



Improving smoking cessation support for pregnant women

Stella Weiland

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Promotores

Prof. dr. M.Y. Berger

Prof. dr. J.J.H.M. Erwich

Copromotores

Dr. D.E.M.C. Jansen

Dr. L.L. Peters

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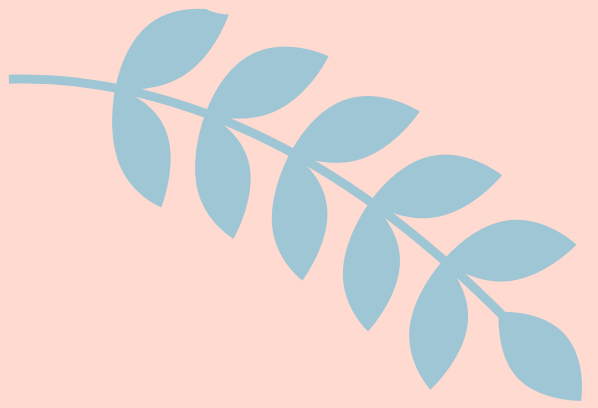
Prof. Dr. A. Dijkstra

Prof. Dr. L. Boendermaker

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Chapter 1

General Introduction



The aim of this PhD-thesis is to gain insight into factors that are associated with smoking during pregnancy and to optimize and evaluate smoking cessation support in daily practice. In this Chapter, background information related to smoking during pregnancy is provided. First, the prevalence of smoking during pregnancy, characteristics of women who smoke during pregnancy and the adverse health outcomes of smoking during pregnancy are described. Second, smoking cessation initiatives and campaigns in the Netherlands, professional smoking cessation support options and the effect of the interventions are elaborated upon. Then, the ZonMw granted project 'Together we'll quit smoking!' will be introduced. At the end of this Chapter, an overview of the studies of this thesis is given.

Smoking during pregnancy

Globally, the estimated prevalence of women who smoke during pregnancy is 1.7%.¹ This estimated prevalence is the highest in the European Region (8.1%) and the lowest in the African Region (0.8%).¹ In the Netherlands, 8% of women smoke during part of their pregnancy, and 4.8% smoke during their entire pregnancy.² Around 0.8% of women use the e-cigarette or hookah during pregnancy.² Moreover, 35% percent of the women who succeed to quit smoking during pregnancy start smoking again postpartum.²

Smoking during pregnancy is associated with adverse health outcomes for both the baby, such as an increased risk of low birth weight, fetal growth restriction and stillbirth, and for the mother, such as cardiovascular disease and cancer.³⁻⁵ There are also long-term infant health consequences associated with maternal smoking during pregnancy, such as an increased risk of obesity, asthma and behavioural disorders.⁶ Research has shown that women who smoke during pregnancy more often have a lower socioeconomic status (SES), are more often single, more often have a partner who smokes, and have more perceived stress.^{7,8} In the Netherlands, among lower or middle educated women, the prevalence of smoking at any time during pregnancy is 15.6%, compared with 1.8% among women with a higher education level.² In the north of the Netherlands, the SES of the residents is low compared to the rest of the Netherlands.⁹ Therefore, the prevalence of women who smoke during pregnancy is estimated to be higher in the north of the Netherlands.²

Considering the health risks of smoking, women who smoke during pregnancy have more high-risk pregnancies and therefore require more specialized care. Early initiation of prenatal care increases the likelihood that women quit smoking during pregnancy,¹⁰ and thereby positively influences birth outcomes.¹¹

Smoking cessation initiatives and campaigns in the Netherlands

In 2018, the Dutch government presented the National Prevention Agreement (in Dutch: Nationaal Preventieakkoord) in collaboration with municipalities, healthcare organisations, health insurance companies and sport associations.¹² This report contains more than 200 agreements on the health issues smoking, obesity and alcohol, with the aim to improve the health of the Dutch inhabitants in the future. One of the goals stated in the report was to decrease the prevalence of pregnant women who smoke to less than five percent in 2020 and to zero percent in 2040.¹² An additional goal was to reduce the prevalence of women who start smoking again postpartum to 25% in 2020.¹²

One of the initiatives of the National Prevention Agreement to realize the above mentioned goals is the campaign 'Smoke free generation' (in Dutch: Rookvrije generatie).¹³ Smoke free generation is an initiative of the Dutch organisations Lung fund, the Dutch Cancer Society and the Heart foundation (in Dutch: Longfond, KWF Kankerbestrijding, Hartstichting) with the aim to make as many public places as possible (e.g. play yards, day cares and sports associations) smoke free for children.¹³ Another campaign is 'PUUR smoke free' (in Dutch: PUUR Rookvrij) which aims to stimulate people to attempt to quit smoking and to make use of smoking cessation support.¹⁴ Part of this campaign focuses specifically on parents with children. For pregnant women and their partners, the Taskforce Smokefree Start (in Dutch: Rookvrije Start) was initiated.¹⁵ The taskforce consists of more than 1000 ambassadors who collaborate to support (future) parents to quit smoking during pregnancy and to remain abstinent postpartum.¹³ The taskforce aims to achieve this by prioritizing smoking cessation for multidisciplinary maternity care professionals and by improving the knowledge of professionals and the lay public.¹³

Since the release of the National Prevention Agreement in 2018, multiple interventions were implemented: taxes for cigarettes have been raised, cigarettes are stored out of sight in shops, cigarettes are sold in neutral packaging and the number of school places that are smoke free has increased.¹⁶ An evaluation of the campaign 'PUUR smoke free' indicated that the confidence of smokers in their ability to successfully quit smoking has increased and that more smokers have made use of smoking cessation support.¹⁷ However, despite these interventions, the goals that were stated in the National Prevention Agreement for 2020 regarding the smoking prevalence of pregnant women (5%) and the relapse rate postpartum (25%), were not met. There is even a small, although not significant, increase in the prevalence of Dutch women who smoked during pregnancy in 2021 compared with 2018.^{2, 18}

Smoking cessation support for pregnant women

A large Cochrane systematic review reported that psychosocial interventions increase the proportion of women who quit smoking in late pregnancy by 35%, compared with care as usual or no intervention.¹⁹ These interventions also reduce the number of babies born with a low birthweight and reduce postpartum hospital admissions.¹⁹ Especially counselling, feedback and financial incentives appear to be effective by increasing smoking cessation rates during pregnancy.^{3, 19} Nicotine replacement therapy might also be effective by increasing smoking cessation rates in late pregnancy, although the evidence for this is of low certainty.²⁰ The effectiveness of health education and social support on smoking cessation rates is less clear.¹⁹

The mechanisms that explain the effectiveness of the various interventions are uncertain. Psychosocial interventions are in general based on theoretical frameworks about behaviour change and aim to increase women's motivation to quit smoking.^{19, 21} However, there is a high variety in interventions, settings, and the context of the interventions. Most studies included in the Cochrane systematic review were performed in high-income countries and did not provide information about the participation rate of interventions.¹⁹ The authors of the Cochrane systematic review conclude that more research is required to investigate which interventions are effective, the mechanisms that explain why interventions are effective, for which population groups and if the setting influences the effects.¹⁹

Factors that enable or hinder women to stop smoking depend on the context of women's lives.²² In interviews, women expressed that self-efficacy, disadvantaged circumstances and their perception of the risk of smoking, influence their motivation and ability to stop smoking.^{22, 23} Women's social network also influences women's smoking behaviour during pregnancy.^{24, 25} Smoking is a social affair, women with many people who smoke in their social network are more likely to be smoking themselves and are less likely to quit smoking.^{8, 26} In a Dutch qualitative study, it was found that the limited supportive networks of women with a low SES negatively affected their attempts to quit smoking during and after pregnancy.²⁴ On the contrary, a high level of social support is associated with successful smoking cessation.²⁷

Barriers expressed by Dutch maternity care professionals to provide smoking cessation support are a perceived lack of women's motivation to quit smoking, a perceived lack of skills, a lack of knowledge about referral options, and barriers in the organisation of care such as the costs of smoking cessation support for women.²⁸⁻³⁰ Studies conclude that the experienced barriers need to be addressed in order to increase the provision of smoking cessation support by maternity

care professionals, for example by increasing their knowledge and skills and to implement interventions that fit women's needs.^{2,30}

Dutch guideline for smoking cessation support

In the Netherlands, the guideline 'Treatment of tobacco addiction and smoking cessation support for pregnant women' (in Dutch: Behandeling van tabaksverslaving en stoppen-met-roken ondersteuning bij zwangere vrouwen) from the Trimbos-Institute is implemented.³¹ The guideline includes specific recommendations for maternal care professionals (e.g. midwives and obstetricians) how to support pregnant women with smoking cessation.³¹ This guideline is written for maternal care professionals, because the midwife, or obstetrician in case of complications or health risks, is pregnant women' primary care provider and gatekeeper in the Netherlands.³² An important part of care provided by the midwife is supporting women in a healthy pregnancy; providing smoking cessation support is part of this.³³

One of the recommendations of the guideline is to provide behavioural counselling, based on the Minimal Intervention Strategy for Midwives (in Dutch: Verloskundigen Minimale Interventie Strategie, V-MIS). The V-MIS was introduced in 2013 and consists of seven steps of behavioural counselling for midwives to discuss smoking behaviour and to support smoking cessation among pregnant women.²⁹ The use of the V-MIS is obligatory for primary care midwives.³¹ The V-MIS is proven to be an effective smoking cessation intervention, it increases the percentage of women who make a quit attempt and the number of women who remain abstinent six weeks postpartum.³⁴ According to the V-MIS, every maternal care professional should discuss women's smoking behaviour and give the advice to quit smoking. If the woman is not motivated, the conversation about smoking behaviour should be repeated during every consultation.³¹ Based on the V-MIS, midwives can support women with smoking cessation themselves, or refer them for more intensive smoking cessation support to another healthcare professional. Women can be referred to a trained nurse practitioner working in general practice, to a smoking cessation coach (for telephonic or face-to-face counselling) or to a smoking cessation counsellor from addiction care.³¹ Furthermore, the guideline recommends the use of nicotine replacement therapy, in combination with behavioural counselling.³¹ The use of e-health is also suggested in the guideline.³¹ The guideline states that use of the e-cigarette is not recommended because of a lack of available evidence about the effectiveness and safety during pregnancy.³¹ Since 2020, health insurance companies reimburse the participation in one smoking cessation program, including the use of medication. The conditions for this reimbursement can differ per health insurance company.³⁵

The results of two studies from the Trimbos-Institute indicate that the implementation of the guideline by maternal care professionals is inadequate.^{2, 28} One study reported that 53% of the midwifery obstetric cooperation units (MCU, in Dutch: Verloskundig Samenwerkings Verband) have a smoking cessation policy in the Netherlands.²⁸ A MCU is a collaboration of maternity care professionals in a certain region that is often centered around a hospital. Six of the 47 MCU's that participated in this study indicated that they work with the guideline.²⁸ The other study reported that a minority, 47% of women who smoke during pregnancy, receive the advice to quit smoking from a healthcare professional.² Furthermore, only 10% of midwives apply all seven steps of the V-MIS.²⁹ Twenty-one percent of Dutch pregnant women make use of smoking cessation support during their quit attempt; nicotine replacement therapy, specialized smoking cessation support provided by a coach and online tools are the most often used.²

Because of the effectiveness of smoking cessation support, optimal implementation of the guideline in daily practice is essential.³⁶ Improved adherence to the guideline can advance the provision of smoking cessation support by maternity care professionals and ultimately decrease smoking during pregnancy.

Together we'll quit smoking!

This thesis is part of the ZonMw-granted project 'Together we'll quit smoking!', which focuses on improving the smoking cessation support for pregnant women in the north of the Netherlands. The project is part of the prevention program of ZonMw that aims to strengthen consciousness about the importance of prevention and lifestyle. The aim of 'Together we'll quit smoking!' is to improve the implementation of the guideline 'Treatment of tobacco addiction and smoking cessation support for pregnant women' (in Dutch: Behandeling van tabaksverslaving en stoppen-met-roken ondersteuning bij zwangere vrouwen) in the three northern Dutch provinces Groningen, Friesland and Drenthe. The project started in 2019 and finishes in 2024.

Thesis aim and scope

The aim of this thesis is to gain insight into factors that are associated with smoking during pregnancy and to optimize and evaluate smoking cessation support in daily practice.

In order to improve smoking cessation support, first insight is needed into the needs of pregnant women and their partners with smoking cessation support (Figure 1). Therefore, in **Chapter 2** we investigated the needs of women and their partners in the north of the Netherlands with smoking cessation support during pregnancy with qualitative research. Then, since adequate use of prenatal care is associated

with smoking cessation during pregnancy, we aimed to gain a better understanding of the influence of women's smoking behaviour on their maternal care trajectory. In **Chapter 3** we investigated the healthcare use of women who smoked during pregnancy compared to women who did not smoke during pregnancy. We analyzed Midwifery Case Registration System (VeCaS) data, to investigate women's initiation-, frequency- and mode of maternal care. Moreover, we examined referrals and reasons for referral to primary care (e.g. the general practitioner) or to secondary care (e.g. the obstetrician and paediatrician). Subsequently, in order to improve the implementation of smoking cessation support in practice, the factors that influence women's smoking behaviour should be taken into consideration. Since the mechanism by which social support influences women's smoking behaviour is unclear, we addressed this in **Chapter 4**. In this Chapter we analyzed data from the Lifelines-Reproductive Origins of Adult Health and Diseases (ROAHD) cohort ³⁷ to investigate if social need fulfillment, an indicator for social support, moderates the association between SES and smoking and/or alcohol use during pregnancy. Because the guideline from the Trimbos-Institute advises against the use of the e-cigarette during pregnancy because of inconclusive evidence, we aimed to gain more insight into the use of the e-cigarette during pregnancy. Therefore, in **Chapter 5** we conducted a cross-sectional study to investigate adverse maternal and infant outcomes of women who differ in smoking status: e-cigarette and tobacco cigarette users. In **Chapter 6** we developed tailored plans for implementing the guideline 'Treatment of tobacco addiction and smoking cessation support for pregnant women' and evaluated the results in the northern regions of the Netherlands. In this Chapter the study design and results of 'Together we'll quit smoking!' are elaborated upon. In the general discussion, **Chapter 7**, we summarize and reflect on the main findings of this thesis including the methodological considerations, implications of the findings and recommendations for practice and research.

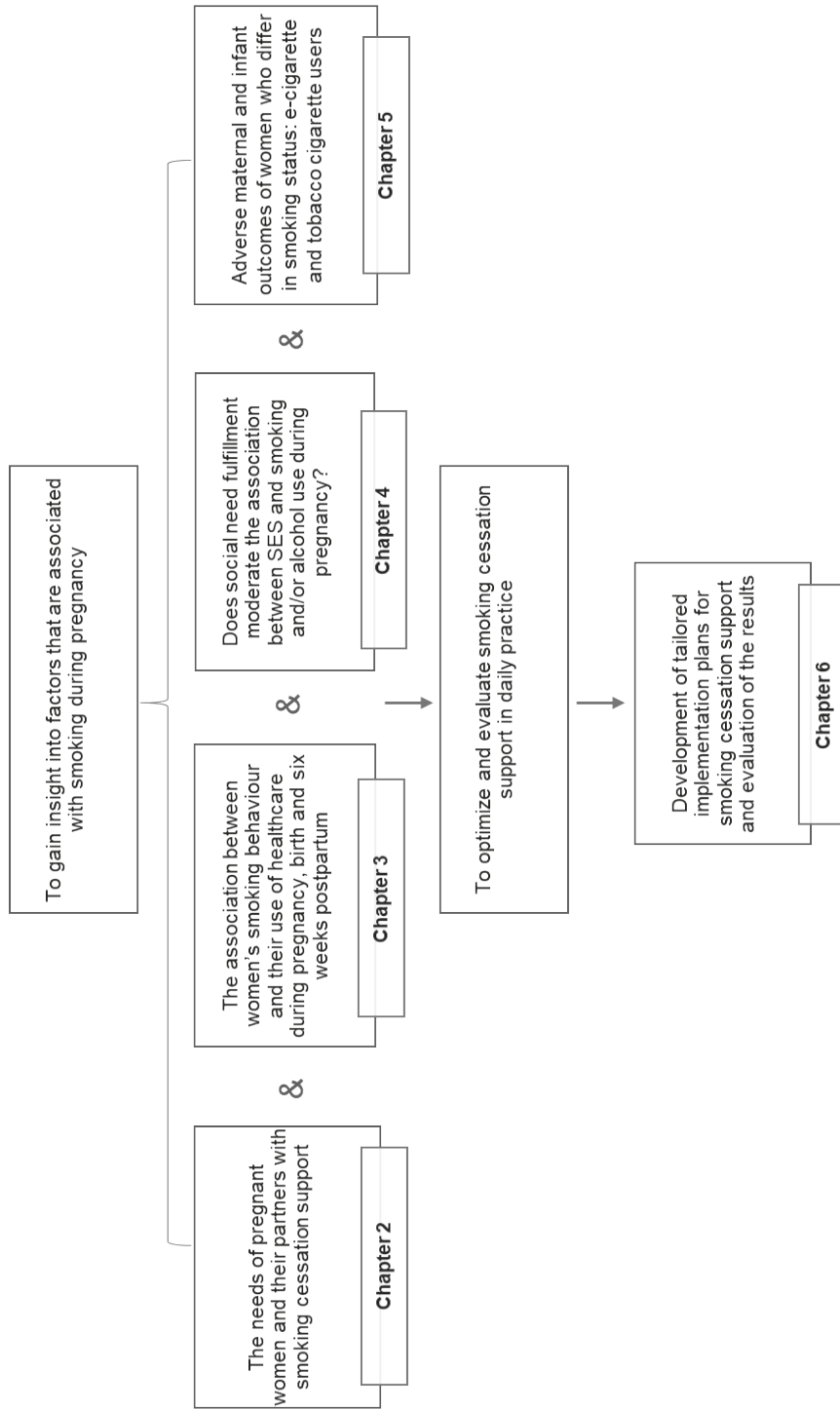


Figure 1. Thesis aim and Chapters.

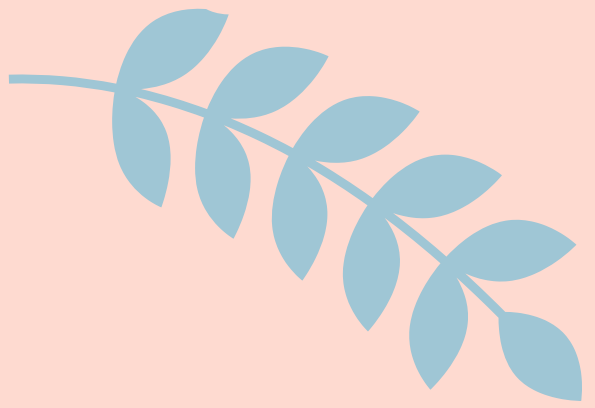
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Chapter 2

The needs of women and their partners regarding professional smoking cessation support during pregnancy: A qualitative study

Weiland, S., Warmelink, J. C., Peters, L. L., Berger, M. Y., Erwich, J. J. H. M., & Jansen, D. E. M. C. (2022). The needs of women and their partners regarding professional smoking cessation support during pregnancy: A qualitative study. *Women and birth: journal of the Australian College of Midwives*, 35(2), 127–134. <https://doi.org/10.1016/j.wombi.2021.03.010>

Abstract

Background

Despite the health risks of smoking, some women continue during pregnancy. Professional smoking cessation support has shown to be effective in increasing the proportion of pregnant women who quit smoking. However, few women actually make use of professional support.

Aim

To investigate the needs of women and their partners for professional smoking cessation support during pregnancy.

Methods

Semi-structured interviews were held with pregnant women and women who recently gave birth who smoked or quit smoking during pregnancy, and their partners, living in the north of the Netherlands. Recruitment was done via Facebook, LinkedIn, food banks, baby stores and healthcare professionals. The interviews were recorded, transcribed and thematically analysed.

Results

28 interviews were conducted, 23 with pregnant women and women who recently gave birth, and five with partners of the women. The following themes were identified: 1) understanding women's needs, 2) responsibility without criticism, and 3) women and their social network. These themes reflect that women need support from an involved and understanding healthcare professional, who holds women responsible for smoking cessation but refrains from criticism. Women also prefer involvement of their social network in the professional support.

Conclusion

For tailored support, the Dutch guideline for professional smoking cessation support may need some adaptations. The adaptations and recommendations, e.g. to involve women and their partners in the development of guidelines, might also be valuable for other countries. Women prefer healthcare professionals to address smoking cessation in a neutral way and to respect their autonomy in the decision to stop smoking.

Keywords

Tobacco smoking, pregnancy, smoking cessation, tailored support, guidelines, qualitative research

Introduction

Smoking during pregnancy is associated with adverse health outcomes for both the baby, such as an increased risk of low birth weight, fetal growth restriction and stillbirth, and for the mother, such as cardiovascular disease and cancer (1,2). However, despite these health risks, some women continue to smoke during pregnancy. With an estimated prevalence of around 8%, Europe has the highest prevalence of smoking during pregnancy compared to other regions in the world (3). Women from lower socioeconomic groups, women who experience higher levels of stress, and women with a smoking partner are more likely to smoke during pregnancy (4,5).

To encourage pregnant women to quit smoking and to remain abstinent postpartum, healthcare professionals provide smoking cessation support. Several guidelines recommend that healthcare professionals provide counselling for behavioural changes (6-8), often based on stages of an individual's readiness for such change (9). If needed, behavioural counselling can be combined with more intensive interventions, like pharmacotherapy or telephone-based support (6-8). Smoking cessation support has shown to be effective in increasing the proportion of women who quit smoking during pregnancy (10,11).

However, despite its effectiveness, only a small percentage of pregnant women make use of professional smoking cessation support: in the United Kingdom (UK) and in the Netherlands respectively 12% and 7% of pregnant women (12,13). Reasons for this might be that some healthcare professionals do not discuss smoking behaviour or offer support because they lack the necessary knowledge and training and are confronted with time restrictions and women's lack of motivation to discuss smoking cessation (14,15). On the other hand, some pregnant women perceive that they have missed opportunities, as they were not informed about support options or have not received the information and support they preferred, and the support by professionals did not fit their needs (16,17).

To the best of our knowledge, only a few studies to date have investigated pregnant women's needs for professional smoking cessation support. These studies, performed in the UK, Australia, and New Zealand, were focused mainly on indigenous and socially disadvantaged women (17-20). Personalised support, easily accessible information, and respectful discussions without judgement were identified as women's needs when considering smoking cessation support (17-19). In addition, the study that focused on a more general population found that pregnant women prefer to receive support from someone who has also had experience with smoking (20).

Because of cross-country differences in smoking cultures, it cannot be said with certainty that these reported needs for professional smoking cessation support are the same as those of pregnant women in the Netherlands. Compared to the Netherlands, the UK and Australia have high levels of implemented tobacco control policies (e.g. budget for public information campaigns and smoking cessation services) (21,22). Furthermore, in these countries the smoking cessation support services for pregnant women differ. The UK handles an opt-out referral system for pregnant women, and offers Carbon Monoxide (CO) testing as standard procedure (6). In Australia and New Zealand, pregnant women are referred to telephone-based counselling (Quitline) for smoking cessation support (8,23), whereas in the Netherlands pregnant women are advised to consult a specialised healthcare professional for more intensive support (7).

Studies performed to evaluate these smoking cessation programs generally report that they are effective by increasing the proportion of pregnant women who stop smoking. In the UK, the introduction of the opt-out referral system with CO testing has-, compared to the previous opt-in system, doubled the proportion of pregnant women who set a quit date and who actually stopped smoking (24). Although no studies are available on the use of the Quitline by pregnant women in Australia and New Zealand, telephone-based counselling in general seems to be effective by increasing cessation rates (11). A study performed in the Netherlands reported that behavioural counselling provided by midwives doubled the proportion of pregnant women who stop smoking (25). However, only 10% of the Dutch midwives actually provide full behavioural counselling; more than 79% of the Dutch midwives refer pregnant women for more specialised support (26).

The aim of this qualitative study was to investigate the needs of pregnant women and their partners in the northern Netherlands for professional smoking cessation support. The focus is on the north of the Netherlands because of its high percentage of pregnant women who smoke (27). Moreover, as the smoking behaviour of pregnant women is associated with the smoking behaviour of partners, the needs of the latter will also be taken into account (5).

Methods

Design

This qualitative study makes use of a phenomenological framework, aimed at understanding people's experiences within the context of their daily life (28). Semi-structured interviews were held to gain insight into the need for smoking cessation support during pregnancy on the part of women and their partners living in the northern Netherlands (28). In February 2020, at a Dutch conference for tobacco control, a peer debriefing was performed. The purpose of a peer debriefing is to

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establish the reliability and trustworthiness of the data (28). On the conference for tobacco control, we presented the method and results of this study to researchers and healthcare professionals responsible for supporting smoking cessation. After the presentation, the interpretation of the results was discussed with the peer researchers and healthcare professionals. The researchers and healthcare professionals at the Dutch conference for tobacco control confirmed the results of this paper.

Recruitment of women and their partners

Interviews were conducted with women and partners living in the northern provinces of the Netherlands, i.e. Groningen, Friesland and Drenthe. Because the prevalence of women who smoke is known to increase postpartum in the Netherlands (13), women who had recently given birth were also involved in this study. Women were invited to participate if they were pregnant and were currently smoking, pregnant and had quit smoking at the start of or during their pregnancy, or if they had given birth within the last year and were currently smoking.

Two experts by experience in poverty and social exclusion, and two researchers from an organisation that represents the voices of consumers in research (in Dutch: Zorgbelang), were involved in the recruitment of women. A flyer with information about the study and contact details of the first author (SW) was distributed via Facebook groups targeting mothers in the north of the Netherlands, social media pages of the researchers (i.e. LinkedIn and Facebook), the network of Zorgbelang, food banks, supermarkets, baby stores, midwives, and obstetricians, and subsequently via women and their partners. We aimed to include a representative sample of women and their partners with different social backgrounds, living in the north of the Netherlands. Women could sign up for the interview by contacting SW via e-mail or telephone. Partners were recruited via the interviewed women. Recruitment continued until data saturation for the interviewed women was reached.

The women and their partners were informed about the aim of the interviews both in person and by an information letter, after which they were asked to sign an informed consent form. Participation was voluntary and women and their partners could withdraw from the interview at any moment. For taking part in the study, women and their partners received a voucher worth €25.

Data collection

Semi-structured interviews were held from May 2019 until October 2019. The experts by experience and the researchers from Zorgbelang were involved in the development of a semi-structured interview guide, whereby special attention was paid to the phrasing of the questions. The main question of interest was: "How would

you like to be supported with smoking cessation during pregnancy?" After each interview, field notes were written down and the interview guide was evaluated. No questions were added to the interview guide.

The interviews were conducted in Dutch by SW, either alone or together with an expert by experience or a researcher from Zorgbelang. All interviewers were female and received interview training beforehand. At the start of the interview, the interviewers introduced themselves to the participant, telling briefly about their work and their involvement in the study. The interviewers had no relationship with the women and their partners before the interview. The interviews were held at a location of the women and their partners' choice, most often at their homes or at the University Medical Center Groningen. Children of the women and their partners were present during eleven interviews. The interviews lasted on average 39 minutes (range 18-66 minutes). The interviews were audio recorded with permission from the women and their partners. A member check was performed by giving women and their partners the option to read and comment on the completed transcripts (28). After completion of the study, women and their partners were informed about the results, but none of them gave feedback on the transcripts or results.

