The Dutch health care system if your child got one of the 12 infectious diseases</p>				
Values	<p><i>Please indicate whether the following statements apply to you</i></p> <p>Religion</p> <p>Homeopathy</p> <p>Naturopathy</p> <p>Anthroposophy</p>	<p><i>Please indicate whether the following statements apply to you</i></p> <p>1 = completely disagree</p> <p>– 7 completely agree</p>	<p>Individual items were used</p> <p>1 = this value does not apply to me to 7 = this value applies to me</p>	NA
Social norm regarding refusing childhood vaccination	<p><i>Please indicate whether the following statements apply to you</i></p> <p>1. Other parents that I know think that I</p>	<p>1 = completely disagree</p> <p>– 7 completely agree</p>	<p>Statements about child vaccine provider</p> <p>1 = not socially acceptable to refuse</p>	<p>.754</p> <p>Montano, Kasprzyk ⁵</p>

table continues

should not vaccinate my child.	& not applicable	childhood vaccinations to 7 = socially acceptable to refuse childhood vaccinations	(CVP) and society thinking you should refuse childhood vaccinations were deleted to improve the reliability of the scale (> .6).
2. Family and friends think that I should not vaccinate my child.			
3. My partner/co-parent/carer thinks that we should not vaccinate our child.			The not applicable answer option resulted in high proportion of missings (17%). Social influence was also assessed for accepting and partially accepting childhood vaccinations, but this line of questioning was mutually exclusive. Meaning, if a parent totally disagreed with the statement that other parents think you should refuse all vaccinations, they agreed with the statements that other parents think that you should accept all childhood vaccinations. Thus, questions about social influence regarding accepting and partially accepting childhood vaccinations were

excluded from this analysis.				
Social norm regarding accepting childhood vaccination	1. How many of your family and friends fully vaccinate their children? <ul style="list-style-type: none"> • all or nearly all • more than half • just a little more than half • half • half • just a little less than half • less than half • none or almost none • not applicable 	(1) almost none of the parents in my social network accept childhood vaccinations to (7) almost all parents in my social network accept childhood vaccinations.	The two items were summed and averaged into a concept.	.864 Montano, Kasprzyk ⁵
	2. How many of the other parents you know fully vaccinate their children? <ul style="list-style-type: none"> • all or nearly all • more than half • just a little more than half • half • half • just a little less than half • less than half • none or almost none • not applicable 			
Anticipated regret	1. If I had had my child <u>fully</u> vaccinated and my child developed problems with the side effects of one of the vaccinations, then I would feel 2. If I had had my child <u>partially</u> vaccinated and my child developed problems with side	1 = experience a lot of anticipated regret to 7 = no anticipated regret is experienced	Reliability analysis showed that the Cronbach's alpha was below .6. A concept could not be created, and thus, the individual item was used.	NA Harmsen, Lambooij, Ruiter, et al. ⁴

table continues

effects of one of the vaccinations, then I would feel

3. If I had had my child fully vaccinated and my child still developed one of the infectious diseases, then I would feel

4. If I had had my child partially vaccinated and my child developed one of the infectious diseases, then I would feel

5. If I had not had my child vaccinated and my child developed one of the infectious diseases, then I would feel

Experience of Barriers	1 = I don't understand the information about the National Immunization Program in the RIVM folder properly.	1 = completely disagree – 7 completely agree	1 = low perception of barriers with regards to childhood vaccinations to 7 = high perception of barriers	Six items were summed and averaged to compute one score of the concept. Two items were excluded because they described physical barriers (unable to make an appointment	0.722	Harmesen, Lambooij, Ruiter, et al. ⁴
2. The staff at the Child welfare clinic						

and the distance to the CWC) and not barriers in decision-making.

don't have enough time to answer all my questions about vaccinations.

3. The staff at the Child welfare clinic don't have enough knowledge to answer all my questions about vaccinations.

4. The staff of the Child welfare clinic do not take enough account of what I want to talk about concerning the National Immunization Program.

5. If I were to consider vaccinating my child other than fully, it would involve a lot of research.

6. I find it difficult to consider vaccinating my child any other way than fully.

Self-Efficacy regarding accepting childhood vaccinations	1. If I want to accept all childhood vaccinations for my child, then I	1 = know for sure that it won't succeed - 7 = know for sure that it will succeed	1 = low perceived ability to accept childhood	Reliability analysis showed that the Cronbach's alpha was below .6. A concept	NA	Dijkstra, Vries ¹¹
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table continues

Self-Efficacy regarding partially accepting childhood vaccinations	2. I would find having my child fully vaccinated	1 = very difficult indeed – 7 = very easy indeed	1 = low perceived ability to partially accept childhood vaccinations to 7 = high perceived ability	Reliability analysis showed that the Cronbach's alpha was below .6. A concept could not be created, and thus, the individual item was used.	NA
	2. I would find having my child partially vaccinated	1 = know for sure that it won't succeed - 7 = know for sure that it will succeed	1 = low perceived ability to partially accept childhood vaccinations to 7 = high perceived ability	Reliability analysis showed that the Cronbach's alpha was below .6. A concept could not be created, and thus, the individual item was used.	NA
Self-Efficacy regarding refusing childhood vaccinations	2. I would find <u>not</u> having my child vaccinated	1 = very difficult indeed – 7 = very easy indeed	1 = low perceived ability to refuse childhood vaccinations to 7 = high perceived ability	Reliability analysis showed that the Cronbach's alpha was below .6. A concept could not be created, and thus, the individual item was used.	NA
	2. I would find having my child partially vaccinated	1 = know for sure that it won't succeed - 7 = know for sure that it will succeed	1 = low perceived ability to refuse childhood vaccinations to 7 = high perceived ability	Reliability analysis showed that the Cronbach's alpha was below .6. A concept could not be created, and thus, the individual item was used.	NA

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