Data analysis

The recordings of the interviews were transcribed verbatim and anonymised. Data management and coding was done with the software ATLAS.ti 8.4. Data collection and analysis took place concurrently. The data was analysed using a six phase thematic approach (29). First, SW (health scientist) read all transcripts multiple times to become familiar with the data. The second author (JCW - psychologist) also read seven transcripts. After becoming familiar with the data, SW and JCW discussed the transcripts with the aim to generate initial codes. Afterwards, SW applied the formulated codes to the data. In the third phase, SW and JCW discussed the codes with the aim to identify potential patterns in the data. The codes were arranged in categories which defined themes and sub-themes. In the fifth phase, the identified themes were further refined to interpret the data, as illustrated in Table 1. SW and JCW compared three transcripts with the code tree to ensure that the themes completely covered the essence of the data. During the peer debriefing, the researchers and healthcare professionals agreed with the methods used and the results as formulated. Lastly, the report of the findings was written. Quotes were translated into English by a native speaker.

Table 1. Examples of the coding process: the needs of women and their partners regarding professional smoking cessation support during pregnancy.

Coded segment	Sub-theme	Theme
“Definitely if they know that you smoked before the pregnancy, just ask every time you come, uh, every time you come, are you smoking? You know, give it some attention.” (#3, pregnant, current smoker)	Involvement	Understanding women’s needs
“So, just that it is important that you feel respected, that you don’t just get the feeling that you are doing something bad and that you have to stop.” (#1, recently gave birth, quit smoking during pregnancy)	Being valued	Responsibility without criticism
“I think that if you involve the partner more, you know, because they say: Yeah, you need to stop smoking because YOU are carrying the child. Yeah, that’s all logical and so, but if you have a partner next to you who just keeps on smoking and doesn’t even cut down, then it isn’t easier for yourself.” (#8, recently gave birth, smoked during pregnancy)	Role of the partner	Women and their social network

Results

Women and their partners

Demographic characteristics of the women and their partners are illustrated in Table 2. In total, 23 women and five partners participated in the interviews. Nine women who initially applied for the interview did not participate; two were not living in the north of the Netherlands and seven did not respond to the request to make an appointment. The women and partners were on average 29 years old (range 20-41 years). At the time of the interview, thirteen women were pregnant, of whom four were currently smoking and nine had quit smoking during pregnancy. Most women quit smoking directly after a positive pregnancy test, and one of the women at the end of her pregnancy. Ten women had recently given birth, of whom five smoked during the entire pregnancy and five started smoking again postpartum. Four of the five interviewed partners were currently smoking.

Table 2. Demographic characteristics of women and their partners.

Characteristic	Frequency
Gender	
Female	23
<i>Currently pregnant</i>	13
<i>Recently gave birth</i>	10
Male	5
Age, average (range)	29 (20-41)
Smoking status	
Women	
<i>Currently pregnant</i>	13
Smoking at the time of the interview	4
Quit smoking at the time of the interview	9
<i>Recently gave birth</i>	10
Smoking at the time of the interview	10
Quit smoking during pregnancy	5
Men	
Smoking at the time of the interview	4
Quit smoking at the time of the interview	1
Socioeconomic status¹	
Low SES	5
Middle SES	19
High SES	4
Province	
Groningen	16
Friesland	5
Drenthe	7

¹Classified according to Dutch standard education division (40).

Themes

From the analysis of the data we derived the following three main themes regarding the needs of women and their partners for professional smoking cessation support: 1) Understanding women's needs, 2) Responsibility without criticism, and 3) Women and their social network. The coding tree is shown in Table 3.

Table 3. Coding tree: the needs of women and their partners regarding professional smoking cessation support during pregnancy.

Theme	Sub-theme	Sub-category
1. Understanding women's needs	Stressors	
	Involvement	Give compliments Discuss it more often
	Communication	Ask open questions
	Healthcare professional	Understand complexity
2. Responsibility without criticism	Individual responsibility	
	Information	Health consequences Support options
	No judgment	
	Being valued	
3. Women and their social network	Influence of friends, colleagues and family	
	Role of the partner	Involve partner in smoking cessation support
	Peer support	Group-based prenatal care

1. Understanding women's needs

Women and their partners expressed that apart from the complexity of a nicotine addiction, circumstances in their daily life influenced their decision to continue smoking during pregnancy. Some women experienced serious life-events before and during pregnancy, such as unstable relationships, financial stress, and loss of family members. For these women smoking was a way of coping with these life-events; they expressed that they could consider smoking cessation only when these stressors were dealt with.

In my case it's to have something to do and as little stress as possible. It actually has a bit to do with external circumstances --. Yeah, with me it's just a typical vicious circle. So I know why I smoke and so. (#16, pregnant, current smoker)

Women who were motivated to stop smoking preferred that the healthcare professional continued to ask about their smoking behaviour and need for support during the entire pregnancy. With all women smoking was discussed during the first visit, but often remained unaddressed in subsequent consultations. Both women who managed to quit smoking and those who did not succeed, would have preferred

to discuss their smoking behaviour and need for smoking cessation more often. The women who stopped smoking would have liked to share their struggles and receive compliments from the healthcare professional.

She did not discuss it any further, like “are you struggling with it?”. No, she just asked “have you stopped (smoking)?”. And when I confirmed, that was that. Then I was thinking yes [...] ‘give me a compliment or something’. But she was like “okay, fine!”. (#9, pregnant, quit smoking)

Women who continued to struggle with smoking cessation would have preferred the healthcare professional to keep considering ways to stop smoking. On the other hand, women who did not want to stop smoking expressed that they did not want the healthcare professional to address the issue in subsequent visits. According to the women, healthcare professionals can best discuss smoking cessation by asking open questions (e.g. ‘what would be a reason for you to think about smoking cessation?’ and ‘how can I support you with smoking cessation?’).

I think, just asking what someone needs, [...] more like if a midwife asks ‘how can I support you?’ Like that. (#12, pregnant, quit smoking)

Women and their partners had different preferences as to the kind of healthcare professional to support them with smoking cessation: their midwife, general practitioner, a practice nurse, an addiction expert, or an expert by experience with smoking. In general, women and their partners emphasised the importance of someone with personal knowledge of nicotine addiction, someone who understands their struggle. Some women perceived that their healthcare professional did not really understand how difficult smoking cessation was for them.

But then you get that advice, the really standard advice. Like oh yes, you just have to go on, and if you feel the urge you should eat a grape or drink a glass of water. I think that is just no use. That’s just the kind of advice non-smokers give. (#26, pregnant, quit smoking)

2. Responsibility without criticism

The majority of women and some partners highlighted how important it was that the healthcare professional recognises a woman’s own responsibility in smoking cessation. Smoking and smoking cessation were seen as individual decisions. Although women wanted the healthcare professional to show involvement, some women and their partners expressed that they wanted to make the decision to quit smoking themselves, and therefore did not need additional support from a healthcare professional.

The needs of women and their partners regarding professional smoking cessation support

But I want to do it myself. I'm the boss over my own body; that's how I see it. [...] Then I think 'yes, I'm the one who started, I know there are lots of disadvantages to smoking, um, I'm a grown woman. So then I should be able to do it myself. (#4, pregnant, quit smoking)

For most women, the health of the fetus and their wish to be a role model for their children was their main motivation to quit smoking. To be able to make an autonomous, informed decision, women indicated that they would have liked to receive more tailored and visual information from healthcare professionals about the health damage of smoking for them and for their fetus, for example information about the oxygen level in their placenta or the condition of their own lungs.

I don't know, I think that it is because these television programs like 'Four hands on one belly' where you see that a baby is actually born prematurely and is small and has to be put in the incubator. [...] That could eh be a tip, to really make it visual. (#7, pregnant, quit smoking)

In addition, women wanted to receive information about the various methods for smoking cessation support (e.g. nicotine replacement therapy). A few women expressed a need for medication that can help with smoking cessation and can be taken during pregnancy.

Since women and their partners perceived smoking as their own responsibility, they did not want healthcare professionals to interfere with this. Therefore, healthcare professionals who criticise women for smoking during pregnancy, and who address the issue in a judgmental way, evoke resistance on the part of the women and their partners. The women and their partners expressed that they wanted to be valued and respected by the healthcare professionals, whether or not they stopped smoking.

That they didn't use pressure or nag, that they made their point clear in a very respectful manner. But that they tried to do everything in agreement with me, also giving information. That way you don't feel forced, you don't feel as if the school teacher is waving his finger at you. That was very nice. (#21, recently gave birth, smoked during pregnancy)

3. Women and their social network

The women had many smokers in their social networks. Apart from their partners, most women had friends, family, and colleagues who also smoked. Being exposed to the smoking behaviour of others can be challenging for these women. Although

most women did not expect their partner to stop smoking during their pregnancies, they did express that this would be of great support for them.

And I think eh if my boyfriend would not smoke, it would be a lot easier. Well, he can quit, but he says: "one should be ready for it, one should not be obliged to stop, because then it won't work". And then for a while, he only smoked at his work. But then I noticed that he became a bit more grumpy and because of that we got into arguments. And then I said: you know, please start smoking again. Because I ... it shouldn't be at the expense of your relationship. (#2, pregnant, current smoker).

We did talk about it, that he would also quit smoking. Especially when the baby is born. But yes, I also know how difficult it is to stop smoking [...]. The baby is of course in my belly, not in his. So I also understand that for him-, well, that he does not have the big stick that I have. #17, pregnant, quit smoking)

Some women indicated that the healthcare professional should involve the partner in smoking cessation during pregnancy.

I mean, uh, I definitely think that if there are two smokers in a relationship, that you should almost, uh, actually take on the project together. Of course, uh, some things you can only do alone, but you need support from others and if you are constantly being tempted, yeah, that doesn't have much impact. (#10, partner, quit smoking)

In addition to the role of the partner, the women felt the need to receive support from others in their social network. Most women said that during their pregnancy their friends and family did not smoke in their presence. Some women preferred the support of friends and family above support from a professional.

Yes, I really do think from the family. I think family and friends could pull me through better than somebody from outside. (#25, recently gave birth, quit smoking)

Furthermore, some women experienced great support from other pregnant women when dealing with smoking cessation. They expressed that these women knew and understood what they were going through. A number of women received group prenatal care, where they experienced professional support in a group where some other women had also stopped smoking.

Discussion

Although healthcare professionals offer smoking cessation support for pregnant women, only few women actually make use of this support (12,13). We aimed to gain insight into the needs of pregnant women, and of women who recently gave birth and their partners in the north of the Netherlands with different social backgrounds in relation to professional smoking cessation support. We identified three main themes: 1) Understanding women's needs, 2) Responsibility without criticism, and 3) Women and their social network. The results indicate that women need support from an understanding and involved healthcare professional who tailors the support to their needs; women's experienced stressors and motivation levels have implications for their support needs. Women want the healthcare professional to discuss smoking cessation in a neutral way and to support them in making their own decision about it. Women also value the involvement of their social network in the professional support.

Our first result suggests that some pregnant women do want to quit smoking, but cannot because of serious life-events which they have experienced before or during pregnancy. Women indicated that it is difficult for them to be open to smoking cessation support if these stressors persist. This result is in line with other studies that identified stress as an important barrier to smoking cessation (15,30). These studies conclude that learning to cope with stressors should be part of smoking cessation programs (15,30). However, although stress reduction interventions seem to be effective for reducing stress levels during pregnancy (31), the pregnancy period may be too short and too intensive to deal adequately with stressors. In light of the importance of smoking cessation during pregnancy, stressors should be made open to discussion and women taught to cope with these, preferably in an early phase or even before pregnancy.

A second result is that the needs of women who are motivated to stop smoking seem to differ from those of non-motivated women. While motivated women indicated that they need (more) support from an involved healthcare professional, non-motivated women seemed to prefer less involvement. This result illustrates that women need support that is tailored to their own level of readiness to quit smoking (9). In previous qualitative studies, women perceived healthcare professionals to be coercive or nagging when the support was not tailored to their own readiness to change (17,20). Although the Dutch guideline recommends repeated discussion of smoking cessation even if women are not motivated to stop smoking (7), little evidence is available about the effectiveness of such repetition (32). This raises the question whether healthcare professionals should persist in discussing smoking cessation if women are not ready for it. Based on the needs of the women and their partners in our study, healthcare professionals might first need to ask women in

what way and how frequently they want to be supported, so as to tailor the support to their readiness to change. This is contradictory to the principle of an opt-out referral system in the UK, where women are automatically referred for smoking cessation support (6).

A third finding of our study is that pregnant women and their partners perceive smoking behaviour as their own responsibility. This perceived autonomy in smoking behaviour was not reported in previous studies, performed in the UK, Australia and New Zealand, to address pregnant women's support needs (17-20). However, a Dutch study among people with chronic obstructive pulmonary disease (COPD) also reported that they had a need for autonomy in smoking behaviour. The authors stated that this could be related to the Dutch emphasis on individualism (33). Furthermore, the perception of autonomy might be fed by public health campaigns that hold the individual responsible for adopting a healthy lifestyle (34). Our finding implies that respect for autonomy in the smoking behaviour of women and their partners is an important element for tailored smoking cessation support.

Related to the women and their partners' desire for autonomy in smoking behaviour is their wish to receive more information about how smoking affects their own health and the health of the fetus; women indicated that they preferred to see proof, hoping that this information would motivate them to quit smoking. This could indicate that to enhance women's motivation to stop smoking more attention could be focused on providing feedback and personalised information (11). In the UK this information is given in the form of Carbon Monoxide (CO) feedback, found to be a helpful tool in motivating women to quit smoking (24). CO testing is not a standard part of the Dutch guideline for smoking cessation support during pregnancy, but might be an option to explore (7).

The women in our study preferred the healthcare professional to involve their social network in the smoking cessation support. Having ascertained the great influence of partners on women's smoking behaviour (5), previous studies also reported the importance of involving them in smoking cessation support (5,35). Although women in our study preferred the involvement of their social networks, this might be difficult to achieve because partners and others members of their network are not always willing to be involved and to stop smoking (36). Despite this discrepancy, a recent Dutch study recommends adjusting the guideline for smoking cessation support to include individuals from women's social network in smoking cessation support by giving them advice to stop smoking, providing information about third-hand smoke, and referring them for intensive smoking cessation support (36).

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Strengths and limitations

A strength of this study is its use of multiple methods to increase the validity and reliability of the results. After conducting the interviews, we used a member check and peer debriefing to ensure agreement over the results. Furthermore, we involved experts by experience and researchers of Zorgbelang in the design and execution of the interviews. They ensured that the interview questions were phrased in a way that made women feel at ease to share their experiences, as smoking during pregnancy could be a delicate issue to discuss. Furthermore, the involvement of these experts made it possible to recruit women with a lower socioeconomic status, who are difficult to recruit (37).

Some limitations of this study must also be acknowledged. One is that a response bias may be present in the recruitment of the women and their partners. The women who applied for the interview might be more willing than other women to share their needs. Furthermore, because we interviewed only a small number of partners we did not reach data saturation for them.

Recommendations

Based on our results we can offer a few recommendations to improve the implementation of the guidelines for smoking cessation support and thereby the use of smoking cessation support by pregnant women. The adaptations and recommendations might also be valuable for other countries.

First, already in an early phase or before pregnancy some women might need to receive support focused on stress relief and coping with stress. Second, healthcare professionals can best discuss smoking cessation in a neutral way, and tailor their support to women's needs by asking them how they want to be supported. Third, options could be explored to incorporate in the smoking cessation support guidelines tailored information and feedback about the negative effects of smoking on women's own health and the health of the fetus. Fourth, future research could explore ways to increase the involvement of partners and others (e.g. friends and family members) from women's social networks in professional smoking cessation support. Lastly, involvement of women and their partners in the development of smoking cessation support guidelines could make the latter more tailored to women's needs and thus more likely to be implemented (38,39).

Conclusion

Although professional smoking cessation support increases the prevalence of women who quit smoking during pregnancy, few women actually make use of smoking cessation support. We aimed to gain insight into the needs of women and their partners for professional smoking cessation support during pregnancy. The

findings of our study indicate that women and their partners have clear ideas about how the support could be organised. To better tailor this support to women's needs, the current guidelines for professional smoking cessation support could benefit from some adaptations. Moreover, women's needs for smoking cessation support may differ depending on the influence of stress in their lives and their motivation levels. The findings of our study add that pregnant women and their partners perceive smoking behaviour as their own responsibility. Therefore, healthcare professionals can best address smoking cessation in a neutral way, and respect women's autonomy in their decision about smoking cessation. More research is needed regarding the inclusion of women's social networks in smoking cessation support. Early involvement of women and their partners in the development of guidelines could improve the implementation of the guidelines and the use of smoking cessation support. Healthcare professionals in other countries where smoking during pregnancy is prevalent may also benefit from the insights provided by this study (3).

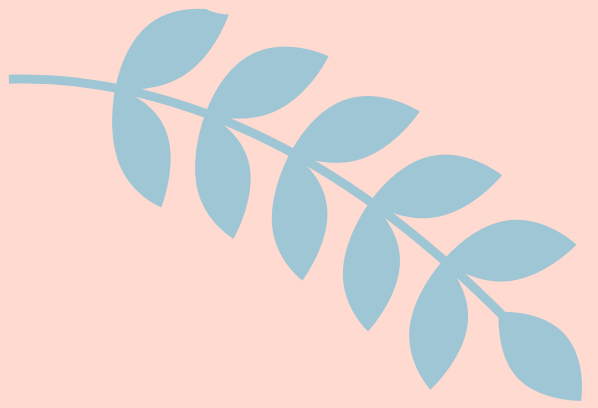
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Chapter 3

Women who smoke during pregnancy are more likely to be referred to an obstetrician during pregnancy and birth: results from a cohort study

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Abstract

Background

Women who smoke during pregnancy make less use of prenatal care; the relation of smoking behaviour with the use of other forms of maternal healthcare is unknown. The objective of this study is to investigate the association between women's smoking behaviour and their use of healthcare during pregnancy, birth and six weeks postpartum.

Methods

We analysed data from the Dutch Midwifery Case Registration System (VeCaS), period 2012-2019. We included women with a known smoking status, singleton pregnancies, and who had their first appointment before 24 weeks of gestation with the primary care midwife. We compared three groups: non-smokers, early stoppers (stopped smoking in the first trimester), and late- or non-stoppers (stopped smoking after the first trimester or continued smoking). Descriptive statistics were used to report maternal healthcare utilization (during pregnancy, birth and six weeks postpartum), statistical differences between the groups were calculated with Kruskal-Wallis tests. Multivariable logistic regression was conducted to assess the association between smoking behaviour and referrals to primary, secondary or tertiary care.

Results

We included 41 088 pregnant women. The groups differed significantly on maternal healthcare utilization. The late- or non-stoppers initiated prenatal care later and had less face-to-face consultations with primary care midwives during pregnancy. Compared to the non-smokers, the early- and late- or non-stoppers were statistically significantly more likely to be referred to the obstetrician during pregnancy and birth. Postpartum, the early- and late- or non-stoppers were statistically significantly less likely to be referred to the obstetrician compared to the non-smokers.

Conclusions

Although the early- and late- or non-stoppers initiated prenatal care later than the non-smokers, they did receive adequate prenatal care (according to the recommendations). The results suggest that not smoking during pregnancy may decrease the likelihood of referral to secondary or tertiary care. The large population of smokers being referred during pregnancy underlines the important role of the collaboration between healthcare professionals in primary and secondary or tertiary care. They need to be more aware of the importance of smoking as a medical and as a non-medical risk factor.

Keywords

Prenatal care, maternal healthcare utilization, smoking, referral and consultation

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Background

Research has shown that women who smoke during pregnancy have fewer contact moments with their midwives, and start prenatal care later compared to women who do not smoke during pregnancy, despite equal availability of prenatal care (1, 2). Less contact moments with the midwife and later initiation of prenatal care for women who smoke during pregnancy has a twofold impact: both smoking during pregnancy and insufficient prenatal care are associated with an increased risk of low birth weight, neonatal death and stillbirth (3, 4). Therefore, early initiation and adequate use of prenatal care should be pursued for women who smoke during pregnancy (5).

In the Netherlands it is common (more than 80%) that women start prenatal care with an independent primary care midwife (6). If the midwife detects a serious risk factor during pregnancy or birth, she refers the woman to secondary or tertiary care (7). A few studies reported an increase in referrals of pregnant women to secondary and tertiary care in the Netherlands, compared to years ago (8-11). The main indications for this increase in referrals are fetal distress, a need for pain relief, meconium-stained amniotic fluid, and postpartum haemorrhage (8-11).

The influence of smoking status on the course of healthcare utilization has not been addressed in previous studies. Although we know that women who smoke during pregnancy begin later with prenatal care and pay less visits to the midwife (1, 2), we know little about their further maternal care trajectory. The association between smoking status, referrals and indications for referrals has not been studied before. Furthermore, the association between smoking cessation in the first trimester and referrals during the postpartum period are not examined in previous studies. The reported associations between smoking during pregnancy and increased risk of stillbirth, and operative birth interventions imply that women who smoke have more high-risk pregnancies and require more specialized care (3, 12, 13).

Therefore, in the present study we aim to gain insight into the association between smoking status and healthcare utilization during pregnancy, birth, and six weeks postpartum. We aim to investigate initiation of maternal healthcare, number of contact moments with the midwife (contact in person or via telephone), frequency of referrals to primary, secondary and tertiary care, and the association of these factors with smoking status and the main indications for referrals. For this study we will use three groups: 1) pregnant women who do not smoke, 2) women who stopped smoking in the first trimester and 3) women who stopped smoking after the first trimester or who continued smoking during pregnancy. Insight into the course of healthcare utilization and referrals of pregnant women that differ in smoking status will increase our understanding of the impact of smoking on the maternal

care trajectory. Based on the results of this study, recommendations for maternal care of women who smoke during pregnancy will be given.

Methods

Study design

We performed a cohort study based on data from the Midwifery Case Registration System (Verloskundig Casusregistratie Systeem, VeCaS) (14), initiated by the Midwifery Science Department from Zuyd University Maastricht, and the Midwifery Academy Amsterdam Groningen (AVAG). The VeCaS data consists of routinely extracted data from two different electronic healthcare registration systems: Orfeus and Vrumun (15, 16), both used by Dutch midwifery care practices. The database contains data from 44 primary midwifery care practices spread across the Netherlands. The data for this study were collected in the period from January 1, 2012 until December 31, 2019. All women in the database provided informed consent for the use of their anonymized data. The women in the VeCaS database are comparable to the national population of women in primary midwife-led care in the Netherlands (14). We obtained ethical approval for use of the database from the regional Medical Research Ethics Committee Maastricht (nr 09-4-061) (14).

Participants

For this study we selected women with singleton pregnancies, a known smoking status, a known parity and whose first appointment with their primary care midwife took place before 24 weeks of gestation. The threshold of 24 weeks was chosen because we wanted to have a sufficient amount of data of women's pregnancy to be able to investigate their maternal healthcare utilization. Moreover, women who initiated care after 24 weeks of gestation likely started care at another midwifery care practice because they moved to another residence. We compared three groups of women based on smoking status, based on the categorisation of smoking behaviour in the healthcare registration systems: non-smokers, early stoppers (women who stopped smoking during the first trimester), and late- or non-stoppers (women who stopped smoking after the first trimester or continued smoking during the entire pregnancy).

Outcomes

From the electronic healthcare registration systems we extracted routinely collected data about the healthcare utilization of women during pregnancy, birth, and up to six weeks postpartum. We also extracted data regarding demographic characteristics: maternal age, Body Mass Index (BMI), ethnic background (Dutch, Western non Dutch, Non-Western or other), marital status (single, in a relationship), parity (nulliparous or multiparous), gestational age at birth (extremely preterm, very preterm, moderate to late preterm, term, and post term) (17), lifestyle characteristics (alcohol and drug

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consumption), socioeconomic status (SES), and smoking status. SES was calculated based on data from the Netherlands Institute for Social Research (SCP), including employment, education, and income level of the residential postal code area. Combined with the number of inhabitants per residential postal code area, based on data from Statistics Netherlands (CBS), we calculated national percentiles. We divided SES into low, middle, and high, based on percentile cut-off points: SES below the 25th percentile we classified as low, and SES above the 75th percentile as high. Smoking status was self-reported and divided into three categories: no smoking, stopped smoking in the first trimester, and stopped smoking after the first trimester or continued smoking during the entire pregnancy.

Next, we collected data of pregnancy and birth characteristics: gestational diabetes mellitus, hypertensive disorder, placenta previa and fetal growth restriction (18-20). Hypertensive disorder was defined based on the Dutch guideline as two blood pressure measurements after 20 weeks gestation with a diastolic pressure ≥ 90 and/or a systolic pressure ≥ 140 mmHg (21). We also collected data regarding the mode of birth (spontaneous vaginal, instrumental, caesarean delivery), the maternal outcome postpartum haemorrhage >1000 ml, and infant characteristics (sex, birth weight, and mortality). For mortality, we defined neonatal death as death during the first 28 days postpartum.

We assessed maternal healthcare utilization based on the number of appointments with the primary care midwife, including specific details like week of gestation and mode of contact (face-to-face or via the telephone). Besides face-to-face contact, we decided to report telephone appointments since this is an important part of the provision of midwifery care. Dutch women can call the midwife for minor and for major issues. We defined initiation of care as the first personal appointment with the primary care midwife, indicated by both a registered blood pressure measurement and a known term date, expressed in gestational weeks.

Furthermore, we examined maternal healthcare utilization based on frequency of referrals from the primary care midwife to the general practitioner in primary care, or to the obstetrician, paediatrician or other specialist in secondary or tertiary care. We classified referrals to the obstetrician as either incidental referrals or referrals resulting in handover of care. The data in the healthcare registration system did not provide the ability to distinguish between referrals to secondary or tertiary care.

From the data we derived the indications for referrals for each group, based on smoking status during pregnancy, birth, and postpartum.

Statistical analysis

To report baseline characteristics we used descriptive statistics. To assess differences in baseline characteristics between the three groups of women based on smoking status we used chi-square tests. The data of initiation of care in gestational weeks, number of face-to-face contact moments, and number of telephonic contact moments were not normally distributed, we reported the medians (interquartile range) and calculated statistical differences between the three groups by means of Kruskal-Wallis tests.

We performed multivariable logistic regression analyses to examine associations between smoking status and referrals during pregnancy, birth, and up to six weeks postpartum. Smoking status (non-smokers, early stoppers and late- or non-stoppers) was taken as independent variable, with non-smokers as reference category. Referrals to primary care (general practitioner) and secondary or tertiary care (incidental referrals, referrals resulting in handover of care by the obstetrician, referrals to the paediatrician, and referrals to an other specialist), were taken as dependent variables. We first calculated crude Odds Ratios (OR) with corresponding 95% Confidence Intervals (95% CI). We subsequently calculated adjusted Odds Ratios, and adjusted for possible confounders: BMI (continuous), maternal age (continuous), SES (using dummies with middle SES as reference category), and dichotomous variables: ethnicity (Dutch or non-Dutch) and parity (nulliparous or multiparous) (22, 23). We did not control for pregnancy complications, because these are reasons for referral and are causally associated with smoking behaviour. Furthermore, we were not able to control for e-cigarette use during pregnancy because no women in our dataset reported using the e-cigarette.

Main indications for referrals are described according to a selection of the five main reasons for referral, based on smoking behaviour during pregnancy, during birth, and up to six weeks postpartum.

All data were analysed in SPSS version 26.0 (SPSS Inc., Chicago, IL, USA). A p-value of 0.05 was considered statistically significant.

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Results

From VeCaS we attained data of 61 717 women. From the dataset we excluded a total of 20 629 (33.4%) women. Reasons for exclusion were: no singleton pregnancy (n= 9278), not receiving care between 2012 and 2019 (i.e. these women received care after the inclusion period) (n= 7023), unknown smoking status (n= 2770), no first checkup with the primary care midwife (n= 448), starting prenatal care after 24 weeks of gestation (n= 1105) or unknown parity (n= 5) (illustrated in Figure 1 - Flowchart).

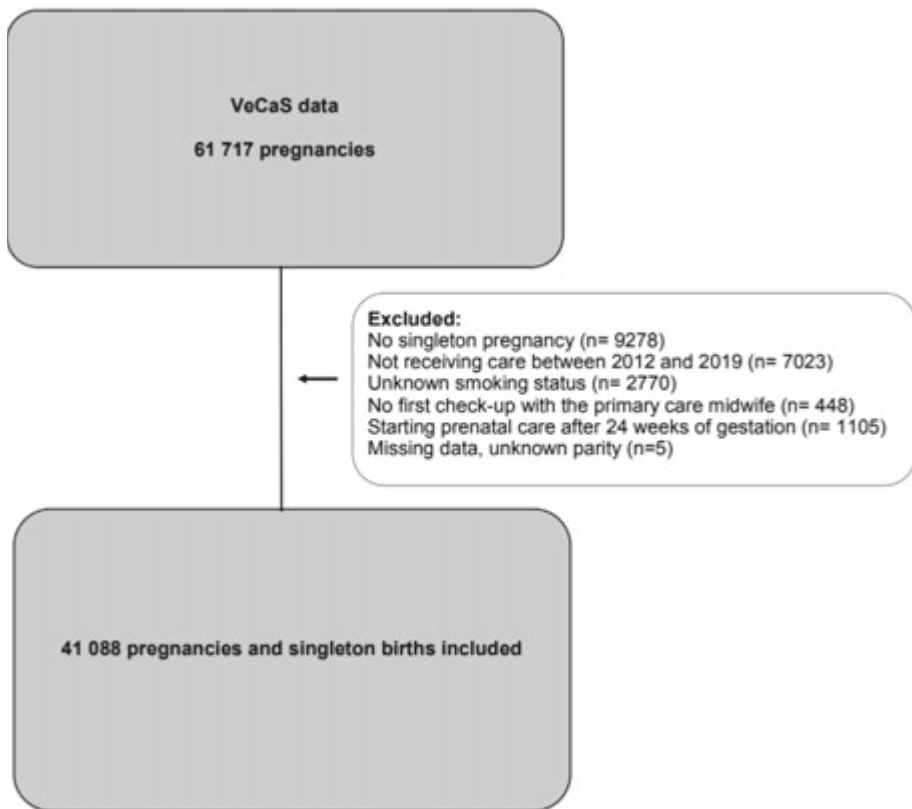


Figure 1. Flowchart of participants in the VeCaS data

Participants

In total, we included 41 088 pregnant women with a known smoking status and singleton pregnancies, and whose first appointment with the primary care midwife, before 24 weeks of gestation, took place between 2012 and 2019. Of this population, 83.0% were non-smokers, 7.8% were early stoppers, and 9.2% were late- or non-stoppers (Table 1). The three groups showed statistically significant differences on all maternal, birth and infant characteristics, except for the pregnancy complications gestational diabetes mellitus and placenta previa, and the infant characteristic mortality. Compared with the non-smokers, the late- or non-stoppers were of younger age, had a lower SES, were more often single, and showed a higher alcohol and drugs consumption. The late- or non-stoppers also showed higher proportions on maternal characteristics (preterm birth), pregnancy complications (fetal growth restriction) and infant characteristics (lower birthweight). The early stoppers were more often nulliparous, more likely to have hypertensive disorders, or had more often given birth by caesarean delivery.

Table 1. Maternal and infant characteristics by maternal smoking behaviour during pregnancy; non-smokers, early stoppers and late- or non-stoppers.

	Total population	Non-smokers	Early stoppers	Late- or non-stoppers	Statistical differences between subgroups that differed in smoking status
	N = 41 088	n = 34 102 (83.0%)	n = 3217 (7.8%)	n = 3769 (9.2%)	p-value
	N (%)^a	n (%)^a	n (%)^a	n (%)^a	
MATERNAL CHARACTERISTICS					
Maternal age (in years)					≤0.001
<20	249 (0.6)	118 (0.3)	54 (1.7)	77 (2.0)	
20-24	3209 (7.8)	1997 (5.9)	438 (13.6)	774 (20.5)	
25-29	12 499 (30.4)	9939 (29.1)	1200 (37.3)	1360 (36.1)	
30-34	16 660 (40.5)	14 577 (42.7)	1055 (32.8)	1028 (27.3)	
35-39	7331 (17.8)	6482 (19.0)	410 (12.7)	439 (11.6)	
>39	1140 (2.8)	989 (2.9)	60 (1.9)	91 (2.4)	
BMI^b					≤0.001
Underweight	1266 (3.1)	944 (2.8)	97 (3.0)	225 (6.0)	
Normal weight	24 251 (59.0)	20 521 (60.2)	1831 (56.9)	1899 (50.4)	
Pre-obesity	9542 (23.2)	7867 (23.1)	753 (23.4)	922 (24.5)	
Obesity class I	3496 (8.5)	2741 (8.0)	333 (10.4)	422 (11.2)	
Obesity class II	1170 (2.8)	915 (2.7)	103 (3.2)	152 (4.0)	
Obesity class III	270 (0.7)	210 (0.6)	27 (0.8)	33 (0.9)	

Table 1. Maternal and infant characteristics by maternal smoking behaviour during pregnancy; non-smokers, early stoppers and late- or non-stoppers. (continued)

	Total population	Non-smokers	Early stoppers	Late- or non-stoppers	Statistical differences between subgroups that differed in smoking status
	N = 41 088	n = 34 102 (83.0%)	n = 3217 (7.8%)	n = 3769 (9.2%)	p-value
	N (%)^a	n (%)^a	n (%)^a	n (%)^a	
Ethnic background²					≤0.001
Missing	1093 (2.7)	904 (2.7)	73 (2.3)	116 (3.1)	
Dutch	31 271 (76.1)	25 965 (76.1)	2462 (76.5)	2844 (75.5)	
Western (non-Dutch)	2668 (6.5)	2107 (6.2)	275 (8.5)	286 (7.6)	
Non-Western	3892 (9.5)	3407 (10.0)	195 (6.1)	290 (7.7)	
Other	243 (0.6)	183 (0.5)	33 (1.0)	27 (0.7)	
Missing	3014 (7.3)	2440 (7.2)	252 (7.8)	322 (8.5)	
Socio economic status³					≤0.001
Low	12 942 (31.5)	9874 (29.0)	1170 (36.4)	1898 (50.4)	
Middle	20 841 (50.7)	17 643 (51.7)	1626 (50.5)	1572 (41.7)	
High	6992 (17.0)	6325 (18.5)	394 (12.2)	273 (7.2)	
Missing	313 (0.8)	260 (0.8)	27 (0.8)	26 (0.7)	
Marital status					≤0.001

Table 1. Maternal and infant characteristics by maternal smoking behaviour during pregnancy; non-smokers, early stoppers and late- or non-stoppers. (continued)

	Total population	Non-smokers	Early stoppers	Late- or non-stoppers	Statistical differences between subgroups that differed in smoking status
	N= 41 088	n= 34 102 (83.0%)	n= 3217 (7.8%)	n= 3769 (9.2%)	p-value
	N (%)^a	n (%)^a	n (%)^a	n (%)^a	
Parity					≤0.001
Single	926 (2.3)	515 (1.5)	117 (3.6)	294 (7.8)	
In a relationship	39 040 (95.0)	32 832 (96.3)	2964 (92.1)	3244 (86.1)	
Missing	1122 (2.7)	755 (2.2)	136 (4.2)	231 (6.1)	
Nulliparous	19 300 (47.0)	15 616 (45.8)	1989 (61.8)	1695 (45.0)	
Multiparous	21 788 (53.0)	18 486 (54.2)	1228 (38.2)	2074 (55.0)	
Gestational age at birth					≤0.001
Extremely preterm (< 28 weeks)	337 (0.8)	272 (0.8)	25 (0.8)	40 (1.1)	
Very preterm (28-32 weeks)	196 (0.5)	159 (0.5)	14 (0.4)	23 (0.6)	
Moderate to late preterm (32-37 weeks)	1535 (3.7)	1184 (3.5)	138 (4.3)	213 (5.7)	
Term (37-42)	36 109 (87.9)	30 136 (88.4)	2783 (86.5)	3190 (84.6)	

Table 1. Maternal and infant characteristics by maternal smoking behaviour during pregnancy; non-smokers, early stoppers and late- or non-stoppers. (continued)

	Total population	Non-smokers	Early stoppers	Late- or non-stoppers	Statistical differences between subgroups that differed in smoking status
	N = 41 088	n = 34 102 (83.0%)	n = 3217 (7.8%)	n = 3769 (9.2%)	p-value
	N (%)^a	n (%)^a	n (%)^a	n (%)^a	
Postterm (≥42 weeks)	547 (1.3)	478 (1.4)	41 (1.3)	28 (0.7)	
Missing	2364 (5.8)	1873 (5.5)	216 (6.7)	275 (7.3)	
LIFESTYLE					
Alcohol consumption⁴					
No	24 367 (59.3)	20 310 (59.6)	1875 (58.3)	2182 (57.9)	≤0.001
Yes	241 (0.6)	183 (0.5)	28 (0.9)	30 (0.8)	
Stopped after a positive pregnancy test	611 (1.5)	448 (1.3)	106 (3.3)	57 (1.5)	
Missing	15 869 (38.6)	13 161 (38.6)	1208 (37.6)	1500 (39.8)	
Drug consumption⁵					
No	22 700 (55.2)	18 949 (55.6)	1767 (54.9)	1984 (52.6)	≤0.001
Yes	182 (0.4)	56 (0.2)	43 (1.3)	83 (2.2)	
Stopped recently	150 (0.4)	25 (0.1)	56 (1.7)	69 (1.8)	

Table 1. Maternal and infant characteristics by maternal smoking behaviour during pregnancy; non-smokers, early stoppers and late- or non-stoppers. (continued)

	Total population	Non-smokers	Early stoppers	Late- or non-stoppers	Statistical differences between subgroups that differed in smoking status
	N = 41 088	n = 34 102 (83.0%)	n = 3217 (7.8%)	n = 3769 (9.2%)	p-value
	N (%)^a	n (%)^a	n (%)^a	n (%)^a	
Missing	18 056 (43.9)	15 072 (44.2)	1351 (42.0)	1633 (43.3)	
PREGNANCY COMPLICATIONS^b					
Gestational Diabetes Mellitus	1385 (3.4)	1142 (3.3)	106 (3.3)	137 (3.6)	0.63
Hypertensive disorder	2311 (5.6)	1925 (5.6)	220 (6.8)	166 (4.4)	≤0.001
Placenta previa	212 (0.5)	177 (0.5)	17 (0.5)	18 (0.5)	0.94
Fetal growth restriction	1489 (3.6)	1055 (3.1)	131 (4.1)	303 (8.0)	≤0.001
MODE OF BIRTH CHARACTERISTICS					
Spontaneous vaginal birth	30 327 (73.8)	25 358 (74.4)	2223 (69.1)	2746 (72.9)	≤0.001
Instrumental birth	3212 (7.8)	2639 (7.7)	301 (9.4)	272 (7.2)	
Caesarean delivery	4060 (9.9)	3317 (9.7)	379 (11.8)	364 (9.7)	
Other	695 (1.7)	578 (1.7)	61 (1.9)	56 (1.5)	

Table 1. Maternal and infant characteristics by maternal smoking behaviour during pregnancy; non-smokers, early stoppers and late- or non-stoppers. (continued)

	Total population	Non-smokers	Early stoppers	Late- or non-stoppers	Statistical differences between subgroups that differed in smoking status
	N = 41 088	n = 34 102 (83.0%)	n = 3217 (7.8%)	n = 3769 (9.2%)	p-value
	N (%)^a	n (%)^a	n (%)^a	n (%)^a	
MATERNAL OUTCOMES					
Missing	2794 (6.8)	2210 (6.5)	253 (7.9)	331 (8.8)	≤0.001
Postpartum haemorrhage >1000ml	1227 (3.0)	1032 (3.0)	104 (3.2)	91 (2.4)	
INFANT CHARACTERISTICS					
Sex					
Female	18 819 (45.8)	15 688 (46.0)	1383 (43.0)	1748 (46.4)	0.005
Male	19 837 (48.3)	16 490 (48.4)	1612 (50.1)	1735 (46.0)	
Missing	2432 (5.9)	1924 (5.6)	222 (6.9)	286 (7.6)	
Birthweight (grams)					
≤ 1500	415 (1.0)	323 (0.9)	33 (1.0)	59 (1.6)	≤0.001
1501-2500	1271 (3.1)	854 (2.5)	120 (3.7)	297 (7.9)	
2501-3500	18 052 (43.9)	14 519 (42.6)	1438 (44.7)	2095 (55.6)	
3501-4500	18 055 (43.9)	15 709 (46.1)	1342 (41.7)	1004 (26.6)	

Table 1. Maternal and infant characteristics by maternal smoking behaviour during pregnancy; non-smokers, early stoppers and late- or non-stoppers. (continued)

	Total population	Non-smokers	Early stoppers	Late- or non-stoppers	Statistical differences between subgroups that differed in smoking status
	N= 41 088	n= 34 102 (83.0%)	n= 3217 (7.8%)	n= 3769 (9.2%)	p-value
	N (%)^a	n (%)^a	n (%)^a	n (%)^a	
≥ 4501	750 (1.8)	671 (2.0)	55 (1.7)	24 (0.6)	
Missing	2545 (6.2)	2026 (5.9)	229 (7.1)	290 (7.7)	
Mortality					0.125
Fetal death	273 (0.7)	218 (0.6)	18 (0.6)	37 (1.0)	
Neonatal death	43 (0.1)	37 (0.1)	2 (0.1)	4 (0.1)	

Percentages may not add up to 100% due to rounding

¹ BMI classified as: Underweight (< 18.5), Normal Weight (18.5-24.9), Pre-obesity (25.0-29.9), Obesity class I (30.0-34.9), Obesity class II (35.0-39.9), Obesity class III (> 40)

² Ethnic background classified as: Dutch, Western non-Dutch (European), Non-Western (African, Asian, Turkish, Moroccan) and other migration backgrounds

³ Socioeconomic status classified as: Low (below the 25th percentile), Middle (between the 25th and 75th percentile), High (above the 75th percentile)

⁴ Alcohol consumption: No (no alcohol use), Yes (ranging from occasional use to daily use), Stopped after a positive pregnancy test

⁵ Drugs consumption: No (no drug use), Yes (ranging from occasional use to daily use), Stopped recently

⁶ Multiple pregnancy complications are possible, therefore they do not add up to 100%

Initiation of maternal healthcare

The three groups differed significantly regarding the gestational age at initiation of maternal healthcare, number of face-to-face visits, and the number of contact moments by telephone with the midwife ($p \leq 0.001$) (Table 2). The late- or non-stoppers started maternal care significantly later, at a median of 9.4 weeks of pregnancy (IQR 8.0-11.2), than the early stoppers, at a median of 9.1 weeks (IQR 8.0-10.7). Although the three groups differed significantly on the number of face-to-face visits, the medians and interquartile ranges were mostly similar. Based on the lower quartile, the late- or non-stoppers (IQR 8-14) had fewer face-to-face visits with the primary care midwife than the non-smokers (IQR 9-14) and early stoppers (IQR 9-14). With regard to the number of telephonic consultations, the non-smokers seem to have less consultations via telephone (IQR 0-3) than the early- (IQR 0-4) and the late- or non-stoppers (IQR 0-4) based on the upper quartile.

Table 2. Initiation and frequency of antenatal consultations with the midwife by smoking behaviour during pregnancy.

	Total	Non-smokers	Early stoppers	Late- or non-stoppers	p-value
	N= 41 088	n= 34 102	n= 3217	n= 3769	
	Median (Interquartile Range)	Median (IQR)	Median (IQR)	Median (IQR)	
Initiation of maternal healthcare (in weeks of gestation)	9.4 (8.1-11.0)	9.4 (8.1-11.0)	9.1 (8.0-10.7)	9.4 (8.0-11.2)	≤ 0.001
Number of antenatal face-to-face visits (regular consultations in person)	12.0 (9.0-14.0)	12.0 (9.0-14.0)	12.0 (9.0-14.0)	12.0 (8.0-14.0)	≤ 0.001
Number of contact moments via telephone	2.0 (0.0-4.0)	2.0 (0.0-3.0)	2.0 (0.0-4.0)	2.0 (0.0-4.0)	≤ 0.001

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Referrals

The results of referrals are indicated per stadium of pregnancy, birth, and six weeks postpartum.

Concerning referrals to the obstetrician during pregnancy, the majority were referred for an incidental consult (40.0%), followed by handover of care (33.1%). Of the late- or non-stoppers, 40.5% were referred to the obstetrician, resulting in handover of care during pregnancy. Across all three groups, women were least often referred to an other specialist (0.6%) (Table 3). Compared to the non-smokers, both the early stoppers and the late- or non-stoppers were statistically significantly more likely to be referred to the obstetrician for an incidental referral, with Crude ORs of 1.15 (95%CI 1.07-1.24) and 1.24 (95%CI 1.16-1.33) respectively. This association remained significant after adjustment for confounders: aOR 1.11 (95% 1.03-1.20) for the early stoppers and 1.20 (95%CI 1.11-1.29) for the late- or non-stoppers. Compared to non-smokers, the early stoppers and late- or non-stoppers also were statistically significantly more likely to be referred to the obstetrician resulting in handover of care, with Crude ORs of 1.58 (95%CI 1.45-1.73) and 1.64 (95% CI 1.52-1.78), respectively. After adjusting for confounders, this remained significant: aOR 1.49 (95%CI 1.36-1.63) for early stoppers and aOR 1.58 (95%CI 1.45-1.73) for the late- or non-stoppers.

During birth, for most women who had been referred to the obstetrician (22.6%), the referral resulted in handover of care. Compared to the non-smokers, the late- or non-stoppers were statistically significantly more likely to be referred to the obstetrician resulting in handover of care: OR 1.56 (95%CI 1.42-1.72) and OR 1.41 (95%CI 1.29-1.54), respectively. After adjusting for confounders, the associations remained statistically significant: aOR 1.30 (95%CI 1.17-1.44) for early stoppers and aOR 1.40 (95%CI 1.27-1.55) for late- or non-stoppers. Referrals to the general practitioner, paediatrician and other specialists were not taken into account, since these referrals were not applicable during birth.

Up to six weeks postpartum, most women (1.7%) were referred to the obstetrician resulting in handover of care; followed by referrals to the paediatrician (1.5%). A small number of women were referred to the general practitioner (n= 33) or an other specialist (n= 21). The late- or non-stoppers were statistically significantly less likely to be referred for an incidental referral to the obstetrician: OR 0.69 (95%CI 0.49-0.99), compared to the non-smokers. This association remained statistically significant after adjusting for confounders: aOR 0.69 (0.47-0.99). The early stoppers were statistically significantly less likely to be referred to the obstetrician resulting in handover of care: OR 0.69 (95%CI 0.47-0.99), compared to the non-smokers. After adjusting for confounders, this association remained statistically significant, aOR 0.63 (95%CI 0.43-0.93). Due to the low frequencies of referrals, we omitted the general practitioner and the other specialist from the calculation.

Table 3. Association between smoking status and referrals to maternal care professionals.

	Proportion N (%)	Crude OR (95% CI)	Adjusted OR (95% CI)^a
REFERRAL OUTCOMES			
<u>During pregnancy</u>			
General practitioner	432 (1.1)		
Non-smokers	363 (1.1)	Ref.	Ref.
Early stoppers	30 (0.9)	0.88 (0.60-1.27)	0.88 (0.59-1.32)
Late- or non-stoppers	39 (1.0)	0.97 (0.70-1.36)	0.92 (0.64-1.32)
Obstetrician (incidental)	16 436 (40.0)		
Non-smokers	13 378 (39.2)	Ref.	Ref.
Early stoppers	1374 (42.7)	1.15 (1.07-1.24)^b	1.11 (1.03-1.20)
Late- or non-stoppers	1684 (44.7)	1.24 (1.16-1.33)	1.20 (1.11-1.29)
Obstetrician (handover of care)	13 612 (33.1)		
Non-smokers	10 844 (31.8)	Ref.	Ref.
Early stoppers	1242 (38.6)	1.58 (1.45-1.73)	1.49 (1.36-1.63)
Late- or non-stoppers	1526 (40.5)	1.64 (1.52-1.78)	1.58 (1.45-1.73)
Other specialist	237 (0.6)		
Non-smokers	194 (0.6)	Ref.	Ref.
Early stoppers	25 (0.8)	1.37 (0.90-2.08)	1.50 (0.98-2.30)
Late- or non-stoppers	18 (0.5)	0.84 (0.52-1.36)	1.03 (0.63-1.68)
<u>During birth</u>			
Obstetrician (incidental)	340 (0.8)		
Non-smokers	286 (0.8)	Ref.	Ref.
Early stoppers	22 (0.7)	0.86 (0.55-1.33)	0.79 (0.50-1.25)
Late- or non-stoppers	32 (0.8)	1.10 (0.76-1.59)	0.94 (0.62-1.43)
Obstetrician (handover of care)	9298 (22.6)		
Non-smokers	7540 (22.1)	Ref.	Ref.
Early stoppers	851 (26.5)	1.56 (1.42-1.72)	1.30 (1.17-1.44)
Late- or non-stoppers	907 (24.1)	1.41 (1.29-1.54)	1.40 (1.27-1.55)
<u>≤ 6 weeks postpartum</u>			
General practitioner	33 (0.1)		
Non-smokers	27 (0.1)	Ref.	Ref.
Early stoppers	4 (0.1)	NA	NA

Women who smoke during pregnancy are more likely to be referred to an obstetrician

Table 3. Association between smoking status and referrals to maternal care professionals. (continued)

	Proportion N (%)	Crude OR (95% CI)	Adjusted OR (95% CI)^a
Late- or non-stoppers	2 (0.1)	NA	NA
Obstetrician (incidental)	541 (1.3)		
Non-smokers	468 (1.4)	Ref.	Ref.
Early stoppers	40 (1.2)	0.96 (0.69-1.32)	0.88 (0.62-1.24)
Late- or non-stoppers	33 (0.9)	0.69 (0.49-0.99)	0.69 (0.47-0.99)
Obstetrician (handover of care)	682 (1.7)		
Non-smokers	606 (1.8)	Ref.	Ref.
Early stoppers	30 (0.9)	0.69 (0.47-0.99)	0.63 (0.43-0.93)
Late- or non-stoppers	46 (1.2)	0.89 (0.65-1.20)	0.82 (0.59-1.13)
Paediatrician	618 (1.5)		
Non-smokers	525 (1.5)	Ref.	Ref.
Early stoppers	39 (1.2)	0.79 (0.57-1.09)	0.73 (0.51-1.04)
Late- or non-stoppers	54 (1.4)	0.93 (0.70-1.23)	0.92 (0.68-1.24)
Other specialist	21 (0.1)		
Non-smokers	20 (0.1)	NA	NA
Early stoppers	1 (0.0)	NA	NA
Late- or non-stoppers	-	NA	NA

^a Multivariable logistic regression models were adjusted for maternal age, BMI, socioeconomic status, parity, and ethnicity.

^b Associations in bold are statistically significant $p \leq 0.05$.

Indications for referral

During pregnancy, the five main indications for referral were decreased fetal movements, post-date pregnancy, hypertension/(pre)eclampsia, previous caesarean delivery and ultrasound for determination of the due date (Figure 2). The main indications for the non-smokers and the early stoppers were similar; only the ranking differed. The main indications for referral were the same for the late- or non-stoppers, except for the indication suspicion of fetal growth restriction. Instead of five indications we reported six indications for referral for the late- or non-stoppers, because the percentages of some indications (previous caesarean delivery and hypertension/(pre)eclampsia) were equal.

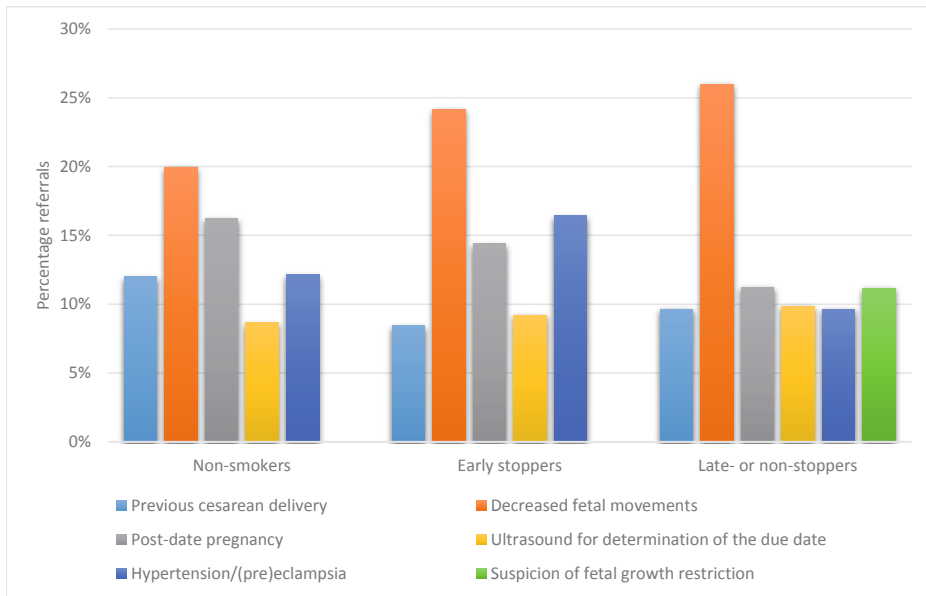
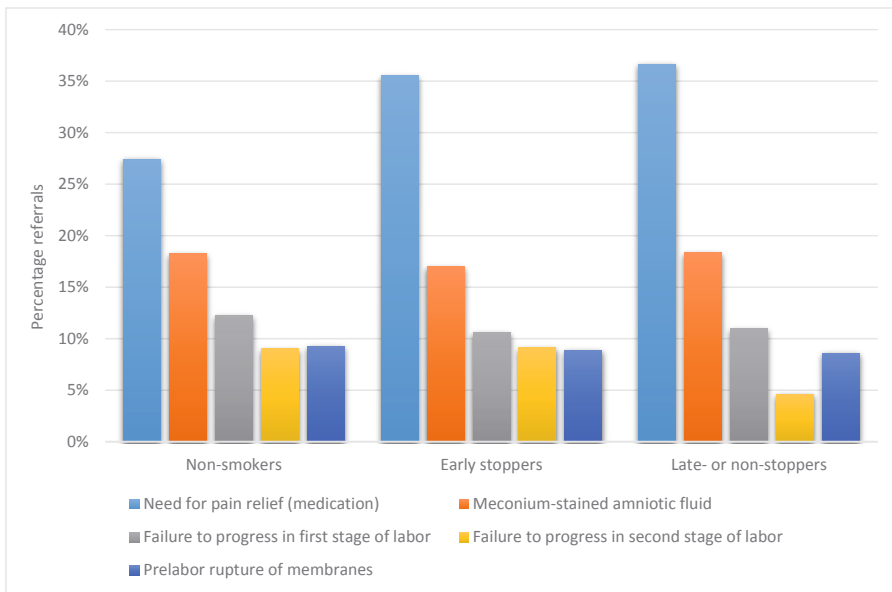


Figure 2. The main indications for referral during pregnancy.

During birth, the main indications for referral were: need for pain relief, meconium-stained amniotic fluid, failure to progress in first stage of labor, failure to progress in second stage of labor, and prelabour rupture of membranes (Figure 3). The late- or non-stoppers were less often referred for failure to progress in second stage of labor compared to the other groups.

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Figure 3. The main indications for referral during birth.

Postpartum, the main indications for referral were 3rd or 4th degree perineal tear, postpartum haemorrhage >1000 ml, various physical symptoms, and other problems (Figure 4). These indications were the same for the non-smokers and the early stoppers, the late- or non-stoppers also had admission to the neonatal intensive care unit (NICU) as main indication for referral.

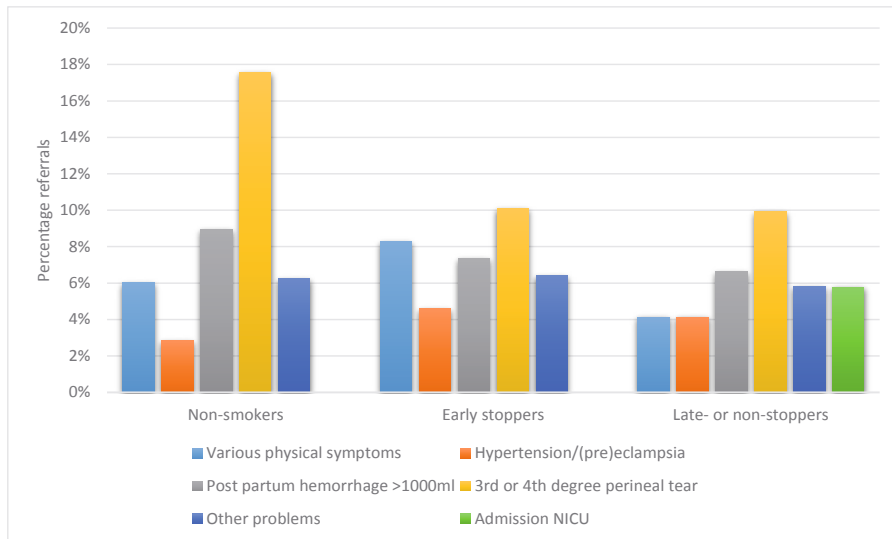


Figure 4. The main indications for referral postpartum.

Discussion

Main findings

The aim of this study was to investigate maternal healthcare utilization for three groups of women, classified according to smoking status: non-smokers, early stoppers, and late- or non-stoppers. These groups showed statistically significant differences in the gestational age at initiation of maternal healthcare and number of contact moments, and in referrals during pregnancy, birth, and postpartum. First, we found that the late- or non-stoppers initiate maternal care later, and have fewer face-to-face visits with the midwife, compared to non-smokers or early stoppers. The non-smokers have less telephonic consultations with the midwife compared to the early stoppers and the late- or non-stoppers. Second, compared to the non-smokers, the early stoppers and the late- or non-stoppers were statistically significantly more likely to be referred to the obstetrician during pregnancy and birth. This seems to be reversed postpartum, the early stoppers and the late- or non-stoppers were statistically significantly less likely to be referred to the obstetrician compared to the non-smokers. Third, we identified the main indications for referral during pregnancy, birth, and postpartum; these were mostly similar for the three groups.

Strengths and limitations

This study has some strengths and limitations to consider when interpreting the results. One strength is its use of primary midwifery care registration data; the

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women in the VeCaS data are comparable to the Dutch national population of women in primary midwife-led care (14). The observed prevalence of smokers is a bit higher than that of the average population in the Netherlands (24), but the observed rates of referral are comparable to those in a previous Dutch study (9). In addition, the large sample size made it possible to investigate differences in maternal healthcare utilization among the three groups of smokers.

A first limitation of our study is that referrals to the general practitioner and the other specialist may be underreported, as pregnant women may visit general practitioners and an other specialist without referral by the midwife. The results of a previous study, using general practitioner registration data, imply that 65% of pregnant women contact their general practitioner (25). This percentage is much higher than the 1.1% of women in our study who were referred to the general practitioner. The previous study offers a possible explanation for this difference by stating that pregnant women might contact their general practitioner first before they contact their midwife, because women are more familiar with their general practitioner or do not know whether a symptom is pregnancy related. It could also be that referrals to the general practitioner are underreported in VeCaS, since pregnant women can contact the general practitioner by themselves and do not need interference from a midwife. Second, in our study we have not taken the number of cigarettes into account. The number of cigarettes smoked is known to influence health outcomes of the baby (26), and thereby possibly maternal healthcare utilization. Third, we were not able to make a distinction between women who stopped smoking after the first trimester and women who continued smoking, because the VeCaS data only contains data about the three groups of smokers. Fourth, we do not have data of women who find out they were pregnant during birth, although this will be a very small percentage of women. Data of these women is available in Perined, a Dutch data registry that captures primary, secondary and tertiary care data. We decided not to use Perined data for our study because smoking status is heavily underreported in this dataset (27). Lastly, we are aware that the association between smoking behaviour and healthcare utilization is complex (e.g. smoking behaviour is also related to other lifestyle factors like diet and physical activity). In our study we decided to take a pragmatic approach, focusing only on the association between smoking behaviour and healthcare utilization.

Interpretation

Our finding that late- or non-stoppers initiate prenatal care later and have fewer face-to-face visits with the midwife could possibly be explained by the pregnancy recognition time. Previous studies reported that smoking during pregnancy is associated with unplanned pregnancy (28), leading to a later initiation of care and less prenatal visits (29). Although the late- or non-stoppers initiate maternal care significantly later, our results do not indicate that either early stoppers or late- or

non- stoppers have inadequate use of care. This finding partly corresponds to the results of previous studies, reporting that women who smoke during pregnancy initiate prenatal care later (1, 2, 30, 31). In accordance with the recommendations in the Dutch guideline, the early stoppers and late- or non-stoppers in our study have a median initiation of care before 10 weeks of gestation, and a median of 12 face-to-face visits with the midwife (32). Therefore, the late- or non-stoppers still meet the recommendations, despite the statistically significant differences between the groups on their use of maternal care; the differences are therefore not clinically relevant. This also applies to the number of face-to-face visits and telephonic consultations. The statistically significant differences, despite the similarities in medians, could be explained by skewed distributions and the large group sizes. We found that compared to the non-smokers, women who are early stoppers or late- or non-stoppers have more telephone consultations with the primary care midwife. Telephone consultations are often performed at the initiative of the pregnant women themselves, and are used by midwives to provide education, support, and triage (33). Based on the telephone consults, midwives can decide to refer women to secondary or tertiary care (33). This higher number of telephonic consultations may be related to the increased referral rates of early- and late- or non-stoppers.

Secondly, we found that pregnant women who smoke at the beginning of pregnancy, both early stoppers- and late- or non-stoppers, are more likely to be referred to the obstetrician during pregnancy and birth. Previous studies reported a positive effect of early smoking cessation on birth outcomes (26, 34), implying that early stoppers would be less likely to be referred to the obstetrician than late- or non-stoppers. However, we did not find large differences in referrals between the early stoppers and the late- or non-stoppers. This finding could be explained by the relatively higher proportions of fetal growth restriction, preterm births, and lower birth weights of infants that we found in our population of early stoppers and late- or non-stoppers, compared to the non-smokers. These are all possible negative health consequences of smoking during pregnancy (3), and indications for referral to secondary or tertiary care (35). Postpartum, the association between smoking behaviour during pregnancy and birth, and referrals, seems to be reversed. The early- and late- or non-stoppers are less likely to be referred to the obstetrician. A possible explanation may be the higher rates of referral to the obstetrician during pregnancy and birth, resulting in the handover of care. This might imply that women with higher risk pregnancies are already in secondary or tertiary care and therefore are not referred again postpartum. Therefore, additional referral postpartum is not applicable. This could also be illustrated by the differences in mode of birth between the groups (8, 9). The early stoppers more often have an instrumental birth or caesarean delivery, implying that they already receive care from an obstetrician during birth in secondary or tertiary care.

Women who smoke during pregnancy are more likely to be referred to an obstetrician

Third, among the three groups we did not find differences in indications large enough to explain the significant differences in referral rates. Women's smoking behaviour might be unrelated to the main indications for referral. Our identified indications for referral are generally comparable to those reported in previous studies (8, 9). Nevertheless, despite these similar indications for referral in the three groups, our results show that women who smoke during pregnancy are more often referred to the obstetrician. Considering the negative health effects of smoking (3), it may be that, for smokers, the indications for referral involve more serious health consequences, leading to higher referral rates. Furthermore, other concomitant non-medical risk factors associated with smoking during pregnancy may possibly influence the higher referral rates, such as a lower SES, lower education level, higher alcohol and drug use, and higher levels of anxiety and depression (5, 36). These factors are also associated with adverse pregnancy outcomes, such as small for gestational age, preterm delivery and stillbirth (37-39), which could lead to higher referral rates to secondary and tertiary care. The higher prevalence of these factors in women who smoke during pregnancy might imply that they form a vulnerable group with a higher risk for adverse pregnancy outcomes, requiring more specialized care.

In the Netherlands, special care paths are available that describe how vulnerable pregnant women can receive specialized care during pregnancy. The care for vulnerable pregnant women also involves consultations in which interdisciplinary healthcare professionals collaborate in the care for vulnerable women. However, a previous study reports that interdisciplinary care for vulnerable pregnant women still should be improved (40). The study recommends that interdisciplinary healthcare professionals should take both medical risk factors (pregnancy outcomes) and non-medical risk factors (such as a low SES and poor lifestyle behaviours) into account (40). The results of our study indicate the importance of smoking as a risk factor, related to both medical and non-medical factors, that should be taken into account in the care for (vulnerable) pregnant women.

Conclusion

In this study we aimed to gain insight into similarities and differences in maternal healthcare utilization for women who do not smoke during pregnancy, early stoppers, and late- or non-stoppers. Our results indicate that the three groups differ in their utilization of care. However, although the late- or non-stoppers initiate maternal care later, their use of prenatal care is adequate. Furthermore, women who smoke at the beginning of pregnancy are more often referred to the obstetrician during pregnancy and birth than non-smokers. The large population of smokers being referred during pregnancy underlines the important role of the collaboration between healthcare professionals in primary and secondary or tertiary care. They

need to be more aware of the importance of smoking as a medical and as a non-medical risk factor. More research is needed on the influence of the amount of cigarettes smoked on maternal healthcare use. We recommend future studies to make a distinction between women who stopped smoking after the first trimester and women who continued smoking to investigate the association on referrals to secondary or tertiary care.

Acknowledgments

We would like to thank the midwives who participate in the VeCaS project and the women who consented to use their data.

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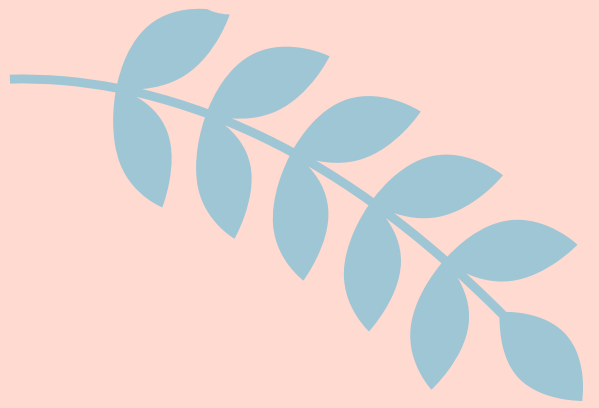
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Chapter 4

Does social need fulfillment moderate the association between socioeconomic status and health risk behaviours during pregnancy?

Weiland S MSc, Jansen DEMC PhD, Groen H MD PhD, de Jong DR BSc, Erwich JJHM MD PhD, Berger MY MD PhD, Hoek A MD PhD, Peters LL PhD

Abstract

Background

Smoking and consuming alcohol during pregnancy are associated with socioeconomic status (SES). Socioeconomic differences in health risk behaviours during pregnancy may be influenced by social relations. In this study we aimed to investigate if social need fulfillment moderates the association between SES and health risk behaviours (smoking and/or alcohol consumption) during pregnancy.

Methods

We used baseline data from the LifeLines Cohort Study merged with data from the LifeLines Reproductive Origin of Adult Health and Disease (ROAHD) cohort. We included women who had experienced at least one pregnancy. Education level was used to determine SES, categorized into low, middle and high, with middle SES as the reference category. Social need fulfillment was taken as indicator for social relations and was measured with the validated SPF-IL scale. The dependent variable was smoking and/or alcohol consumption during pregnancy. Univariable and multivariable logistic regression analysis was conducted to assess the association of SES and social need fulfillment with health risk behaviours and to test for effect modification.

Results

We included 1107 pregnant women. The results showed that women with a high SES had statistically significantly lower odds of health risk behaviours during pregnancy. The interaction effect between SES and social need fulfillment on health risk behaviours was not statistically significant, indicating that no moderation effect is present.

Conclusions

The results indicate that social need fulfillment does not modify the effect of SES on health risk behaviours during pregnancy. However, in literature, social relations are identified as an important influence on health risk behaviours. More research is needed to identify which measure of social relations is the most relevant regarding the association with health risk behaviours.

Keywords

Prenatal care, smoking, alcohol, socioeconomic status, social relations

Introduction

In the Netherlands, 8% of women smoke during (part of) their pregnancy and 2.6% consume alcohol during pregnancy (1). Women who smoke or consume alcohol during pregnancy tend to engage in other health risk behaviours during pregnancy, such as an unhealthy diet, and inadequate folic acid intake (2). These health risk behaviours are associated with adverse outcomes, such as low birthweight, preterm birth and miscarriage (3, 4).

Health risk behaviours during pregnancy are associated with socioeconomic status (SES), where women with a lower SES are at greater risk of continuation of unhealthy behaviours during pregnancy compared to women with higher SES (5). Socioeconomic differences in health behaviours during pregnancy may be explained by psychosocial stress and available resources (2, 6). Women with a lower SES tend to have fewer resources, such as income, knowledge, and social support, compared to women with higher SES (7). Lacking these resources increases psychosocial stress and may make individuals at greater risk to turn to unhealthy behaviours to cope with psychosocial stress (7). One study reported that stress is a mediator between lower SES and postpartum smoking relapse (8). Studies on the pathways between SES and the consumption of alcohol during pregnancy are scarce, one study reports that women consume alcohol during pregnancy as a mechanism to cope with stress (9).

Social relations may positively help manage psychosocial stress. Previous studies stated that social relations play an important role in socioeconomic differences in health behaviours (7, 10). Social relations may function as a buffer against psychosocial stress and thereby have a positive influence on health behaviours (11, 12). On the other hand, social relations might negatively influence health behaviours. Women who smoke often have many smokers in their social networks, which influences women's attitudes towards smoking during pregnancy (13).

The mechanism could be different for pregnant women compared to the general population because pregnant women are not only responsible for their own health, but also for the health of their unborn child. Putatively, this new responsibility for the unborn makes women more dependent on social support to cope with general and pregnancy related stress (8). There are limited studies that examined the moderating effect of social relations on the association between SES and health behaviours during pregnancy. One previous study investigated pathways between SES and smoking during pregnancy (14). This study did not report evidence in favor of the moderating effect of social relations. This study used the quality of the primary intimate relationship as operationalization for social relationships and had smoking in the third trimester as outcome (14). There are no previous studies performed to the moderating effect of social relations on the association

between SES and alcohol consumption during pregnancy. The results of one study, not performed among pregnant women, indicated that social support may act as a buffer for stress and problem drinking (15).

Another way of operationalization of social relationships is social need fulfillment as defined within the Social Production Function theory (SPF) (16, 17). According to this theory, all humans are motivated to optimize their social needs (e.g., the need for social support and friendship), and therefore achieve psychosocial wellbeing (16, 17). Social need fulfillment relates to the social aspect of the SPF theory. According to the SPF theory, individuals have three basic social needs and goals: affection, behavioural confirmation, and status. Affection refers to the need to be loved, liked and accepted. Behavioural confirmation refers to the need of feeling that important others think that you are a good person or that you are doing the “right” thing. Status refers to the need of feeling that you have an influence, are taken seriously, or are known for your skills and achievements. The fulfillment of these three social needs leads to social wellbeing (16, 17). We will use the SPF theory, as measured with the validated Social Production Function Instrument for the Level of Wellbeing (SPF-IL) questionnaire, to investigate the following research question: does social need fulfillment moderate the association between SES and health risk behaviours (smoking and/or alcohol consumption) during pregnancy? By answering this question, we aim to understand the role of social need fulfillment in the association between SES and health behaviours during pregnancy (Figure 1).

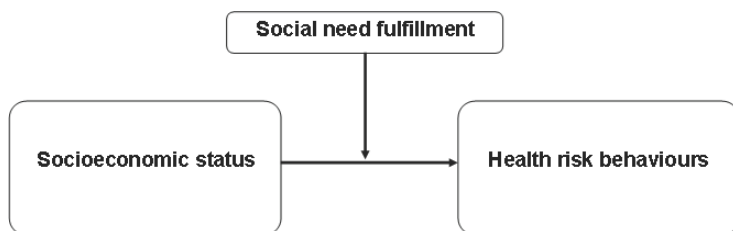


Figure 1. Hypothesized moderation effect of social need fulfillment on socioeconomic status and health risk behaviours.

Methods

Design and study population

In this study we used baseline data from the LifeLines Cohort Study merged with data from the LifeLines Reproductive Origin of Adult Health and Disease (ROAHD) cohort. LifeLines is a large representative population-based cohort study and a biobank in the northern provinces of the Netherlands with the aim to investigate risk factors for multifactorial diseases (18, 19). Recruitment for the LifeLines Cohort study was performed between 2006 and 2013 (N=167,729). The LifeLines cohort study

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collects different types of data: biomaterial (e.g., urine, blood), physical examination (e.g., pulmonary function, blood pressure), and questionnaires. All participants gave informed consent before they underwent a physical examination. Participants completed multiple questionnaires about general characteristics (i.e., education, work), health (i.e., healthcare use, health status), lifestyle and environment (i.e., smoking, nutrition) and psychosocial parameters (i.e., social relations assessed with the SPF-IL questionnaire, stress) (18).

The aim of the LifeLines-ROAHD cohort is to investigate the health of women in their reproductive age (20-45 years). In total 5412 women participated in the Lifelines ROAHD study of which 2604 women had not been pregnant and 2808 women had experienced 6158 pregnancies and 5068 births (20). LifeLines-ROAHD comprised items on women's health: menstrual cycle characteristics, menopause, contraceptive use, fertility problems and assisted reproduction treatments. If women had experienced a pregnancy, they also received items about conception, medication use during pregnancy, lifestyle (smoking during pregnancy, second-hand smoking, alcohol use, weight gain), course of pregnancy, and pregnancy outcomes. If women had given birth they received additional questions about the onset of delivery, mode of birth, birth outcomes, health outcomes for mothers and infant health problems (20).

The current study focuses on the population of women in the northern parts of the Netherlands (age ≥ 18 years). We included the women who had experienced at least one pregnancy independent of pregnancy outcome. From the Lifelines-ROAHD cohort we selected women with data about health behaviours during pregnancy around two years prior to and after the LifeLines baseline assessment, including the social need fulfillment questionnaire (SPF-IL). If women were pregnant more than once in this time interval, we selected the pregnancy that occurred closest to the baseline assessment. Women were excluded from the analyses when they had missing data on education level or more than two missing values on the SPF-IL questionnaire.

Measurements

Demographics

Demographic characteristics that were collected included maternal age, marital status (single or in a relationship), migration background (Dutch or non-Dutch) and socioeconomic status (SES) operationalized as the respondents highest attained education level. We chose education level as measure for SES because education is related to non-material resources such as knowledge and health literacy, which facilitate a healthy lifestyle (21). In addition, there is an association between education level with smoking and alcohol consumption (1). We categorized

education level into a SES score according to the guideline of Statistics Netherlands, which is based on the International Standardized Classification of Education (ISCEI) (22). We categorized a low SES as being lower educated (having finished primary education or lower- or preparatory secondary education), a middle SES as being middle educated (having finished middle or higher secondary education) and a high SES as being higher educated (having finished higher vocational education or university). Furthermore, we collected data about the lifestyle characteristic Body Mass Index (BMI, kg/m², overweight and obesity), and pregnancy characteristics planned pregnancy (yes or no) and parity (nulliparous or multiparous).

Health risk behaviours during pregnancy

Health behaviours included in this study were smoking behaviour and/or alcohol consumption during pregnancy. In the ROAHD questionnaire, women were asked whether they had smoked or consumed alcohol during the pregnancy. They could either answer: (1) "yes, during part of the pregnancy", (2) "yes, during the entire pregnancy", or (3) "no". The two variables (smoking and alcohol consumption) were combined into one variable. If women had either smoked or consumed alcohol during a part or their entire pregnancy, they were categorized as 'yes'. If women never smoked or consumed alcohol during pregnancy, they were categorized as 'no'.

Social need fulfillment

Social need fulfillment was assessed using the validated nine-item Social Production Function Instrument for the Level of Wellbeing (SPF-IL) scale (17, 23). The SPF-IL scale contains questions relating to the three social needs during the past three months: affection (3 items), behavioural confirmation (3 items), and status (3 items). For example, respondents were asked: "do you feel that people really love you" (affection), "do others appreciate the things you do?" (behavioural confirmation), and "do people find you an influential person" (status). The items were scored on a 4-point Likert scale ranging from 0 (never) to 3 (always) resulting in a summed scale score with a maximum of 27. A higher score indicates higher social need fulfillment.

Other control variables

We pre-identified possible confounders. We identified maternal age (continuous) as possible confounder from the demographic characteristics (24). From pregnancy characteristics we included partners in consecutive pregnancies (dichotomized as same partner compared to multiple partners), parity (24), and planned pregnancy (dichotomous) (25) as possible confounders. With respect to parameters of lifestyle we included BMI (continuous) (24), second-hand smoke exposure (dichotomous), physical illness (dichotomous), and psychological illness (dichotomous) as confounders. We decided to take second-hand smoke exposure into account because it is associated with smoking during pregnancy (26). Because the presence of physical or psychological disease may influence health behaviours (27, 28), we

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also controlled for the presence of physical or psychological diseases prior to pregnancy, as measured in the LifeLines baseline assessment. Having a chronic physical disease may positively influence health behaviours (i.e., not smoking or drinking), while psychological diseases may negatively influence health behaviours (27, 28). The most common physical diseases with a high burden among women in the reproductive age are hypertension and migraine (29, 30). If women had one or both chronic diseases, they were categorized as having at least one physical disease (dichotomous). Common psychological diseases are depression, social phobia, agoraphobia, panic disorder, (other) anxiety disorder and manic-depressive disorder (31). If women had one or more of these psychological diseases, they were categorized as having at least one psychological disease (dichotomous).

Statistical analysis

To report baseline characteristics we used descriptive statistics. To assess differences between subgroups who differed on SES we used Chi-Square tests and Fisher-Freeman-Halton exact test, where appropriate. Differences between the SES-groups on the SPF-IL score were tested with Kruskal Wallis test, since the data were not normally distributed.

Univariable and multivariable logistic regression was used to assess the hypothesized effect modification of social need fulfillment (as measured with the total score of the SPF-IL) on the association between SES and health risk behaviours during pregnancy. First, we performed an univariable logistic analysis with SES as independent variable and health risk behaviours as dependent variable. Middle SES was taken as the reference category. For the selection of confounders, we performed an univariable analysis for each potential confounder with health risk behaviours separately. Confounders that were statistically significantly associated ($p \leq 0.05$) with health risk behaviours were included in the multivariable models. Second, we performed multivariable logistic regression analyses and added the total SPF-IL score and the control variables (model 1). Third, we added the interaction variable of the total SPF-IL score with SES to the model (model 2). For each model we calculated Odds Ratios (OR) with corresponding 95% Confidence Intervals (95% CI).

All data were analyzed in SPSS version 26.0 (SPSS Inc., Chicago, IL, USA). A p-value ≤ 0.05 was considered statistically significant.

Results

Participants

From the 2808 women of the Lifelines-ROAHD cohort that experienced at least one pregnancy, in total 1701 women were excluded because: they did not experience a pregnancy two years before or after completing the baseline questionnaire (n= 1694), had more than two missing values on the SPF-IL (n=3) or because they had missing values on education level (n=4). Our final study population consisted of 1107 women with a mean age (SD) of 31.7 (3.8) years. A minority of 5.0% had a low SES, 36.3% a middle SES and 58.7% a high SES (Table 1). The SES-subgroups showed statistically significant differences on maternal age, number of partners in consecutive pregnancies, parity, BMI, smoking behaviour, second-hand smoke exposure, health risk behaviours, presence of physical disease and of psychological disease. Compared to women with a middle and high SES, women with a low SES were more often multiparous, obese, and smoked more often during pregnancy. Women with a low SES had a statistically significantly ($p \leq 0.001$) higher prevalence of health risk behaviours (smoking and/or alcohol consumption) during pregnancy compared with women with a middle or high SES. Women with a low SES had statistically significantly lower scores on the SPF-IL ($p \leq 0.001$), compared with women with a middle or high SES, median scores (interquartile range) were 24.0 (21.0-25.0), 25.0 (23.0-27.0) and 25.0 (24.0-27.0) respectively, indicating they had a lower social need fulfillment.

Table 1. Population characteristics of women in the LifeLines Cohort study and LifeLines ROAHD by socioeconomic status.

	Total population N= 1107	Low SES n = 55 (5.0%)	Middle SES n = 402 (36.3%)	High SES n = 650 (58.7%)	Statistical differences between SES groups
	N (%)^a	n (%)	n (%)	n (%)	p-value
MATERNAL CHARACTERISTICS					
Maternal age (in years) during pregnancy					0.05
18-30	333 (30.1)	24 (43.6)	136 (33.8)	173 (26.6)	
31-35	518 (46.8)	19 (34.5)	184 (45.8)	315 (48.5)	
=> 36	256 (23.1)	12 (21.8)	77 (19.2)	154 (23.7)	
Migration background					0.26
Dutch	1058 (95.6)	55 (100)	382 (95.0)	621 (95.5)	
Non-Dutch	49 (4.4)	-	20 (5.0)	29 (4.5)	
Marital status					0.60
Single	37 (3.3)	≤10 (≤0.2)	≤10 (≤0.02)		
In a relationship	741 (66.9)	38 (69.1)	274 (68.2)	429 (66.0)	
Missing	329 (29.7)	14 (25.5)	114 (28.4)	201 (30.9)	
PREGNANCY CHARACTERISTICS					
Partners consecutive pregnancies					0.03
Same partner	881 (79.6)	45 (81.8)	308 (76.6)	528 (81.2)	
Two or more partners	70 (6.3)	≤10 (≤0.2)	35 (8.7)	31 (4.8)	
Missing	156 (14.1)	≤10 (≤0.2)	59 (14.7)	91 (14.0)	
Parity					≤0.001
Nulliparous	497 (44.9)	14 (25.5)	167 (41.5)	316 (48.6)	
Multiparous	610 (55.1)	41 (74.5)	235 (58.5)	334 (51.4)	
Planned pregnancy					0.08
Yes	960 (86.7)	34 (78.2)	344 (85.6)	573 (88.2)	
No	147(13.3)	12 (21.8)	58 (14.4)	77 (11.8)	

Table 1. Population characteristics of women in the LifeLines Cohort study and LifeLines ROAHD by socioeconomic status. (*continued*)

	Total population N= 1107	Low SES n = 55 (5.0%)	Middle SES n = 402 (36.3%)	High SES n = 650 (58.7%)	Statistical differences between SES groups
LIFESTYLE CHARACTERISTICS					
BMI^b					≤0.001
Overweight	285 (25.7)	17 (30.9)	123 (30.6)	145 (22.3)	
Obesity	136 (12.3)	13 (23.6)	67 (16.7)	56 (8.6)	
Smoking behaviour					≤0.001
No	1026 (92.7)	43 (78.2)	357 (88.8)	626 (96.3)	
Yes	81 (7.3)	12 (21.8)	45 (11.2)	24 (3.7)	
Second hand smoke exposure^c					≤0.001
Yes	50 (4.5)	≤10 (≤0.2)	31 (7.7)	15 (2.3)	
Alcohol consumption					0.59
Yes	66 (6.0)	≤10 (≤0.2)	20 (5.0)	43 (6.6)	
Health risk behaviours^d					≤0.001
No	984 (88.9)	43 (78.2)	346 (86.1)	595 (91.5)	
Yes	123 (11.1)	12 (21.8)	56 (13.9)	55 (8.5)	
Presence of physical disease					
No	787 (71.1)	39 (70.9)	265 (65.9)	483 (74.3)	0.01
Yes	320 (28.9)	16 (29.1)	137 (34.1)	167 (25.7)	
Presence of psychological disease					
No	947 (85.5)	43 (78.2)	328 (81.6)	576 (88.6)	0.01
Yes	160 (14.5)	12 (21.8)	74 (18.4)	74 (11.4)	

^a Percentages may not add up to 100% due to rounding

^b BMI classified as: Overweight (25.0-29.9), Obesity (>30)

^c As response to the question: Are there other household members smoking inside the house during pregnancy?

^d Composite outcome of smoking and/or alcohol consumption during pregnancy. The numbers of smoking behaviour and alcohol consumption do not add up to the composite outcome, since some participants smoke and consume alcohol.

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Moderation effect

The univariable logistic analysis showed that women with a high SES had statistically significantly lower odds of health risk behaviours during pregnancy (OR 0.57, 95%CI 0.39-0.85) (Table 2). Social need fulfillment was not statistically significantly associated with health risk behaviours (OR 0.96, 95%CI 0.91-1.02).

In the multivariable logistic regression analysis, including SES and the total social need fulfillment score (Model 1), there were no significant associations between SES and health risk behaviours. In Model 2, there were no statistically significant associations reported between SES and health risks behaviours. The interaction effect between SES and social need fulfillment on health risk behaviours was not statistically significant, indicating that no moderation effect is present (Table 2).

Table 2. Univariable and multivariable logistic regression models on health risks behaviours during pregnancy.

	Univariable logistic regression	Multivariable logistic regression	
	Health risk behaviour OR (95% CI)	Health risk behaviour Model 1 aOR (95% CI)²	Health risk behaviour Model 2 aOR (95% CI)²
Socio Economic Status			
Middle	Ref.	Ref.	Ref.
Low	1.72 (0.86-3.47)	1.91 (0.87-4.20)	0.01 (0.00-9.32)
High	0.57 (0.39-0.85)³	0.70 (0.44-1.11)	0.35 (0.01-11.70)
SPF-IL score¹	0.96 (0.91-1.02)	0.98 (0.92-1.05)	0.95 (0.86-1.05)
SES*SPF-IL score¹			
Low SES			1.23 (0.94-1.61)
High SES			1.03 (0.89-1.18)

¹The total Social Production Function Instrument for the Level of Wellbeing (SPF-IL) score.

²Adjusted for the dichotomous variables second hand smoke exposure, partners in consecutive pregnancies and planned pregnancy.

³Numbers in bold indicate statistically significant results (p≤0.05).

Discussion

Main findings

In this study we aimed to investigate if social need fulfillment moderates the relationship between SES and health risk behaviours (smoking and or consuming alcohol) during pregnancy. In our study population, women with a low, middle and high SES showed statistically significant differences on maternal age, number of partners in consecutive pregnancies, parity, BMI, smoking behaviour, second-hand smoke exposure, health risk behaviours, presence of physical disease and presence of psychological disease. Women with a low SES had a statistically significant lower social need fulfillment score than women with a middle or high SES. Concerning health risk behaviours during pregnancy, the results show that women with a high SES had lower odds of smoking and/or consuming alcohol during pregnancy compared with women with a middle SES, however this association did not remain after adjustment for confounders. The interaction effects between SES and social need fulfillment on health risk behaviours were not statistically significant, indicating that no moderation effect is present.

Strengths and limitations

Some strengths and limitations need to be considered while interpreting the results of this study. A strength of this study is the richness of the available data about women's pregnancies, such as BMI of women, data about second-hand smoke exposure and partners in consecutive pregnancies, if the pregnancy was planned and data about smoking and alcohol consumption. The prevalence of smoking in this cohort is comparable to the prevalence in the Dutch population, the observed prevalence of alcohol consumption is higher than reported in a previous study (1). However, smoking and alcohol consumption might still be underreported, since these were self-reported measures. Furthermore, the data was retrospectively collected which might have caused a recall bias. Another limitation is the relatively high proportion of women with a high SES in the data compared to the general Dutch population (32). In our study 59% of the women had a high SES, whereas in the Dutch population this is 40% (32). The overrepresentation of women with a high SES and the relative low number of women with a low SES influences the generalisability of the results.

Interpretation

Our results show that women with a low SES have a lower social need fulfillment score, indicating that they feel less affection, behavioural confirmation and status compared with women with a middle or high SES (17, 23). This result is in accordance with a previous study which reports that women with a low SES have fewer resources, which influences their health behaviours (7). In our study we also found that women with a low SES were more often obese, smoked more often and had

a higher prevalence of health risk behaviours during pregnancy compared to high SES women. Although women with a low SES tend to have a less healthy lifestyle (5), we did not find a statistically significant association between a low SES and health risk behaviours during pregnancy. However, for the high SES group we did find a statistically significant association with health risk behaviours. The high SES group had statistically significant lower odds of health risk behaviours during pregnancy compared with the middle SES group. It could be that the association between SES and health behaviours differs across groups (33). Other factors than SES influence health behaviours during pregnancy and could be a reason for differences in associations between SES groups (33). For example, years of smoking, confidence, self-efficacy and health concerns are associated with health risk behaviours (34). Inequalities in health risk behaviours between SES groups could also be related to treatment compliance and number of smokers in the household (35).

Contrary to the results of previous studies, we did not find a statistically significant association between social need fulfillment and health risks behaviours during pregnancy (12, 36). This could be related to the influence of pregnancy on women's lifestyle. Pregnancy is considered a window of opportunity; women are more likely to change their lifestyle during pregnancy because they are responsible for the health of the unborn child (37). Despite the importance of social relations (8), pregnancy itself could be a main factor for women to change their health behaviours (37). Another potential reason could be the differences in measures for social relations that were used. Previous studies used the quality of the intimate relationship or the perceived availability of interpersonal resources as measures for social relations, which are different concepts than social need fulfillment (11, 14). Especially support from a partner seems to be an important factor, as support from a partner and being married are associated with smoking cessation and a reduced likelihood of binge drinking during pregnancy (26, 38).

The measure used for social relations might also explain why we did not find a moderation effect, indicating that social need fulfillment does not influence the association between SES and health risk behaviours during pregnancy. We hypothesized that social need fulfillment could act as a buffer for stress and therefor positively influence health risk behaviours (10-12). However, the type of social support that functions as a buffer for stress might depend on the source and type of stress and the type of social support (12). Also women's personality characteristics, such as neuroticism and optimism, could influence the effect of social relations on health (12). In literature there is no conclusive evidence about how social relations influence health behaviours (12, 14). While some studies argue for a moderation effect, another study found evidence for a mediating effect with stress and social relations as mediators for the association between SES and health behaviours (11, 12, 14). More research is needed to the influence and pathways of

social relations and SES on health behaviours. Future studies should particularly focus on the measure of social relations that influences health behaviours during pregnancy. Insight into the influence of social relations on health behaviours during pregnancy has important implications for interventions. Interventions aiming to improve social support are effective by improving the social wellbeing and might be beneficial for health risk behaviours of pregnant women (39). Furthermore, interventions that focused on peer support, seem to be promising for addressing substance use during pregnancy (40).

Conclusion

In this study we aimed to investigate if social need fulfillment moderates the relationship between SES and health risk behaviours during pregnancy. The results indicate that social need fulfillment does not modify the effect of SES on health risk behaviours during pregnancy. However, in existing literature social relations are identified as an important influence on health risk behaviour. More research is needed to understand the pathways and to identify which measure of social relations is the most relevant regarding the association with health risk behaviours. Insight into the influence of social relations on health behaviours during pregnancy can provide an important starting point for interventions.

Acknowledgments

We would like to thank all women who participated in the Lifelines-ROAHD cohort.

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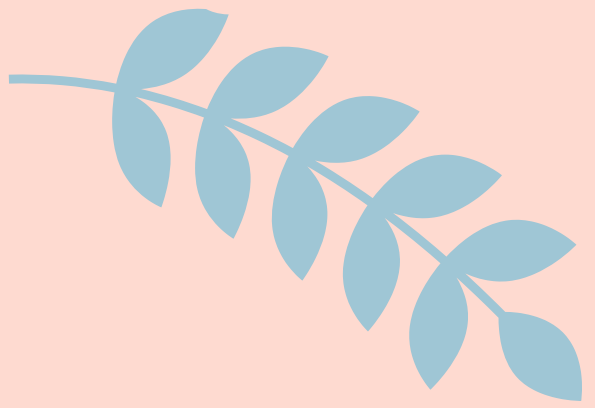
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Chapter 5

Adverse maternal and infant outcomes of women who differ in smoking status: E-cigarette and tobacco cigarette users

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Abstract

Background

The electronic cigarette (e-cigarette) became commercially available around 2004, yet the characteristics of pregnant women who use these devices and their effects on maternal and infant health remain largely unknown. This study aimed to investigate maternal characteristics and pregnancy outcomes according to maternal smoking status.

Methods

We conducted a cross-sectional study of Dutch women with reported pregnancies between February 2019 and May 2022, using an online questionnaire to collect data on smoking status and demographic, lifestyle, pregnancy, and infant characteristics. Smoking status is compared among non-smokers, tobacco cigarette users, e-cigarette users, and dual users (tobacco and e-cigarette). We report descriptive statistics and calculate differences in smoking status between women with the chi-square or Fisher (Freeman–Halton) test.

Results

Of the 1937 included women, 88.1% were non-smokers, 10.8% were tobacco cigarette users, 0.5% were e-cigarette users, and 0.6% were dual users. Compared with tobacco users, e-cigarette users more often reported higher education, having a partner, primiparity, and miscarriages. Notably, women who used e-cigarettes more often had small infants for gestational age.

Conclusions

Despite including few women in the e-cigarette subgroup, these exploratory results indicate the need for more research to examine the impact of e-cigarettes on pregnancy outcomes.

Keywords

prenatal exposure, electronic cigarettes, health consequences, nicotine, derivatives

Introduction

Smoking tobacco cigarettes during pregnancy is associated with low birth weight, preterm birth, neural underdevelopment, and stillbirth (1–4). The mechanisms behind these effects are largely attributable to nicotine and carbon monoxide released by burning tobacco, which may decrease placental blood flow and contract fetal arteries (3,5). Tobacco cigarettes also affect the health of the mother, being associated with gestational hypertension, preeclampsia, gestational diabetes, and postpartum haemorrhage (6–8).

The electronic cigarette (e-cigarette) was introduced in 2004 as a healthier alternative to regular tobacco cigarettes for heavy smokers (9,10) with the main use scenario being to facilitate smoking cessation (11). They benefit from feeling like conventional cigarettes to use, having the ability to add pleasant flavors, and heating an “e-liquid” instead of burning tobacco (12). However, e-liquids cannot be considered safe because they can still contain nicotine (0–36.6 mg/mL) and other potentially harmful chemicals with known adverse health effects in non-pregnant users and a growing prevalence of e-cig/vaping-associated lung injury (EVALI) in the United States (10,13–15). EVALI is characterized by dyspnea, cough, and hypoxemia with bilateral airspace opacities on chest imaging, where patients often have to be admitted to the intensive care unit (15). The continued growth in their popularity, especially among teenagers, is a cause for concern (16). As of 2021, about 1.4% of adults in the Netherlands use e-cigarettes regularly, with an estimated 0.4% of pregnant women reportedly using substances like hookah, nitrous oxide, and/or e-cigarettes in 2018 (17,18). Given that e-cigarettes are not benign devices, often still contain nicotine, and appear to show increased use among women of childbearing age, we urgently require a better understanding of the risks to both the mother and infant.

Studies of how e-cigarettes affect maternal and infant outcomes have produced inconclusive results to date, with most focusing on nicotine exposure and its effects on blood flow (6,19,20). Consistent with the literature on tobacco smoking, data from animal and laboratory research have shown that nicotine may cause poor placentation, while data from animal studies and one cohort study suggest it may cause low birthweight (21–24). However, in a review of fetal toxicity associated with e-cigarette use, Greene and Pisano concluded that we still lack strong epidemiological evidence from studies comparing e-cigarette use with either tobacco smoking or non-smoking during pregnancy (25). To our knowledge, only one questionnaire-based observational study has compared the characteristics of pregnant women who used e-cigarettes to those of pregnant women who used tobacco cigarettes or did not smoke. Of the 4442 British women included in that research, the 2.8% who used e-cigarettes during pregnancy were mostly younger,

of British origin, lived in deprived areas, had left full-time education at a younger age (≤ 18 years), and had a partner who also smoked when compared with non-smokers and tobacco users (26). There is no comparable research in the Dutch population, which must be corrected to know where to target research and public health initiatives.

Existing guidance on e-cigarette use during pregnancy largely relies on evidence from studies into either tobacco cigarette smoking during pregnancy or the chemicals and toxins in e-cigarette smoke combined. This lack of specific evidence led the Dutch Association of Obstetricians and Gynecologists (NVOG) and the Royal Dutch Association of Midwives (KNOV) to recommend discouraging e-cigarette use during pregnancy (27). Unraveling the complex relationship between e-cigarette use and maternal and infant outcomes will inform future iterations of this guidance and the advice given to pregnant women. An important first step is to define the characteristics of women who use e-cigarettes during pregnancy.

This study aimed to investigate the individual characteristics and adverse maternal and infant outcomes of women according to their smoking status, comparing non-smokers, tobacco users, e-cigarette users, and dual users of tobacco and e-cigarettes.

Methods

Study Design and Ethics

This cross-sectional study used data collected by an online questionnaire between March 2020 and May 2022. We targeted Dutch-speaking women aged ≥ 16 if they had been pregnant between February 2019 and May 2022 and lived in the Netherlands. The questionnaire was completed at most one year after birth. Women were excluded if they did not consent to the anonymous use of their data or if they had missing data for any inclusion criterion and/or their smoking status (i.e., non-smokers, tobacco cigarette users, e-cigarette users, or dual users). This type of research does not require ethical approval in the Netherlands, and the ethical review board of the University Medical Hospital Groningen provided a waiver stating that the Medical Research Involving Human Subjects Act (WMO) does not apply (number: METc 2019/099).

Recruitment Strategy

Women received an invitation to complete the online questionnaire via four routes: (1) 456 primary midwifery care practices in the Netherlands; (2) social media posts by Midwifery Academy Groningen Amsterdam and participating researchers (e.g., personal LinkedIn pages); (3) posts on 3 forums, 37 Facebook groups, and 5 Facebook pages related to pregnancy and birth; and (4) targeting e-cigarette users through

the municipal health services of Groningen, Friesland, and Drenthe. Completing the questionnaire was voluntary and was not rewarded with any compensation.

Questionnaire Construction

The online questionnaire comprised 90 questions, of which 22 were open-ended and 68 were closed, with data collection performed using Google Forms. Depending on the women's answers for smoking status and end of pregnancy, they answered different questions targeted at their specific situation. This study collected the following data on demographic and lifestyle characteristics: maternal age, migration background (i.e., Western or non-Western), education level (i.e., low, middle, or high), marital status (no partner or partner), smoking status (i.e., non-smokers, tobacco cigarette users, e-cigarette users, or dual users), smoking duration, e-cigarette nicotine dose (i.e., none, low [≤ 10 mg], medium [11–22 mg], or high [≥ 23 mg]), previous smoking, second-hand smoke exposure, and pre-pregnancy body mass index (kg/m^2). We also collected data about pregnancy characteristics (i.e., mode of conception, parity), maternal outcomes (mode of birth, hypertensive disorders of pregnancy, gestational diabetes, or postpartum haemorrhage >1 L), and infant outcomes (e.g., birth weight, gestational age, size for gestational age, hospital admission within 1 year, or perinatal death). Adverse outcomes associated with smoking tobacco cigarettes were included on the basis that they might also be associated with e-cigarette use (1,2,4,6–8,28).

Statistical Analysis

Demographic, lifestyle, and pregnancy characteristics, together with maternal and infant outcomes, are reported descriptively and stratified by smoking status. Adverse maternal and infant outcomes are grouped as composite dichotomous variables, with their presence operationalized as having at least one adverse outcome. For adverse maternal outcomes, we considered hypertensive disorders of pregnancy, gestational diabetes, and/or postpartum haemorrhage, whereas for adverse infant outcomes, we considered preterm birth, small for gestational age (SGA), hospital admission, and/or stillbirth. Missing data on items of the questionnaire was reported; women were not excluded from the missing values. Statistical differences in the characteristics and outcomes were calculated by smoking status using chi-square or Fisher (Freeman–Halton) exact tests, as appropriate. The Monte Carlo test was used if the Fisher exact test could not be calculated. A p -value of ≤ 0.05 was defined as statistically significant, and all analyses were performed with IBM SPSS Version 25.0 (IBM Corp., Armonk, NY, USA).

Results

Participants and descriptive data

In total, 2041 women completed the questionnaire, from which we excluded 81 for not meeting the eligibility criteria (Figure 1). We also excluded 23 who completed the online questionnaire more than once, which probably occurred due to technical problems (e.g., failure to load the next page or internet connectivity issues). Missing values on items of the questionnaire ranged from 0% (items about maternal age and migration back-ground) to 58.1% (item about hospital admission in the first year of an infant's life).

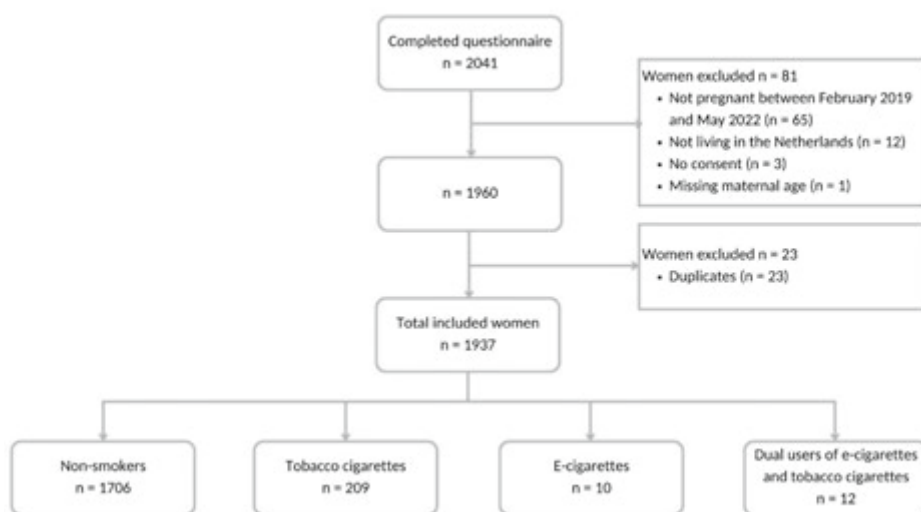


Figure 1. Flowchart of the included population.

Thus, 1937 women (mean age, 30.5 ± 4.1 years; range, 17–44 years) were included in the study, of whom 88.1% did not smoke ($n = 1706$), 10.8% used tobacco cigarettes ($n = 209$), 0.5% used e-cigarettes ($n = 10$), and 0.6% were dual users ($n = 12$). In total, 13.1% of non-smokers had quit smoking in the year before their pregnancy. Women who smoked tobacco cigarettes or were dual users had smoked for more than 3 years before their current pregnancies, 85.7% and 58.3% respectively. Of the e-cigarette users, 40.0% had used the device for more than 3 years before their pregnancy. Table 1 summarizes the demographic and lifestyle characteristics by smoking status. Of note, most women were considered Western (99.0%) and had a partner (97.7%).

Table 1. Demographic and lifestyle characteristics by smoking status (N = 1937).

	Maternal Smoking Status					<i>p</i> *
	Total Population	Non-Smokers	Cigarette Users			
			Tobacco	e-cig	Both	
N (%)	N (%)	N (%)	N (%)	N (%)		
	1937 (100%)	1706 (88.1%)	209 (10.8%)	10 (0.5%)	12 (0.6%)	
Maternal age						≤0.001
17–30 years	998 (51.5)	857 (50.2)	128 (61.2)	2 (20)	11 (91.7)	
31–35 years	728 (37.6)	663 (38.9)	60 (28.7)	4 (40)	1 (8.3)	
36–40 years	180 (9.3)	156 (9.1)	20 (9.6)	4 (40)	-	
≥40 years	31 (1.6)	30 (1.8)	1 (0.5)	-	-	
Migration background ^a						
Western	1918 (99.0)	1688 (98.9)	208 (99.5)	10 (100)	12 (100.0)	0.77
Non-Western	19 (1.0)	18 (1.1)	1 (0.5)	-	-	
Education level ^b						≤0.001
Low	129 (6.7)	94 (5.5)	32 (15.3)	-	3 (25.0)	
Middle	845 (43.6)	709 (41.6)	124 (59.3)	6 (60)	6 (50.0)	
High	941 (48.6)	892 (52.3)	42 (20.1)	4 (40)	3 (25.0)	
Missing	22 (1.1)	11 (0.6)	11 (5.3)	-	-	
Marital status						≤0.001
Partner	1893 (97.7)	1677 (98.3)	198 (94.7)	10 (100)	8 (66.7)	
Single ^c	44 (2.3)	29 (1.7)	11 (5.3)	-	4 (33.3)	
Second-hand smoke						≤0.001
Not exposed	262 (13.5)	261 (15.3)	-	1 (10)	-	
Exposed	588 (30.4)	485 (28.4)	90 (43.1)	7 (70)	6 (50.0)	
Missing	1089 (56.1)	960 (56.3)	119 (56.9)	2 (20)	6 (50.0)	
Smoked throughout pregnancy						≤0.001
Not smoked	1706 (88.1)	1706 (100.0)	NA ^d	NA	NA	
Part of pregnancy	110 (5.7)	NA	100 (47.8)	5 (50)	5 (41.7)	
Full pregnancy	121 (6.2)	NA	109 (52.2)	5 (50)	7 (58.3)	

Table 1. Demographic and lifestyle characteristics by smoking status (N = 1937). (continued)

	Maternal Smoking Status					p *
	Total Population	Non-Smokers	Cigarette Users			
			Tobacco	e-cig	Both	
N (%)	N (%)	N (%)	N (%)	N (%)		
	1937 (100%)	1706 (88.1%)	209 (10.8%)	10 (0.5%)	12 (0.6%)	
BMI start pregnancy						0.50
Not obese	980 (50.6)	859 (50.4)	107 (51.2)	7 (70)	7 (58.3)	
Obese	844 (43.6)	752 (44.1)	84 (40.2)	3 (30)	5 (41.7)	
Missing	113 (5.8)	95 (5.6)	18 (8.6)	-	-	

* Statistical differences among the four smoking statuses. *p*-value in bold if less than alpha 0.05.

^a Western background = birth in Austria, Belgium, Canada, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Hungary, Iceland, Ireland, Italy, Latvia, Lichtenstein, Lithuania, Luxembourg, Malta, Monaco, Norway, Poland, Portugal, San Marino, Slovakia, Slovenia, Spain, Sweden, The Netherlands, United Kingdom, United States, or Vatican City(29).

^b Education level = low (none or primary school), middle (secondary school), high (higher education).

^c Single = divorced, widowed, single, or not married (not cohabiting).

^d NA = not applicable e.g., non-smokers have not smoked for any part of their pregnancy.

E-Cigarette Users

Women who used e-cigarettes were older (typical age ≥ 31 years) than women in the other three subgroups (typical age < 31 years). They also had higher education levels than tobacco users, whereas dual users had similar education levels to the tobacco users (Table 1). All e-cigarette users had a partner, while tobacco users and dual users were more often single. Compared with non-smokers, we found that smokers (tobacco, e-cigarette, and dual users) more often had exposure to second-hand smoking. The nicotine dose in the e-cigarettes also varied between e-cigarette and dual users. Among the ten e-cigarette users, three used variants containing no nicotine (30.0%) and seven used variants containing a low dose (70.0%), while among the twelve dual users, three used no nicotine (25.0%), six used a low dose (50.0%), and three used a high dose (25.0%).

Maternal and Infant Characteristics and Outcomes

Tables 2 and 3 summarize the characteristics and outcomes of mothers and infants by maternal smoking status. The e-cigarette and dual users were more often primiparous compared with the other subgroups. Women who used e-cigarettes during pregnancy had a much higher proportion of miscarriages before 20 weeks of gestation (30%) compared with either non-smokers (4.1%) or tobacco cigarette

smokers (5.7%). Furthermore, compared with non-smokers, women who smoked (tobacco, e-cigarettes, and dual users) more often gave birth to SGA infants.

Table 2. Maternal characteristics and outcomes by smoking status.

	Maternal Smoking Status					<i>p</i> *
	Total Population	Non-Smokers	Cigarette Users			
			Tobacco	e-cig	Both	
N (%)	N (%)	N (%)	N (%)	N (%)		
	1937 (100%)	1706 (88.1%)	209 (10.8%)	10 (0.5%)	12 (0.6%)	
CHARACTERISTICS						
Conception						0.15
Spontaneous	1774 (91.6)	1555 (91.1)	198 (94.7)	9 (90)	12 (100.0)	
Artificial reproductive treatment ^a	160 (8.3)	149 (8.7)	10 (4.8)	1 (10)	-	
Missing	3 (0.2)	2 (0.1)	1 (0.5)	-	-	
Parity						0.01
Primipara	870 (44.9)	761 (44.6)	92 (44.0)	7 (70)	10 (83.3)	
Multipara	1017 (52.5)	906 (53.1)	107 (51.2)	2 (20)	2 (16.7)	
Missing	50 (2.6)	39 (2.3)	10 (4.8)	1 (10)	-	
Mode of birth						0.27
Spontaneous vaginal birth	1458 (75.3)	1291 (75.7)	154 (73.7)	3 (30)	10 (83.3)	
Assisted vaginal birth	130 (6.7)	116 (6.8)	12 (5.7)	1 (10)	1 (8.3)	
Caesarean section	257 (13.3)	224 (13.1)	29 (13.9)	3 (30)	1 (8.3)	
Missing	92 (4.7)	75 (4.4)	14 (6.7)	3 (30)	-	
ADVERSE OUTCOMES						
Hypertensive disorders						0.71
No	1748 (90.2)	1540 (90.3)	189 (90.4)	9 (90)	10 (83.3)	
Yes	189 (9.8)	166 (9.7)	20 (9.6)	1 (10)	2 (16.7)	
Gestational diabetes						0.15
No	1821 (94.0)	1608 (94.3)	193 (92.3)	8 (80)	12 (100.0)	
Yes	116 (6.0)	98 (5.7)	16 (7.7)	2 (20)	-	

Table 2. Maternal characteristics and outcomes by smoking status. (continued)

	Maternal Smoking Status					<i>p</i> *
	Total Population	Non-Smokers	Cigarette Users			
			Tobacco	e-cig	Both	
N (%)	N (%)	N (%)	N (%)	N (%)		
	1937 (100%)	1706 (88.1%)	209 (10.8%)	10 (0.5%)	12 (0.6%)	
Postpartum haemorrhage						0.18
No	1803 (93.1)	1585 (92.9)	199 (95.2)	9 (90)	10 (83.3)	
Yes	134 (6.9)	121 (7.1)	10 (4.8)	1 (1)	2 (16.7)	
Composite adverse maternal outcome^b						0.27
No	1533 (79.1)	1351 (79.2)	168 (80.4)	6 (60)	8 (66.7)	
Yes	404 (20.9)	355 (20.8)	41 (19.6)	4 (40)	4 (33.3)	
Miscarriage						0.01
No	1852 (95.6)	1636 (95.9)	197 (94.3)	7 (70)	12 (100.0)	
Yes	85 (4.4)	70 (4.1)	12 (5.7)	3 (30)	-	

* Statistical differences among the four smoking statuses; *p*-value in bold if less than alpha 0.05.

^a Artificial reproductive treatment: conception through in-vitro fertilization, intracytoplasmic sperm injection, intra-uterine insemination, or donor.

^b Maternal adverse outcome: hypertensive disorder, gestational diabetes, or postpartum haemorrhage; or any combination of the three.

Table 3. Infant characteristics and outcomes by smoking status.

	Total Population	Maternal Smoking Status			<i>p</i> *	
		Non-Smokers	Cigarette Users			
			Tobacco	E-cig		Both
N (%)	N (%)	N (%)	N (%)	N (%)		
	1937 (100%)	1706 (88.1%)	209 (10.8%)	10 (0.5%)	12 (0.6%)	
CHARACTERISTICS						
Sex						0.88
Female	917 (47.3)	809 (47.4)	100 (47.8)	3 (30)	5 (41.7)	
Male	929 (48.0)	823 (48.2)	95 (45.5)	4 (40)	7 (58.3)	
Missing	91 (4.7)	74 (4.3)	14 (6.7)	3 (30)	-	

Table 3. Infant characteristics and outcomes by smoking status. (continued)

	Total Population N (%)	Maternal Smoking Status			<i>p</i> [*]
		Non-Smokers Tobacco N (%)	Cigarette Users E-cig N (%)	Both N (%)	
	1937 (100%)	1706 (88.1%)	209 (10.8%)	10 (0.5%)	12 (0.6%)
Gestational age					0.75
Preterm birth (<37 weeks)	86 (4.4)	76 (4.5)	9 (4.3)	-	1 (8.3)
Term/post-term birth (≥37 weeks)	1761 (90.9)	1557 (91.3)	186 (89.0)	7 (70)	11 (91.7)
Missing	90 (4.6)	73 (4.3)	14 (6.7)	3 (30)	
ADVERSE OUTCOMES					
Size gestational age^a					0.02
Small for gestational age	95 (4.9)	77 (4.5)	15 (7.2)	2 (20)	1 (8.3)
Missing	117 (6.0)	97 (5.7)	17 (8.1)	3 (30)	-
Hospital admission first life year					0.43
No	687 (35.5)	604 (35.4)	73 (34.9)	4 (40)	6 (50.0)
Yes	121 (6.2)	108 (6.3)	11 (5.3)	2 (20)	-
Missing	1129 (58.3)	994 (58.3)	125 (59.8)	4 (40)	6 (50.0)
Composite adverse infant outcome^b					0.11
No	1649 (85.1)	1464 (85.8)	170 (81.3)	5 (50)	10 (83.3)
Yes	173 (8.9)	147 (8.6)	22 (10.5)	2 (20)	2 (16.7)
Missing	115 (6.0)	95 (5.6)	17 (8.1)	3 (30)	-

* Statistical differences among the four smoking statuses; *p*-value in bold if less than alpha 0.05.

^a Size at gestational age, as reported by women and defined as “the baby was too small for the gestational age.”

^b Infant adverse outcome: preterm birth, small for gestational age, hospital admission, or stillbirth; or any combination of the three.

Discussion

This study describes the characteristics of Dutch women who used e-cigarettes in pregnancy compared with non-smokers, tobacco cigarette users, and dual users. In our sample, women who used e-cigarettes were older than non-smokers and tobacco users and had more often completed higher education than tobacco users. Compared with the other groups, e-cigarette users were also more likely to have a partner and to have been exposed to second-hand smoke. Moreover, they were more likely to be primiparous, have a pregnancy that ended in a miscarriage, and give birth to SGA infants.

The findings that e-cigarette users were older and had higher education levels compared with tobacco cigarette users, dual users, or non-smokers may reflect the age at which different women have their first infant. E-cigarette users were more often primiparous, possibly reflecting their education levels or age, with higher-educated women tending to be older first-time mothers (30). A study among young adults in New York City reported that adolescents with higher education levels were more likely to smoke e-cigarettes (31). By contrast, a study in the UK showed that women with lower education used e-cigarettes more often (26). The difference in findings could be due to contrasting policies around e-cigarette use during pregnancy in the UK and the Netherlands. In the UK, e-cigarette use is preferred to tobacco cigarette use in pregnancy, whereas both practices are discouraged in the Netherlands (27,32). Interestingly, e-cigarette users were also more often primiparous in our sample. A Norwegian study reported that women who smoked tobacco cigarettes during their first pregnancy had more often quit smoking before their second pregnancy, leading to a lower prevalence of smoking among multiparous women (33). This might apply to e-cigarette users too, potentially explaining our finding of relatively more primiparous than multiparous e-cigarette users. We also found that all e-cigarette users in our study had a partner. Studies of tobacco use have shown higher levels among single women, consistent with the high number of single and dual tobacco users in this research (33,34).

When looking at pregnancy outcomes, the pregnancies of women who used e-cigarettes ended more often in a miscarriage compared with the other groups. This result has not been reported in the literature and may represent an incidental finding due to the low number of e-cigarette users. However, tobacco cigarette use during pregnancy has been associated with miscarriage, and our findings indicate that this might also apply to e-cigarette users (35). However, we are aware that the subgroup of e-cigarette users is small; therefore, no firm conclusions can be drawn.

Furthermore, women in all three smoking groups had higher proportions of SGA infants than non-smokers, consistent with existing literature (24,36). When

investigating the effect of e-cigarette use on birth weight, Cardenas et al. found that users had a higher chance of having an SGA newborn (24). Our study adds that the characteristics of e-cigarette and dual users (i.e., typically older and primiparous) may account for this association. Further research on the association between e-cigarettes and pregnancy outcomes should account for these characteristics. Finally, the composite adverse maternal outcomes and composite adverse neonatal outcomes showed no statistical differences between the women based on their smoking status. This is not consistent with research on tobacco smoking and adverse pregnancy outcomes (1–4,6–8). One explanation for this could be the woman's previous smoking. Research has shown that smoking during pregnancy is associated with gestational hypertension (37). Because 13.1% of non-smokers smoked in the year preceding their pregnancy, this, along with other factors such as age and parity, may have confounded the effect of current smoking on maternal and infant outcomes. As policy support, future research with a larger sample size should look into the effect of e-cigarette and tobacco use on pregnancy outcomes.

Strengths and limitations

To our knowledge, this is one of the first studies to describe the characteristics of women based on their smoking status, including e-cigarette users. To prevent recall bias, we recruited women who had been pregnant for a maximum of 1 year before completing the questionnaire.

An important characteristic that was included in this study is previous smoking behaviour, as the effects of previous smoking can have a lasting effect on pregnancies, even after smoking cessation (37). A limitation of the study is that we did not inquire about information on cessation support for the non-smokers, either with or without nicotine replacement therapy. Among the various limitations of this work, the mostly online recruitment could have introduced selection bias, favoring responses from women interested in participation (38). To reduce this bias, we also recruited women through parent-child centers, which most Dutch infants and their parents attend in the first 4 years after birth (39). However, despite the varied recruitment strategies, we only included a relatively small group of e-cigarette users. In our study, 0.5% of women used an e-cigarette during pregnancy, which increased to 1.1% when including dual users. Given that previous data in the Netherlands indicated that only 0.4% of pregnant women reportedly used substances like hookah, nitrous oxide, and/or e-cigarettes, this could represent either selection bias or a true growth in e-cigarette use (17). Large differences between sample and population can arise by chance in small samples, which most statistical tests will not capture. The low power of the study precluded the use of multivariate analyses. Therefore, more extensive research into e-cigarettes and their associations with pregnancy outcomes is warranted, with, for example, data from biological samples (e.g., urinary cotinine to indicate nicotine exposure) or nationwide cohort data from

medical records (40). Currently, data from Dutch maternity care records is collected in the Perined database (41). Though the Perined database is very valuable for research, data on the detailed smoking status of pregnant women is not available in this database yet.

Conclusions

Women who used e-cigarettes during pregnancy were on average older, had higher education levels, were more often primiparous, and more often had miscarriages and SGA infants compared with non-smokers, tobacco cigarette smokers, and dual users. These findings, coupled with the existing literature linking tobacco cigarettes to adverse pregnancy outcomes, should pave the way for more extensive research into e-cigarettes and their effects on pregnancy outcomes. This could be facilitated by midwives and obstetricians improving the data they record on smoking status in electronic health registries. Until more is known, Dutch practitioners should continue to follow existing guidelines and not recommend e-cigarette use during pregnancy (27).

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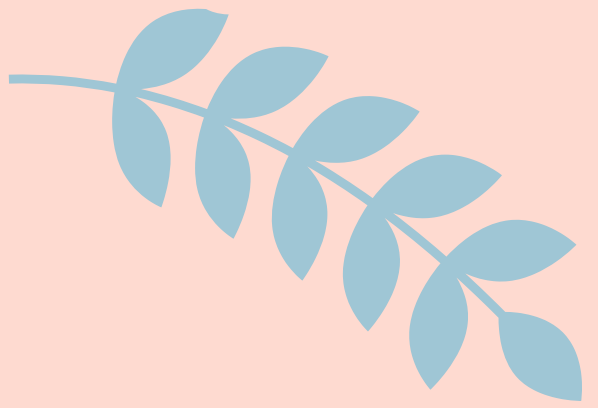
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Chapter 6

How to improve smoking cessation support for pregnant women? Development and evaluation of plans for guideline implementation in the north of the Netherlands

Stella Weiland MSc, Danielle E.M.C. Jansen PhD, Gera A. Welker PhD, Marjolein Y. Berger MD PhD, Jan Jaap H.M. Erwich MD PhD, Lilian L. Peters PhD

Abstract

Background

The aim of this study was to develop and evaluate plans for the implementation of the Dutch guideline “Treatment of tobacco addiction and smoking cessation support for pregnant women”.

Methods

Participatory action research was used as research design for the development and evaluation of implementation plans for seven maternity collaboration units in the north of the Netherlands. Mixed-methods were used to evaluate the implementation by using the Reach, Effectiveness, Adoption, Implementation and Maintenance (RE-AIM) framework.

Results

The maternity collaboration units implemented the intervention to refer smoking pregnant women to a counsellor from addiction care. Twenty-one of the 50 midwifery care practices (42%) and two of the five obstetrics departments (40%) referred women to addiction care. The results showed that of the 558 women who smoked during pregnancy in 2021, 73 women were referred to addiction care, 58 started a coaching trajectory and 12 women stopped smoking. The results of interviews and focus groups gave insight into the challenges for referral and indicated that the communication between the midwife/counsellor and the pregnant woman is important for smoking cessation counselling.

Conclusions

A minority of maternal care professionals referred women to a counsellor from addiction care and a small percentage of women managed to stop smoking. Opportunities in the repetition of implementation strategies and increasing skills in motivational interviewing for maternity care professionals could improve adoption of interventions in future implementation. To increase the effectiveness of the intervention, the counsellors could consider combining their counselling with nicotine replacement therapy, feedback or incentives.

Keywords

Implementation study, smoking cessation, participatory action research, mixed-methods

Background

In the Netherlands, 8% of women smoke at some point during pregnancy (1). Smoking during pregnancy is an important preventable risk factor for complications; women who stop smoking during pregnancy decrease their risk for adverse outcomes such as miscarriage, a low birthweight baby, and stillbirth (2). Smoking cessation support can increase the proportion of women who quit smoking during pregnancy (3, 4). The Dutch guideline "Treatment of tobacco addiction and smoking cessation support for pregnant women" from the Trimbos-Institute includes specific recommendations for Maternity Care Professionals (MCP's, e.g. midwives and obstetricians) on how to support pregnant women with smoking cessation (Figure 1) (5).

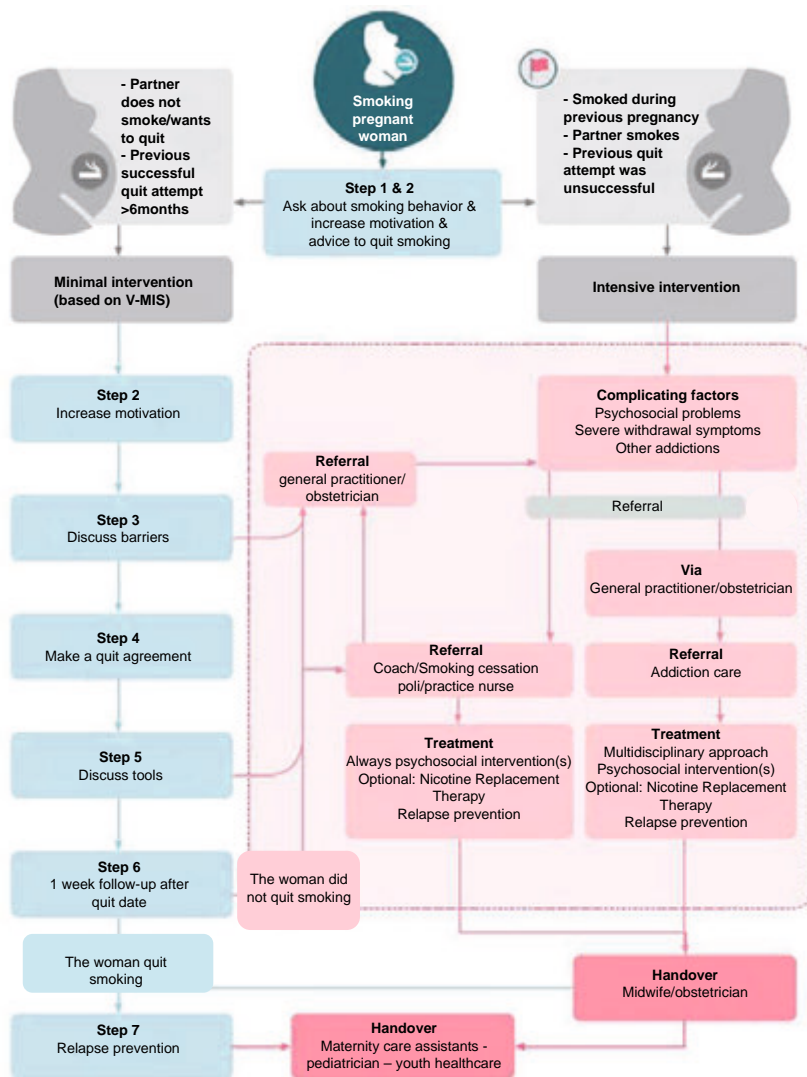
One of the main recommendations of the guideline is to provide behavioral counselling via the Minimal Intervention Strategy for Midwives (V-MIS). The V-MIS consists of seven steps to support pregnant women and their partners with smoking cessation, ranging from discussing smoking behavior to increasing motivation for relapse prevention (5). Women can also be referred to a trained nurse practitioner working in general practice or to a smoking cessation counsellor, such as a counsellor from addiction care, for behavioral counselling (5). The guideline also describes the use of nicotine replacement therapy, e-health and the electronic-cigarette (5).

Two studies from 2019 investigated the degree of implementation of this guideline in the north of the Netherlands (6, 7). The results of these studies indicated that 21% - 45% of the intended users (MCP's) of the guideline were not familiar with the guideline, 33% - 37% were familiar with the guideline but did not use it, and only 22% - 31% used the guideline (6, 7). A few studies evaluated specifically the implementation of the V-MIS and reported a poor implementation in daily midwifery care (8, 9). Other parts of the guideline, such as referral to a trained nurse practitioner and a smoking cessation counsellor, have not been evaluated. Until now, smoking cessation counselling provided by a counsellor from addiction care was not implemented in the north of the Netherlands.

Because of the effectiveness of smoking cessation support, optimal implementation of the guideline in daily practice is essential (3, 4). Improved adherence to the guideline can advance the provision of smoking cessation support by MCP's and ultimately decrease smoking during pregnancy. From implementation research, we know that implementation success is influenced by tailoring the implementation to the barriers and facilitators of the target groups (10). Therefore, we hypothesized that plans for implementing the guideline were needed in the Maternity Collaboration Units (MCU) located in the three northern Dutch provinces of Groningen, Friesland and Drenthe. In an MCU, maternity care professionals collaborate in a region, often centered around a hospital. We focused on the north of the Netherlands because

relatively many pregnant women smoke in this region, compared to other parts of the Netherlands (11, 12). This is related to the relatively low socioeconomic status (SES) of residents in the north (11, 12).

The aim of this study was to develop and to evaluate plans for the implementation of the guideline regarding smoking cessation support of pregnant women in the north of the Netherlands. The implementation was evaluated by using the Reach, Effectiveness, Adoption, Implementation and Maintenance (RE-AIM) framework (13).



Figuur 1. Graphical representation of the guideline, adapted and translated to English, from the Trimbos-Institute (5).

Methods

Setting and study population

In this study we focus on seven MCU's in the northern Provinces of Groningen (MCU Martini, MCU Ommelander), Friesland (MCU Sneek, MCU Rondon Zwangerschap, MCU Middenin) and Drenthe (MCU Assen and MCU Stadskanaal-Hoogeveen-Emmen). Two MCP's (midwives and/or obstetricians) per MCU, who were in charge of the smoking cessation policy within the respective MCU, were recruited to participate in the study. By granting consent to participate in the study, they acted as representatives for their MCU and were the point of contact for the researchers and the other MCP's of the MCU. The representatives received an annual fee of €250 to participate in the study.

Women who smoked during pregnancy formed the target population and were recruited by MCP's of the MCU's. Pregnant women were informed about the study in person by the MCP's and via an information letter. Women signed an informed consent form for their participation in the study.

Study design

This study used Participatory Action Research (PAR) as a research design. PAR is a research methodology in which researchers and stakeholders closely collaborate to achieve change (14). PAR increases the likelihood of the success of implementation of an intervention (15, 16). To tailor the implementation strategies to the specific contexts of each MCU, the barriers, facilitators and needs were discussed for each MCU and implementation plans were developed in collaboration with several stakeholders: two midwives and/or obstetricians per MCU, physicians and counsellors from addiction care, an implementation expert, pregnant women, and two experts by experience in poverty and social exclusion (17). The experts by experience represented the voices and preferences of women with a low socioeconomic status for each MCU.

Our first step in developing and evaluating plans for smoking cessation support involved conducting interviews to gain insight into women's and their partners' experiences and needs with smoking cessation support in the north of the Netherlands (14). The methods and results of the interviews were described in a previous paper (18). Additionally, we conducted three focus groups with MCP's in the provinces Groningen (n=7), Friesland (n=7) and Drenthe (n=6) to investigate their experienced barriers, facilitators and needs with providing smoking cessation support according to the guideline (19). The focus groups were moderated by an independent researcher from "Zorgbelang" Groningen, an organization which represents the voices of people who make use of healthcare.

The second step was discussing for each MCU which form of cessation support (intervention) would fit best for the barriers and facilitators and needs of each MCU. After the intervention per MCU was determined, tailored implementation strategies were chosen per MCU based on the barriers, facilitators and needs that were found during the interviews and focus groups (10, 17). Then, the intervention and implementation strategies were written down in an implementation plan per MCU to guide the implementation for each MCU. Execution of the implementation plan took place in 2020 and 2021.

The third step was evaluating the actual implementation using the Reach, Effectiveness, Adoption, Implementation and Maintenance (RE-AIM) framework (13). The SQUIRE 2.0 checklist was used to report this study (20).

Data collection for the evaluation of the implementation

We used quantitative and qualitative data to evaluate the implementation according to the RE-AIM framework (Table 1) (13). We used mixed methods because they provide the opportunity to understand the results of the implementation in a specific context (21). In this study we did not take maintenance into account because data on long-term outcomes were not available during the study period. All data collection was done during or after the implementation.

Table 1. Outcome measures and methods for the evaluation of the implementation based on the RE-AIM framework (13).

RE-AIM framework	Operationalization outcome measures	Method
Reach <i>The number of people who are willing to participate in an intervention</i>	1) Total women who received maternal care 2) Total women who smoked during pregnancy 3) Total women who participated during the implementation in 2021	- The registry data of electronic patient files of 2021 - Data from the logbooks
Effectiveness <i>The impact of an intervention</i>	The impact of the implementation on the smoking behaviour of pregnant women: continued smoking, reduced number of cigarettes or stopped smoking during pregnancy	Data from the logbooks
Adoption <i>The number of people who are willing to initiate an intervention</i>	The number of midwifery care practices and departments obstetrics in the hospital of each MCU that participated in the implementation	Data from the logbooks

Table 1. Outcome measures and methods for the evaluation of the implementation based on the RE-AIM framework (13). (continued)

RE-AIM framework	Operationalization outcome measures	Method
Implementation <i>People's fidelity to the elements of an intervention and adaptations to the intervention and strategies</i>	1) The execution of the implementation strategies as intended 2) The implementation degree of the guideline among MCP's 3) Implementation of the guideline as perceived by pregnant women 4) Experiences of pregnant women and MCP's during the implementation	- Two online questionnaires - Data from the logbooks - Results of the interviews - Results of the focus groups

First, with registry data of electronic patient files from MCP's we aimed to gain insight into the reach of the implementation, the prevalence of women who smoked during pregnancy. The data consisted of numbers of the total women receiving care and the number of women who smoked during pregnancy in 2021. These data were supplied by primary midwifery care practices and departments of obstetrics and gynecology of hospitals of the MCU's that participated in the implementation.

Second, to evaluate the implementation of the guideline among MCP's we used the data from the online survey "Monitor Smokefree start" initiated by the Trimbos-Institute in 2021. We analysed the item "Are you familiar with the Trimbos-Institute guideline?" with the answer options 'no', 'yes but I don't work with it (yet)' and 'yes and I work with it' (7). The online survey was distributed by the researchers and the Trimbos-Institute among the MCP's of the northern MCU's in January 2021. The MCP's that were in charge of the smoking policy of an MCU were invited to participate in the survey and were asked to distribute the survey among their colleagues.

Third, we investigated the implementation of the guideline as received by pregnant women who smoke with another online survey. We opted for a survey because we aimed to reach as many smoking pregnant women as possible. We recruited women who had been pregnant and smoked before or during pregnancy in the period 2019 until 2022 via Facebook pages targeted at pregnant women and mothers in the north of the Netherlands. The survey was pilot tested among four pregnant women, two experts by experience in poverty and social exclusion and two students from the midwifery academy Groningen. Based on the pilot, some questions were reformulated to enhance clarity of the questions. The online survey focused on women who smoked during pregnancy and consisted of items about women's smoking

behavior, the information they received about smoking cessation care from the midwife and/or obstetrician and if they made use of smoking cessation support.

Fourth, to investigate the reach, adoption, implementation and effectiveness of the implementation, the MCP's involved in the implementation (midwives, obstetricians and counsellors) and the researcher (SW) kept logbooks. The logbooks contained information about the number of women who participated in the intervention, the effect of the intervention on women's smoking behavior, the adoption of the intervention by the MCU's and the execution of the implementation strategies as planned.

The qualitative data collection was aimed at gaining insight into the experiences of included women and MCP's during the implementation. Semi-structured interviews were conducted with women who smoked during pregnancy (n=21). The interviews were performed from March 2020 until March 2022 and lasted on average 22 minutes. Semi-structured interviews were also conducted with MCP's (n=9) and were focused on their experiences during the implementation. These interviews were performed in the period March 2020 till January 2022, the interviews lasted between 14 and 64 minutes.

In addition, three focus groups were performed with the MCP's per MCU that were in charge of the smoking cessation policy within the respective MCU in Groningen (n=5), Friesland (n=6) and Drenthe (n=5) in November 2021. The aim of the focus groups was to evaluate their experiences during the implementation. An independent researcher from the foundation "Zorgbelang" Groningen moderated the focus groups. The focus groups each lasted 90 minutes.

Analysis

Descriptive statistics (number and proportions) were used to report all quantitative outcomes according to the RE-AIM Framework (13) in SPSS version 26.0 (SPSS Inc., Chicago, IL, USA).

The interviews and focus groups were audio recorded with permission of the participants and transcribed verbatim. For both the interviews and focus groups, two researchers (SW and WB) independently coded the qualitative data in Atlas.ti 8.4 based on the six steps of the thematic analysis of Braun and Clark (22). First, SW and WB read all transcripts multiple times to familiarize with the data. Subsequently, SW and WB independently coded each transcript and generated initial codes. Then, SW and WB discussed their coding decisions with the aim to identify potential themes in the data. Some codes were clustered and other codes were split to form categories, themes and sub-themes.

Results

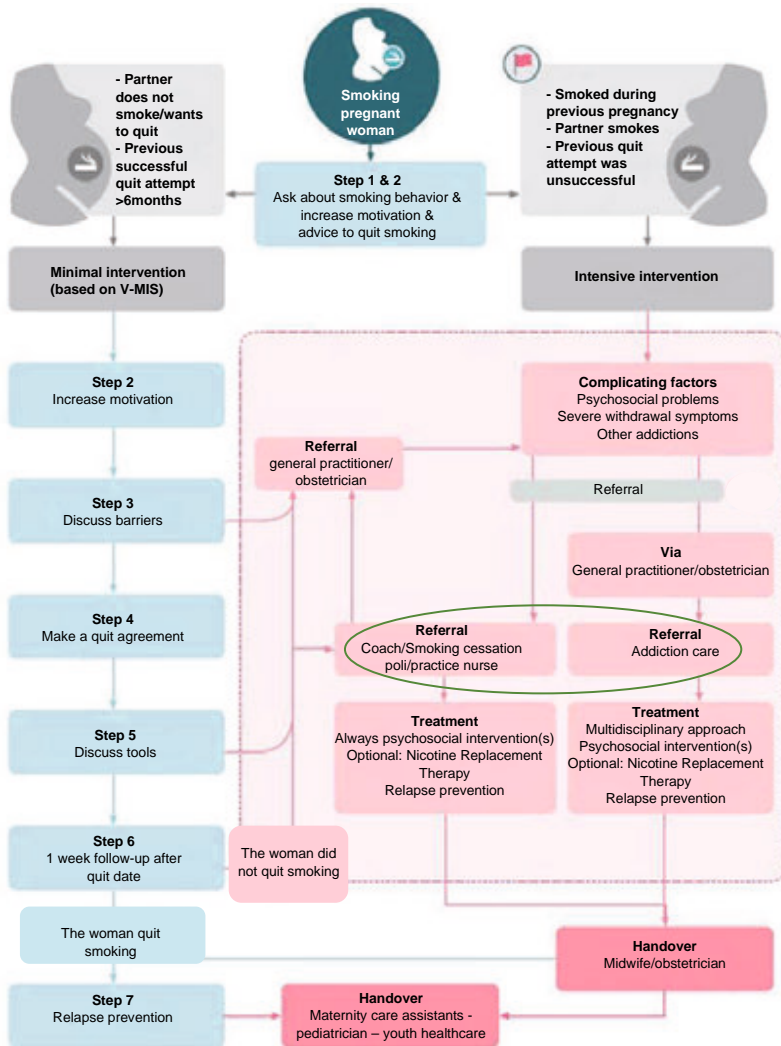
First step: experienced barriers, facilitators and the needs of MCP's regarding smoking cessation support

The results of the interviews with women and their partners are reported in a previous paper (18).

The independent researcher from "Zorgbelang" Groningen wrote a report about the results of the focus groups (19). The results indicated that MCP's experience a lack of referral options and a lack of knowledge about referral options, a lack of skills in motivational interviewing, a lack of time for midwives during their consultation to provide smoking cessation support, and a lack of collaboration in the smoking cessation support of pregnant women as main barriers. Having a maternal care professional who was responsible for the smoking cessation policy within the respective MCU was identified as main facilitator (19). The results of the focus groups indicated that MCP's from the seven MCU's needed clarity about who is responsible for smoking cessation support, a referral option with expertise in providing smoking cessation support, a clear referral process and collaboration between MCP's in the provision of support (19).

Second step: selection of intervention and implementation strategies

The smoking cessation intervention that was chosen by the seven MCU's Assen, Sneek, Stadskanaal-Hoogeveen-Emmen, Martini, Middenin, Rondon Zwangerschap and Ommelander was the option to refer women to a counsellor from addiction care, which is part of the guideline (Figure 2) (5).



○ The intervention of the MCU's Assen, Sneek, Middenin, Rondon Zwangerschap and Ommelander consists of implementing the option to refer women to a counselor from addiction care

Figure 2. The focus of the intervention, adapted and translated to English, from the Trim-bos-Institute (5).

This intervention was tailored to the needs addressed by the seven MCU's for a clear referral option to someone who is responsible for smoking cessation support and who has expertise in support provision. This particular intervention, described in the guideline, was not implemented yet. Multiple implementation strategies (Table 2) were used to enhance the implementation, tailored to the barriers, facilitators and needs of each MCU. Strategies that focused on engaging the MCU's in the implementation of the intervention and increasing MCP's knowledge about the intervention and the procedure for referral were similar for all seven MCU's. First, to inform MCP's about the intervention, the midwives and obstetricians of all seven MCU's were informed about the implementation of the referral option in person, via e-mail and/or by telephone. Second, MCP's from all seven MCU's received an information leaflet about the procedure to be followed when referring to counsellors from addiction care. This procedure meant that MCP's, with the woman's approval, sent the woman's e-mail address and phone number to the counsellor from addiction care, who subsequently reached out to the woman. The counsellor contacted the woman and together they made a tailored smoking cessation plan, which involved setting a goal (i.e. a stop date, reducing the amount of cigarettes) and determining the mode and frequency of contact (telephone, Whatsapp or in person).

Third, in addition to previous described implementation strategies, some MCU's required additional strategies, specifically tailored to the MCU's barriers and facilitators. The MCU Rondon Zwangerschap received a flowchart with all referral options as described in the guideline "Treatment of tobacco addiction and smoking cessation support for pregnant women" from the Trimbos-Institute (5). This implementation strategy addressed their experienced barrier about a lack of knowledge of referral options as described in the guideline. MCP's of the MCU Assen experienced a lack of skills in motivational interviewing as barrier to refer women for smoking cessation support. Therefore, they received training in motivational interviewing by following two e-learnings 'Smokefree Start' and 'Comprehensible Communication' and subsequently the on-site training 'Smokefree Start' from the Trimbos-Institute.

Table 2. Implementation strategies used for the implementation of referral to a counsellor from addiction care.

MCU's	Barriers, facilitators and needs	Implementation strategies
All seven MCU's	Having a MCP who is in charge of the smoking cessation policy for the MCU	Having two MCP's per MCU who acted as representatives for the MCU and were paid an annual fee for their participation in the development and implementation of the implementation plan
	A lack of knowledge about who is responsible for providing smoking cessation support	Providing information about referral to a counsellor of addiction care during an MCU meeting in person Personal introduction of the counsellor of addiction care in an MCU meeting
	A lack of time during the consultation to provide smoking cessation support	Distributing a flyer with information about the counsellor of addiction care via e-mail
	A lack of knowledge about how to refer women	Providing information about the referral process to a counsellor of addiction care via e-mail and by telephone Distributing a flyer with example sentences to use for referral to a counsellor of addiction care Interim visits of the researchers to an MCU meeting to provide information about the progress of referrals to the counsellor
MCU Assen	A lack of skills in motivational interviewing	Providing the e-learnings 'Smokefree Start' and 'Comprehensible Communication' and the on-site training 'Smokefree Start' to maternal care professionals
MCU Rondon Zwangerschap	A lack of knowledge about referral options as described in the guideline	Developing a flowchart with referral options and distributing the printed flowchart with referral options among maternal care professionals

Third step: evaluation of the implementation using the RE-AIM Framework

Reach

Of the 8890 pregnant women who received care in the seven MCU's in 2021, 558 women (6.3%) smoked during pregnancy and 343 women (3.9%) stopped smoking prior to pregnancy or when discovering their pregnancy. Seventy three of the 558 smoking pregnant women (13.1%) were referred by the midwife or gynecologist for smoking cessation support from a counsellor from addiction care in 2021. Of these women, 58 (79.5%) women started a coaching trajectory, and 15 (20.5%) did not reply to the contact attempts of the counsellors or indicated that they preferred to stop smoking without expert support. From the 58 women who started a coaching trajectory, 48 women finished the coaching trajectory (82.8%).

Effectiveness

Of the 48 women who finished the coaching trajectory, 12 women (25%) stopped smoking during pregnancy, 21 women (43.8%) reduced the number of cigarettes smoked and three women (6.3%) did not change their smoking behaviour. The remaining 12 women were lost to follow up.

Adoption

In total 66 midwifery care practices and seven obstetrics departments collaborate in seven MCU's in the north of the Netherlands. Of those, 50 midwifery care practices (75.8%) and five obstetrics departments (71.4%) indicated willingness to refer smoking pregnant women to a counsellor from addiction care. In total 21 of the willing 50 midwifery care practices (42%) and two of the five willing obstetrics departments (40%) actually referred women to a counsellor from addiction care (Table 3). From the MCU Assen, nine midwives and obstetricians followed the training 'Smokefree Start'.

Table 3. Overview the adoption of the implementation to refer women to a counsellor of addiction care.

Adoption	Total	Assen	SHE	Sneek	Middenin	Rondom Zwangerschap	Martini Ommelander
Number of midwifery care practices of a MCU ^a	66	11	10	10	17	14	9
Number of midwifery care practices that indicated to be willing to refer women to a counsellor of addiction care ^a	50	9	7	6	10	10	8
Number of midwifery care practices that actually referred women to a counsellor of addiction care ^a	21	2	6	2	4	1	5
Number of departments obstetrics hospital of a MCU	7	1	1	1	1	1	1
Number of departments obstetrics hospital that were willing to refer women to a counsellor of addiction care	5	1	1	1	1	0	1
Number of departments obstetrics hospital that actually referred women to a counsellor of addiction care	2	1	0	0	0	0	1

^aThe numbers of the MCU's do not add up to the total because some midwifery care practices are part of several MCU's.

Implementation

1. The execution of the implementation strategies as intended

Not all midwifery care practices of the seven MCU's that initially committed to the implementation managed to collect the registry data that was necessary to evaluate the reach of the implementation. The main reason for this was the heavy burden on midwifery care practices during the Covid-19 pandemic. Another reason was that they were occupied with other (research) projects, such as the Very Brief Advice, that also has a focus on reducing smoking (23). As a result, 15 primary midwifery care practices (30%) and three obstetric departments of hospitals (60%) did not collect the registry data.

During the implementation process we made some adaptations to the implementation strategies based on interviews with MCP's and counsellors from addiction care. First, the counsellors indicated that some women did not answer their telephone. Therefore, in the information letter to pregnant women we added that the counsellor would call with an anonymous number. By adding this phrase, the hope was that women would pick up the phone even if it was an anonymous number. The counsellors observed that this adaptation led to an increase in women who picked up their phone. However, it did not result in an increase of women who started a coaching trajectory. Second, because of the increasing number of referrals, more counsellors were recruited to support pregnant women with smoking cessation. Third, because more counsellors were recruited, there was a need from the counsellors from addiction care to centrally manage referrals. Therefore, a special e-mail address was created for all referrals of women to addiction care.

The MCP's also indicated that they would like to have more regular contact with the counsellors to share their experiences with the smoking cessation process of women. Therefore, the counsellors used a feedback form (including information about frequency of contact and women's smoking behavior) which was sent to the midwives and obstetricians after finishing the coaching trajectory, with consent of the women.

Furthermore, some implementation strategies were repeated a few times for MCP's of the hospital of the MCU Martini, because the representative of the MCU noticed that colleagues in the organisation forgot about the intervention. Therefore, the researcher (SW) attended another MCU meeting to provide information about the intervention and the information was provided again by e-mail by the representative of the MCU. In the weeks after repeating this strategy, the number of referrals from the hospital slightly increased.

We did not observe differences in number of referrals from the MCU's that had additional implementation strategies, namely a flowchart with referral options and additional training in motivational interviewing, compared to the other MCU's.

2. Implementation degree of the guideline among MCP's

In total, 63 MCP's from the seven involved MCU's responded to the online survey "Monitor Smokefree Start" initiated by the Trimbos-Institute in 2021 (24). Twenty-two respondents (34.9%) indicated that they knew the guideline and used it in daily practice, 26 respondents (41.3%) did not know the guideline and 15 respondents (23.8%) answered 'yes, but I don't use it (yet)'.

3. Implementation of the guideline as received by pregnant women

There were 86 respondents of the online survey, spread across the provinces Groningen, Friesland and Drenthe, who indicated they had smoked in the three months before their pregnancy. Of the 86 women, 51 stopped smoking (59.3%) and 35 (40.7%) continued smoking during their pregnancy. Of the 35 women that smoked, 24 (68.6%) were informed about smoking cessation support options in the period 2019 till 2022. Of these 24 women, 10 (41.7%) indicated that they actually made use of (combinations of) smoking cessation support: a counsellor from addiction care (n=3), telephone-based counselling "Smokefree Parents" (n=1), a trained nurse practitioner working in general practice (n=4), smoking cessation support apps (n=3), nicotine replacement therapy (n=2) or other options (n=1).

4. Experiences of pregnant women and MCP's during the implementation

Themes

From the analysis of the interviews and focus groups we derived the following two themes regarding the experiences with the implementation of smoking cessation support by counsellors from addiction care: 1) Referral can be a challenge and 2) Communication between midwife/counsellor and pregnant woman seems crucial for smoking cessation counselling (see Table 4 for the code tree).

Table 4. The code tree of the interviews and focus groups with MCP's and with women.

Theme	Sub-theme	Quote
1. Referral can be a challenge	Organization of care	"Well my expectation was perhaps that we could include a little more people, that it would live a little more on our ward" (obstetrician)
	Lack of motivation	"In our area the motivation to quit is also very low. And I think that's related to the society they live in, the neighborhood they live in, everyone around them smokes. Especially partners, who are then even less motivated." (midwife)
	Addiction care	"The pregnant women I spoke to, ehm were frightened by (addiction care institution) in particular, ehm it sounds pretty intense, I think, for pregnant women and that ehm they are also quickly afraid that they will get a label." (midwife)
2. Communication between midwife/ counsellor and pregnant woman seems crucial for smoking cessation counselling	Pressure	"Well sometimes people don't respond to their phones. They don't answer the phone. Sometimes we don't have an email address so you just can't email or they don't respond to the emails. [...] But then in practice it usually turns out that those pregnant women already have doubts and eh- Actually, they just don't want smoking cessation counselling." (counsellor addiction care)
	Contact in person	"I think we had contact in real life two or three times, and after that it was by phone and at some point we also texted. [...] Well, of course it was more of an incentive for me to go there. So I found that more pleasant myself, but yes, with the corona that was no option." (pregnant woman)
	No judgement	"I think that's very important that just uhm people feel understood because the whole world is already against you if you smoke during pregnancy" (pregnant woman)

Theme 1. Referral can be a challenge

Clinical midwives and obstetricians expressed that, for them, the execution of the implementation strategies seems to be more challenging than for primary care midwives. They expressed that this might be related to the organisation of care in the hospital, with relatively many midwives and obstetricians. Therefore, an obstetrician indicated the need to repeat the implementation strategies every now and then.

“That makes it quite difficult indeed, (other obstetrician) also had difficulty with that and gave a nice presentation a few times at a given moment and emphasized again how important it is and how easy it actually is to refer, that it is safe to do. And then we had a few more referrals. So I thought we are now six months further, I’m just going to do it again.” (obstetrician)

The midwives and obstetricians expressed that referral is challenging in case of women who are not motivated to stop smoking. They indicated that, some women, especially those with a low SES, do not want to discuss smoking cessation and will continue smoking. Another challenge for referral is the stigma surrounding addiction care. Midwives mentioned that the opinion that only people with severe addictions go to addiction care, influenced women’s decision not to make use of this smoking cessation support.

“We notice that ehm that for many pregnant women, the name (addiction care institution) evokes negative associations. If you explain that, there is a lot of expertise at (addiction care institution), they will understand that, but the threshold is still too high to go along with it.” (midwife)

Theme 2. Communication between midwife/counsellor and pregnant woman seems crucial for smoking cessation counselling

Women indicated in the interviews that the communication with the midwife influenced their decision to make use of counselling. Some women who agreed to be referred to a counsellor from addiction care expressed that the information about counselling from the midwife and/or obstetrician was not sufficiently provided. Women also expressed that they sometimes experienced pressure from the midwife or obstetrician to be referred to addiction care.

“But she kept bringing it up again and then at a certain moment I said oh okay, [...] let (name counsellor) call or text me and then ehm, I’ll see ehm what I will do” (woman who smoked during pregnancy)

The contact with the counsellor seems to matter for the success of counselling. The counsellors from addiction care expressed that the Covid-19 pandemic influenced

their experiences with coaching pregnant women with smoking cessation. Due to the pandemic all counselling was performed via telephone or Whatsapp instead of face-to-face consultations, which might have caused women to end the coaching trajectory prematurely. Counsellors indicated that women were less likely to stop the coaching trajectory prematurely when at least the first contact was in person.

"When that contact is good, you can simply start counselling much better. Also by phone afterwards. Because then you know what you look like and uh yes then you also know when someone is joking or not, because then you just know each other (...). And when it's only with video calling, it's just less." (counsellor addiction care)

Almost all women who received expert smoking cessation support from a counsellor from addiction care indicated that they liked the way the counsellor approached them, in a very open and understanding way without judgement. Women felt comfortable to discuss their smoking behaviour and their struggles and felt that the counsellor supported them with smoking cessation.

"That it's just really fitted to my needs. I could indicate eh how and why and that she could respond with: 'Well, hey, maybe you can try this or this'. It wasn't like, 'you have to do this and you don't have to' that, so I liked that." (pregnant woman)

Discussion

In this study we developed and evaluated plans for the implementation of the guideline regarding the smoking cessation support of pregnant women in the north of the Netherlands. Seven MCU's chose to implement the intervention to refer smoking pregnant women to a counsellor from addiction care. The implementation strategies were tailored to the barriers, facilitators and needs of the MCU's. Twenty-one of the willing 50 midwifery care practices (42%) and two of the five willing obstetrics departments (40%) actually referred women to a counsellor from addiction care. The results showed that of the 558 women who smoked during pregnancy in the seven MCU's in 2021, 73 (13%) women were referred to addiction care, of which 58 actually started a coaching trajectory and 12 women stopped smoking. The results of the interviews and focus groups gave insight into the challenges for referral and indicated that women and MCP's identified communication between midwife/counsellor and pregnant woman as important elements for smoking cessation counselling.

There are many possible explanations as to why a minority (40%) of the MCP's actually referred women and a minority of women (13%) made use of counselling from addiction care. A first explanation could be that not all MCP's discuss smoking with pregnant women. This was also found in another Dutch study which reported

that 40% of pregnant women have discussed their smoking behavior with a MCP (1). A reason why not all MCP's discuss women's smoking behaviour could be that they experience a lack of knowledge and skills in motivational interviewing (25). Therefore, there could be an opportunity in increasing the adoption of the intervention by improving skills in motivational interviewing. Although we did not observe differences in referral rate for the MCU that received a training in motivational interviewing, we also do not know if all MCP's discussed smoking with women throughout pregnancy. Furthermore, other factors that were not anticipated, such as fewer contact moments due to the Covid-19 pandemic or a lack of time (1, 9), might have influenced referrals.

Implementation of an intervention is complex. Although PAR was used to tailor the implementation strategies to the barriers, facilitators and needs of the MCU's, this did not lead to large differences in results per MCU. A reason for this could be that the pre-intervention context of the MCU's (e.g. already trained in motivational interviewing or presence of a smoking cessation policy) influenced the implementation. We did observe an increase in referrals after repeating some strategies for the MCU Martini. This result emphasizes the importance of the repetition of strategies.

In the interviews, the MCP's provided another explanation why a minority of women were referred to a counsellor. According to the MCP's, not all women were motivated to receive smoking cessation counselling. Based on a previous study, it seems that especially women who are motivated to quit smoking and have confidence in stopping with professional support make use of support (26). This underlines the importance of motivational interviewing in the smoking cessation support of pregnant women. Another possible explanation for the low referral rate can be given based on the results of our survey, which showed that women also made use of other support options, such as referral to the trained nurse practitioner, nicotine replacement therapy or the telephonic support 'Smokefree Parents'. Both counselling by MCP's and nicotine replacement therapy are effective support options, as they increase smoking cessation rates (3, 27).

A result of this study is that 25% of women who received counselling from addiction care stopped smoking. This effectiveness is low compared to the percentage from the Cochrane systematic review by Chamberlain et al. in which they report that counselling increases the likelihood of abstinence in late pregnancy with an average of 44% compared to usual care or no intervention (3). However, it is hard to make an exact comparison with the result of our study because we have no data about the percentage of women who stop smoking without an intervention. It is known from other literature that combination of interventions, such as counselling and nicotine replacement therapy, seems to be the most effective (28).

The percentage of women who were initially referred but who ultimately did not respond to the contact attempts of the counsellors or stopped the trajectory prematurely is 20.5%. From the interviews of this study, one possible explanation emerged, namely women's experienced pressure to be referred. The professionals might have insisted on referral so much that women agreed to be referred, even when they were not motivated to stop smoking. In the interviews, the counsellors also expressed the importance of the first meeting being face-to-face, to establish a relationship with women. The importance of a trusting relationship for women's adherence to support is described in other studies focusing on the patient-provider bond (29, 30).

Limitations and strengths

There are some limitations and strengths that need to be taken into consideration while interpreting the results of this study. A first limitation is that 15 primary midwifery care practices (30%) and three obstetrics departments (60%) did not provide any data due to the heavy burden of the Covid-19 pandemic on their work. Therefore, the exact prevalence of pregnant women who smoke in the MCU's is unknown. Moreover, the women who identified for participation in the study were self-reported smokers. A self-reported smoking status likely underestimates the actual prevalence of women who smoke during pregnancy. This needs to be taken into consideration while interpreting the results (31). Furthermore, for the practices and obstetric departments that did provide data, it could be that some women are counted twice because women may be referred from primary midwifery care to secondary care in the hospital. Another limitation of this study is that we have no data about the maintenance of the implementation, the effect of coaching on women's smoking behavior postpartum, and women's use of other smoking cessation support options.

A strength of the implementation is the participatory action design, with the involvement of midwives, obstetricians, experts by experience in poverty and social exclusion and pregnant women. This design increases the chance for sustainable implementation (32). Another strength is the use of mixed methods to evaluate the implementation plans, which made it possible to understand the results of the implementation in the specific context (21). The results from the interviews provided additional in-depth information about the quantitative results of the implementation.

Recommendations

Based on the results of this study, lessons can be learned for future implementation. The results indicate that despite the use of tailored implementation strategies and

intermediate adaptations of the strategies, the adoption and effectiveness of the intervention can be improved. To realize this, frequent repetition of implementation strategies is necessary. Furthermore, there could be opportunities in the education of MCP's to enhance their skills and knowledge in motivational interviewing. This could increase the rate of women who discuss their smoking behavior with MCP's, address the challenge of referring women who are not motivated and handles the pressure that women experience from their midwife and/or obstetrician in making use of support. More research is needed to the factors that influence referral by MCP's. To improve the effectiveness of the counselling by addiction care, the counsellors could consider combining their counselling with nicotine replacement therapy under supervision of a doctor, feedback (for example by using Carbon Monoxide monitoring) or incentives (3, 28, 33).

Conclusions

In this study we developed and evaluated plans for the implementation of the guideline regarding the smoking cessation support of pregnant women in the north of the Netherlands. PAR was used as the research design to ensure that the implementation was targeted to the needs of both women and MCP's. The RE-AIM model was used to evaluate the implementation. Seven MCU's implemented the intervention to refer pregnant women to a counsellor from addiction care for smoking cessation support. Only a minority of the MCP's actually referred women to a counsellor from addiction care and a small percentage of women managed to stop smoking. Opportunities in the repetition of implementation strategies and increasing skills in motivational interviewing could improve adoption of interventions in future implementation. To increase the effectiveness of the intervention, the counsellors could consider combining their counselling with nicotine replacement therapy, feedback (for example by using Carbon Monoxide monitoring) or incentives.

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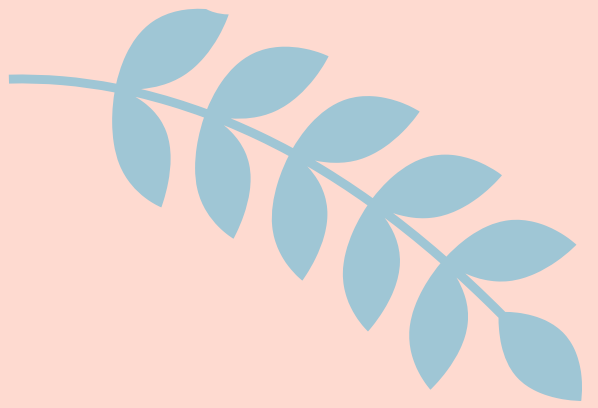
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Chapter 7

General Discussion



The aim of this thesis was to gain insight into factors that are associated with smoking during pregnancy and to optimize and evaluate smoking cessation support in daily practice. In this Chapter, the findings of each study will be summarized. Subsequently, the findings will be discussed and interpreted in a broader context. At the end of this Chapter the methodological strengths and limitations of this thesis will be discussed and the implications for future policy, practice, and research will be elaborated upon.

Main findings

In **Chapter 2** we investigated women's needs for professional smoking cessation support during pregnancy via semi-structured interviews with 23 pregnant women, women who recently gave birth, and five partners of the women, living in the north of the Netherlands. Three themes were identified from the interviews: 1) understanding women's needs, 2) responsibility without criticism, and 3) women and their social network. These themes indicated that women want smoking cessation support from an involved and understanding healthcare professional who tailors the support to their needs. Women indicated that healthcare professionals should take stressors, such as financial stress, and their motivation level into consideration in the provision of smoking cessation support. Furthermore, according to the women, the healthcare professional should support them in making their own informed decision about smoking cessation, while refraining from criticism. Women also value involvement of their social network in the professional smoking cessation support.

In **Chapter 3** we investigated the association between women's smoking behaviour and their use of healthcare during pregnancy, birth and six weeks postpartum. We included 41 088 pregnant women from the Midwifery Case Registration System (VeCaS) and divided them into three groups, classified according to smoking status: non-smokers, early stoppers (stopped smoking in the first trimester), and late- or non-stoppers (stopped smoking after the first trimester or continued smoking). First, we found that the late- or non-stoppers initiated maternal care later, and had fewer face-to-face visits with the midwife, compared to non-smokers or early stoppers. However, these differences were not clinically relevant since all groups met the recommendations as stated in the Dutch guideline for prenatal care. Second, compared to the non-smokers, the early stoppers and the late- or non-stoppers were statistically significantly more likely to be referred to an obstetrician during pregnancy and birth. The associations remained statistically significant after adjusting for the confounders BMI, maternal age, socioeconomic status (SES), ethnicity and parity. The association seems to be reversed postpartum, the early stoppers and the late- or non-stoppers were statistically significantly less likely to be referred to an obstetrician compared to the non-smokers. This reversed association postpartum could be explained by higher rates of referral to the obstetrician during

pregnancy and birth, resulting in handover of care. This implies that women who smoke during pregnancy are already in secondary care and therefore are not referred postpartum. Third, the main reasons for referral during pregnancy, birth, and postpartum were mostly similar for the three groups.

In **Chapter 4** we studied if social need fulfillment, a measure for social relations, moderates the relationship between SES and health risk behaviours (smoking and/or consuming alcohol) during pregnancy using data from the Lifelines-Reproductive Origins of Adult Health and Diseases (ROAHD) cohort. We found statistically significant differences between 1107 women who differed on SES (i.e. low, middle and high SES) on maternal age, number of partners in consecutive pregnancies, parity, BMI, smoking behaviour, second-hand smoke exposure, presence of physical disease and presence of psychological disease. Women with a low SES were more often multiparous, obese, and smoked more often during pregnancy compared with women with a middle or high SES. Women with a low SES had a statistically significant lower social need fulfillment score than women with a middle or high SES. This means that women with a low SES experienced less affection, behavioural confirmation, and status than women with a middle or high SES. Furthermore, the results showed that women with a high SES had statistically significantly lower odds of smoking and/or consuming alcohol during pregnancy compared with women with a middle SES. However, this association did not remain after adjustment for confounders. The interaction effects between SES and social need fulfillment on health risk behaviours were not statistically significant, indicating that social need fulfillment does not modify the effect of SES on health risk behaviours during pregnancy.

In **Chapter 5** we investigated via an online questionnaire the adverse maternal and infant outcomes of 1937 women who differed in smoking status: e-cigarette and tobacco cigarette users. We found that the e-cigarette users were more often higher educated, more often had a partner, were more often primiparous and experienced more miscarriages compared with tobacco users. Furthermore, women who used e-cigarettes during pregnancy more often had infants that were small for gestational age compared with tobacco users. We recommend that more research is needed on the effect of the e-cigarette on pregnancy outcomes.

The results of previous chapters formed the background for optimizing the smoking cessation support for pregnant women in daily practice. The aim of the study presented in **Chapter 6** was to develop and evaluate plans for the implementation of the Trimbos-guideline 'Treatment of tobacco addiction and smoking cessation support for pregnant women' in the north of the Netherlands. Seven midwifery obstetric cooperation units (MCU's) chose to implement the intervention to refer smoking pregnant women to a counsellor from addiction care. Twenty-one of

the willing 50 midwifery care practices (42%) and two of the five willing obstetrics departments (40%) actually referred women to a counsellor from addiction care. The results showed that of the 558 women who smoked during pregnancy, 73 (13%) women were referred to addiction care, of which 58 (80%) actually started a coaching trajectory, 48 (83%) women finished a coaching trajectory and of these 48 women, 12 (25%) women stopped smoking. We conclude that despite the use of tailored implementation strategies, a minority of maternal care professionals actually referred women to a counsellor from addiction care and a small percentage of women managed to stop smoking with support of the counsellor.

Discussion of main findings

Collaboration in smoking cessation support

The results of our studies underline the importance of collaboration in smoking cessation support for pregnant women. In the interviews, pregnant women indicated the need for support from a maternal care professional (Chapter 2) and expressed that they would like to receive support from their social network (Chapter 2). Furthermore, the result that pregnant women who smoke are more often referred to secondary care emphasizes the importance of collaboration between primary and secondary care maternal care professionals for continuation of smoking cessation support (Chapter 3).

Otherwise, the results of our studies highlight that the collaboration in smoking cessation support for pregnant women can be improved; some women felt pressured by the maternal care professional to make use of smoking cessation support (Chapter 6), women's partners did not want to be involved in the counselling by addiction care (Chapter 6), and we experienced that the implementation of our intervention was more challenging in secondary care due to the organisation of care (Chapter 6).

To improve collaboration between maternal care professionals in the provision of smoking cessation support, it is essential that agreements for the collaboration are established in policy. A Dutch study showed that 53% of the MCU's have a smoking cessation policy.¹ Furthermore, around one-third of the MCU's with a smoking cessation policy have made agreements about the collaboration between maternity care professionals, for primary and secondary care, in the provision of smoking cessation support.¹ A lack of policy or a lack of agreement about the execution of this policy might explain the differences in our implementation study in the uptake and implementation of the intervention between maternal care professionals (Chapter 6).

Women's social network

We found that women with a low SES more often smoked during pregnancy and had a lower social need fulfillment score than women with a middle or high SES (Chapter 4). Having a lower social need fulfillment score means that these women experience less affection, behavioural confirmation, and status, compared with women with a middle or high SES. In addition, other studies showed that women with a low SES tend to have fewer resources (e.g., income and knowledge) and experience a lack of social support, greater addiction, and higher levels of stress, which are all associated with smoking during pregnancy.^{2,3} Having fewer resources is negatively associated with smoking cessation, because if women have for example smaller social networks, they may not know others who quit smoking or who support their quit attempt.^{2,4}

On the one hand there lies an opportunity in increasing women's social support as an intervention for smoking cessation during pregnancy. A couple of social support interventions have proven to be effective by reducing the proportion of women who smoke during pregnancy.^{5,6} In our interview study (Chapter 2) women also expressed that they preferred involvement of their social network in smoking cessation support. The results of another study show that maternal care professionals believe that more women will quit smoking if their social network is involved.⁷

On the other hand, involvement of women's social network in smoking cessation support is challenging since in many cases, partners, family members and friends of women who smoke during pregnancy also smoke.⁸ These relatives are difficult to involve in smoking cessation, as is shown in our study: the counsellors of addiction care invited the partners of women to participate in their counselling, but many partners were not open for smoking cessation themselves (Chapter 6). One study recommends that the social norm of smoking as standard practice in social networks should be reflected upon for smoking cessation interventions to be effective.⁹ However, a systematic literature review on the effect of family-based interventions concluded that the evidence of these interventions is unclear, due to the heterogeneity in interventions, suggesting that more research is needed.¹⁰

Motivation for smoking cessation

We developed tailored implementation plans via Participatory Action Research (PAR); taking into consideration women's need for smoking cessation support and the experienced barriers, facilitators and needs from maternal care professionals in providing smoking cessation support. The maternal care professionals chose to implement the option to refer pregnant women to a counsellor from addiction care for smoking cessation support, in addition to other existing referral options as described in the Trimbo's guideline. However, the number of women that were referred to addiction care counsellors was moderate, and some women stopped the counselling prematurely (Chapter 6). How can this result be explained?

One possible explanation, identified by the maternal care professionals that participated in the study, is women's lack of motivation for referral to addiction care (Chapter 6). This experience is shared by maternal care professionals in other studies.^{1,11} Previous studies reported that reasons why women are not motivated to stop smoking are because they need smoking to cope with stress, they have a low self-efficacy in quitting, they do not believe smoking is very harmful to their fetus and because they are addicted.^{12, 13} In our interviews, women also indicated that stress is a barrier for them to stop smoking (Chapter 2). Contrary to the results of the previous studies, the women that participated in our interviews identified the health of the fetus as their main motivation for smoking cessation (Chapter 2). Other studies reported that the use of financial incentives and feedback about the effect

of smoking on the baby by using a Carbon Monoxide (CO) monitor might increase women's self-efficacy and motivation for smoking cessation.^{14, 15}

Women's motivation levels for smoking cessation could be increased by motivational interviewing.¹⁶ Motivational interviewing enhances the likelihood of smoking cessation by increasing women's cognitive dissonance, self-esteem and self-efficacy.¹⁷ With motivational interviewing, the maternal care professional facilitates women to make their own decision about behaviour change.¹⁷ The importance of motivational interviewing was illustrated by the results of our interviews, in which women expressed the need for support from a maternal care professional who is understanding and refrains from criticism about women's smoking behaviour (Chapter 2). Expressing empathy while being nonjudgmental is a key element of motivational interviewing, it allows women to have autonomy in making their decision about behaviour change.¹⁸ Contrary to women's preference, the women in our implementation study felt pressured to make use of counselling from addiction care (Chapter 6). This could indicate that motivational interviewing was not properly applied by some maternal care professionals, which might lead to resistance among women.¹⁷

A second explanation for the low number of women who were referred to addiction care and stopped the counselling prematurely could be stressors in women's lives.¹² In our interviews, women expressed that stress was a main barrier for them to be able to stop smoking (Chapter 2). This is emphasized by the experiences of the counsellors from addiction care. Although they tailored their counselling to the circumstances of women's lives, they experienced that women with high stress levels were less likely to continue the counselling and to stop smoking (Chapter 6). To address this barrier, one study recommends the use of stress management techniques in interventions for smoking cessation.¹⁹ This implies that a broader approach for smoking cessation support, including stress management techniques, is needed.

Lastly, some women indicated that the stigma surrounding addiction care was a reason for them not to make use of counselling (Chapter 6). Other support options, as described in the Trimbos-guideline, might be more suitable and acceptable for these women.²⁰

Taking into consideration that there is a group of pregnant women who is not motivated or able to stop smoking, due to several reasons, the question arises how to optimize smoking cessation support for this group of women. A few studies propose a solution in supporting women with reducing the number of cigarettes smoked instead of quitting completely, which is already used by many women as harm reduction and as a transition before quitting.^{21, 22} We also found this in our

study, where the majority of women reduced the number of cigarettes smoked (Chapter 6). Although focusing on reduction instead of quitting is controversial because women may inhale deeper to compensate for the reduction in cigarettes, reducing the amount of cigarettes does seem to increase the likelihood of complete smoking cessation.^{23, 24} Reducing the amount of cigarettes is associated with a reduction in health risks for the fetus.²⁵

E-cigarette

When the Trimbos-guideline for the smoking cessation support for pregnant women was developed, little research was available about the use of the e-cigarette during pregnancy. Therefore, the guideline states that the use of the e-cigarette is not recommended till further research is performed.²⁰ In the last years, a few new studies were performed on the safety of e-cigarette use during pregnancy. Despite these new studies, the evidence about the safety of the use of the e-cigarette during pregnancy is still inconclusive. Multiple studies reported no association between e-cigarette use during pregnancy and the risk for low gestational weight gain or a high-risk birth.²⁶⁻²⁸ Contradictory to these results, we found that e-cigarette use during pregnancy was associated with miscarriages and a small-for-gestational age infant in our study (Chapter 5). Furthermore, another study found an association between e-cigarette use and a high-risk birth for women who used the e-cigarette with menthol flavor.²⁷ Moreover, the World Health Organization reports that the use of the e-cigarette during pregnancy is harmful to health.²⁹ We conclude in our study (Chapter 5), in accordance with the Trimbos-guideline, that the use of the e-cigarette should not be recommended until further research is performed.

Methodological considerations

This paragraph includes a reflection on the strengths, limitations and lessons learned from the methods that were used in the project 'Together we'll quit smoking!'.

Participatory Action Research

A strength of the project 'Together we'll quit smoking!' is that we used PAR as study design. The aim of this design was to ensure that the implementation plans were tailored to the needs of all stakeholders, including pregnant women. Previous research reported that the use of PAR could enhance implementation success.^{30, 31} In our study, PAR was used in the development and execution of the implementation plans.

A main limitation of this study design was that the implementation plans were tailored to highly motivated and enthusiastic maternal care professionals who participated in the development of the implementation plans. The one or two contact persons for our study per MCU might not be sufficient to motivate other maternal care professionals affiliated at the same MCU's to participate in the implementation. Furthermore, the organisational structure of MCU's can be complex and needs to

be taken into consideration for the implementation. Some MCU's had a dedicated working group for development of the smoking cessation policy, while other MCU's had one motivated professional that worked on smoking cessation. We learned that for future implementation, more focus is needed on motivating all maternal care professionals of the MCU's. For example, the chairs of the MCU's should be more involved, and more time is needed to ensure the commitment from the MCU's.

Target population

A strength of our study is that we involved two experts by experience in poverty and social exclusion to represent the voices of pregnant women with a low SES who smoke. Considering that women with a low SES are more likely to smoke during pregnancy, we aimed to involve this group of women in our study project. From previous studies it is known that this group is difficult to reach in research.^{32, 33} Therefore we worked with the experts by experience for recruiting women with a low SES for interviews. Furthermore, they contributed to the interviews by making sure that the questions were phrased in a neutral way, so women would feel comfortable sharing their experiences.

Despite the involvement of the experts by experience in our study, we hardly reached women with a low SES in our intervention. We found that many women with a low SES were not willing to stop smoking or did not want to receive support (Chapter 6). Besides a lack of motivation, we found that other reasons for non-participation in our study were experienced stigma of addiction care and poor communication from the maternal care professional. Studies have recommended the use of incentives to increase the involvement of participants with a low SES in the research.^{32, 34} Incentives could be financial, social, personal or a combination of those.³² A study reported that incentives are effective for multiple purposes, incentives can increase response rates, facilitate recruitment and prevent loss to follow up.³⁴

Data on smoking status

A limitation of our study is that women's smoking behaviour is likely to be under reported. Not all maternal care professionals register women's smoking behaviour in their electronic healthcare registry systems. Furthermore, when women's smoking behaviour is registered, details about the number of cigarettes or the type of cigarette (e.g., e-cigarette) is often missing. In databases (such as Lifelines ROAHD), and in our implementation study, women's smoking behaviour is self-reported. Under reported smoking behaviour might have influenced the strength of associations found in Chapter 3, Chapter 4 and Chapter 5. Furthermore, it could be the case that women falsely reported that they stopped smoking, which leads to an overestimation of the number of women who stopped smoking in our implementation study (Chapter 6). Therefore, the results of our studies should be

interpreted with caution. To improve the validity of research to smoking during pregnancy, the registration of women's smoking behaviour should be improved.

COVID-19

A limitation is that due to the Covid-19 pandemic all communication went via e-mail and Microsoft Teams, which could have caused a lower sense of involvement from the maternal care professionals and might have influenced implementation outcomes. Furthermore, consultations of pregnant women with the maternal care professional were often performed via telephone or online during the pandemic.³⁵ This might have caused difficulty in having a conversation about smoking cessation including referral to a counsellor from addiction care. Moreover, the Covid-19 pandemic caused a delay in the development of the implementation plans. A year after the initiation of our project, the Covid-19 pandemic started. We just finished the interviews with pregnant women and were working on the development of the implementation plans, when the Netherlands went in lockdown. The pandemic put a high burden on midwifery and obstetric care; working on smoking cessation support had no priority.

Implications

The results of this thesis provide multiple implications for policy and practice, and implications for research to improve the smoking cessation support for pregnant women. Furthermore, a reflection is given on our approach to optimize smoking cessation support for pregnant women.

Implications for policy and practice

First, we recommend that every MCU should have a smoking cessation policy that is known and applied by all members of the MCU. The smoking cessation policy should contain an overview of referral options for smoking cessation support and agreements about the collaboration between the maternal care professionals in the provision of smoking cessation support. The result of our implementation study (Chapter 6), that not all midwifery care practices and departments of obstetrics of hospitals participated in the intervention, might indicate a lack of agreement within MCU's in the organisation of the smoking cessation support for pregnant women. There should be paid special attention to the communication of the policy to all members of the MCU. Our results (Chapter 6) imply that for the midwives and obstetricians in secondary care, the policy should be repeatedly communicated via multiple channels.

Second, we recommend further educating maternal care professionals and students of midwifery and obstetricians in training to enhance their skills in motivational interviewing. The results of two of our studies underline the importance of the communication between women and maternal care professionals (Chapter 2

and Chapter 6) and indicate that there is still room for improvement in the use of motivational interviewing by maternal care professionals. With motivational interviewing, the maternal care professionals can support women with smoking cessation themselves or refer them for professional smoking cessation support. If women are not motivated or when women experience a lot of stress in their lives, the maternal care professional should facilitate women to set a goal that is feasible for them. Complete smoking cessation might not be doable for some women, reducing the number of cigarettes smoked might then be a reasonable alternative.²²

Implications for research

First, more research is needed on the use of financial incentives for smoking cessation in daily practice. Financial incentives are proven to be an effective intervention for smoking cessation; they increase the proportion of women that initiate a quit attempt and lead to long-term abstinence.^{36, 37} During the last years, the interest in the use of incentives for smoking cessation has increased in the Netherlands. Breunis et al. advocate that the use of incentives for smoking cessation in pregnancy should become part of standard practice.³⁸ However, ethical pitfalls (e.g., the encouragement of smoking for participation in the intervention), appropriateness and acceptability of the use of incentives need to be taken into consideration.^{39, 40}

Second, more research is needed to the effectiveness and implementation of CO-monitoring for the smoking cessation support for pregnant women in the Netherlands. The Dutch Trimbos-guideline for smoking cessation support for pregnant women describes the use of the CO-monitor as optional. Little is known about the effectiveness of the CO-monitor on smoking cessation. The use of the CO-monitor is standard practice in the UK, with positive experiences.⁴¹ In an interview study, women expressed to be satisfied with the CO-monitor and indicated that it increased their motivation to quit.¹⁴ We also found in our interviews (Chapter 2) that women like to receive information about the influence of their smoking behaviour on the fetus.

Third, we recommend that further research is performed to the association between the use of the e-cigarette and pregnancy outcomes. In our study the number of women who used the e-cigarette was low (Chapter 5), which makes it difficult to draw conclusions.

Reflection

After four studies to gain insight into factors that are associated with smoking (Chapter 2-5), and a study to optimize and evaluate smoking cessation support for pregnant women, ultimately 12 women stopped smoking during our implementation study (Chapter 6). This raises the question: is all the effort and time that we have put into it worth it? Or is another approach needed to reduce the prevalence of

pregnant women who smoke? The answers depend on the perspective that is taken while interpreting our results.

On the one hand, we interpreted the results of our implementation study (Chapter 6) as moderate or slightly disappointing considering all the hours of work that were put into it from all stakeholders. Instead of focusing on optimizing smoking cessation support, a focus on other measures (e.g., increasing taxes on tobacco products and decreasing the amount of selling points for cigarettes) might be more cost-effective. The World Health Organization reported that raising taxes on tobacco is the most cost-effective measure to reduce the prevalence of smokers.⁴² Furthermore, a focus on prevention by using a combination of interventions focusing on legislation, education, and the social and physical environment might be effective to reduce smoking rates in the group of 18-24 years old.⁴³

On the other hand, every pregnant woman that quit smoking during our implementation study counts, considering the positive health effects for the fetus. In Chapter 2 we found that pregnant women struggle with smoking cessation, and the results of Chapter 6 imply that for some women counselling from addiction care was the answer to be able to successfully stop smoking. It is difficult to draw conclusions on the effectiveness (25% of the women that finished the coaching trajectory stopped smoking) of counselling by addiction care because we have no data about the number of women who stop smoking receiving usual care. A Dutch study reported that 62% of the women who smoke in the weeks before pregnancy quit smoking during pregnancy.⁴⁴ The effectiveness of counselling by addiction care can be considered high compared to the results of one systematic review that reported a 6% reduction in smoking cessation rate during pregnancy following an intervention.⁴⁵ On the contrary, our effectiveness can be considered low compared to another systematic review which reported that counselling increases smoking abstinence in pregnancy with 44%.⁵

In the Dutch law it is stated that every child deserves to grow up with the greatest possible degree of health and healthcare.⁴⁶ From this perspective, every initiative to support women with smoking cessation is important and should be encouraged.

General conclusion

In conclusion, addressing smoking cessation among pregnant women is a multifaceted challenge influenced by various factors. The implementation of counselling from addiction care as an option for pregnant women in the northern Netherlands has shown some promise in supporting smoking cessation efforts. Smoking cessation support for pregnant women can be further optimized by ensuring that every MCU has a smoking cessation policy and works accordingly. Maternal care professionals, students of midwifery and obstetricians in training should receive additional training in motivational interviewing to have the skills to address pregnant women their smoking behaviour. Future research should focus on the use of financial incentives, the CO-monitor and the e-cigarette in the smoking cessation support for pregnant women.

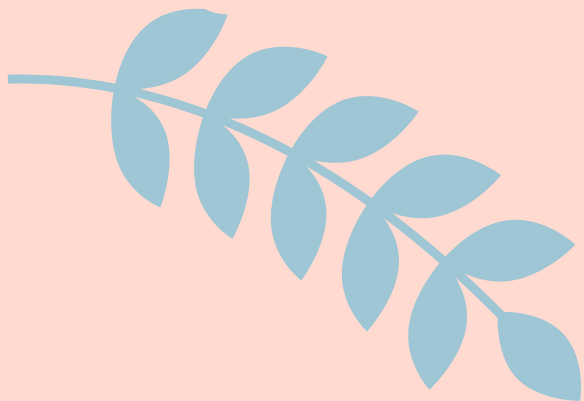
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Appendices

Nederlandse samenvatting

In **Hoofdstuk 1** hebben we de achtergrond geschetst van dit proefschrift. In Nederland rookt nog steeds 8% van de zwangere vrouwen. Gezien de negatieve gezondheidseffecten van roken voor moeder en kind, is het belangrijk dat zwangere vrouwen optimaal ondersteund worden bij het stoppen met roken. Het doel van deze these was om inzicht te krijgen in factoren die samenhangen met roken tijdens de zwangerschap en om de stoppen met roken ondersteuning voor zwangere vrouwen te verbeteren en te evalueren in de dagelijkse praktijk.

In **Hoofdstuk 2** hebben we de behoeften van vrouwen aan professionele stoppen met roken ondersteuning onderzocht. Hiervoor hebben we interviews gehouden met 23 zwangere vrouwen of vrouwen die het afgelopen jaar waren bevallen, en vijf partners, woonachtig in Noord-Nederland. Er kwamen drie thema's uit de interviews naar voren: 1) het begrijpen van de behoeften van vrouwen, 2) verantwoordelijkheid zonder kritiek en 3) vrouwen en hun sociale netwerk. Het eerste thema houdt in dat vrouwen graag ondersteund willen worden door een begripvolle zorgverlener, die de ondersteuning aansluit op de behoeften van de vrouw. De geïnterviewde vrouwen gaven aan dat de zorgverlener ook rekening moet houden met stress en hun motivatie om te stoppen met roken. Het tweede thema reflecteert de mening van de geïnterviewde vrouwen dat zij het belangrijk vinden dat de zorgverlener ze verantwoordelijk houdt voor het maken van een beslissing over hun rookgedrag tijdens de zwangerschap, zonder daarbij kritiek te uiten. Als laatste gaven vrouwen aan dat ze het prettig zouden vinden als hun sociale netwerk betrokken is bij de stoppen met roken ondersteuning door een zorgverlener. Om de ondersteuning beter te laten aansluiten op de behoeften van zwangere vrouwen, zouden er volgens hen een aantal aanpassingen gedaan kunnen worden in de Nederlandse richtlijn voor stoppen met roken ondersteuning van zwangere vrouwen.

In **Hoofdstuk 3** hebben we onderzocht of er een verband is tussen rookgedrag van vrouwen en zorggebruik tijdens de zwangerschap, de bevalling en zes weken postpartum. Hiervoor hebben we gegevens geanalyseerd van 41 088 vrouwen afkomstig van eerstelijns verloskundigen registratie data (VeCaS data). We hebben drie groepen vrouwen vergeleken: vrouwen die nooit gerookt hebben (niet-rokers), vrouwen die in het eerste trimester gestopt zijn (vroeg stoppers), en vrouwen die na het eerste trimester gestopt zijn of hebben doorgerookt tijdens de zwangerschap (late- of niet-stoppers). De resultaten laten zien dat de late- of niet-stoppers later in zorg kwamen bij de eerstelijns verloskundige en minder fysieke afspraken hadden dan de niet-rokers of vroeg stoppers. Deze verschillen waren echter klinisch niet relevant, omdat alle groepen voldeden aan de Nederlandse richtlijn voor prenatale zorg. Het tweede resultaat was dat vroeg stoppers en late- of niet-stoppers statistisch significant vaker werden doorverwezen naar de gynaecoloog

tijdens de zwangerschap en bevalling, vergeleken met niet-rokers. Dit verband was tegenovergesteld zes weken postpartum; toen werden vroege stoppers en late- of niet-stoppers statistisch significant minder vaak doorverwezen naar de gynaecoloog, vergeleken met niet-rokers. Als laatste hebben we de redenen van doorverwijzing tijdens de zwangerschap, de bevalling en postpartum onderzocht, maar deze waren grotendeels gelijk voor de drie groepen. Het resultaat dat zwangere vrouwen die roken vaker werden doorverwezen naar de gynaecoloog toont het belang aan van goede samenwerking tussen zorgverleners in de eerste en tweede lijn in de stoppen met roken ondersteuning van zwangere vrouwen.

In **Hoofdstuk 4** hebben we onderzocht of sociale behoefte vervulling, als maat voor sociale relaties, invloed heeft op het verband tussen sociaaleconomische status (SES) en roken en/of drinken tijdens de zwangerschap. Hiervoor hebben we gebruik gemaakt van data van 1107 vrouwen van het Lifelines-Reproductive Origins of Adult Health and Diseases (ROAHD) cohort. De groepen vrouwen met een lage, midden en hoge SES verschilden statistisch significant in leeftijd, het aantal partners tijdens opeenvolgende zwangerschappen, pariteit, BMI, rookgedrag, blootstelling aan tweedehands rook en de aanwezigheid van fysieke of mentale ziekten. Vrouwen met een lage SES waren vaker al meerdere keren bevallen, hadden vaker overgewicht en rookten vaker tijdens de zwangerschap dan vrouwen met een midden of hoge SES. Vrouwen met een lage SES hadden ook een statistisch significante lagere score op de maat voor sociale behoefte vervulling vergeleken met vrouwen met een midden of hoge SES. Dit betekent dat vrouwen met een lagere SES minder affectie, minder status en minder bevestiging van gedrag ervoeren. Ook bleek dat vrouwen met een hoge SES een lagere kans hadden om te roken en/of drinken tijdens de zwangerschap dan vrouwen met een midden SES. Dit verband bleef alleen niet significant na het corrigeren voor de dichotome confounders blootstelling aan tweedehands rook, verschillende partners in opeenvolgende zwangerschappen en geplande zwangerschap. Het interactie-effect tussen SES en sociale behoefte vervulling op roken en/of drinken tijdens de zwangerschap was niet statistisch significant, wat betekent dat sociale behoefte vervulling geen invloed had op de relatie tussen SES en roken en/of drinken tijdens de zwangerschap.

In **Hoofdstuk 5** hebben we via een online vragenlijst de gezondheidsuitkomsten van moeder en kind onderzocht voor 1937 vrouwen die de e-sigaret en/of de tabakssigaret gebruikten. De vrouwen die de e-sigaret gebruikten waren vaker hoger opgeleid, hadden vaker een partner, waren vaker primipara, en hadden vaker een miskraam dan vrouwen die de tabakssigaret gebruikten. Een andere uitkomst was dat vrouwen die de e-sigaret gebruikten tijdens de zwangerschap vaker kinderen hadden die klein waren voor de zwangerschapsduur. Gezien het lage aantal e-sigaret gebruikers in dit onderzoek, adviseren we dat meer onderzoek nodig is naar het effect van de e-sigaret op zwangerschapsuitkomsten. Het gebruik van de e-sigaret

wordt volgens de Nederlandse richtlijn voor de stoppen met roken ondersteuning van zwangere vrouwen afgeraden tot er meer bekend is over de effecten ervan.

De resultaten van de eerdere hoofdstukken vormden de basis voor het verbeteren en evalueren van de stoppen met roken ondersteuning voor zwangere vrouwen in de praktijk. In **Hoofdstuk 6** hebben we plannen ontwikkeld en geëvalueerd voor de implementatie van de richtlijn 'Behandeling van tabaksverslaving en stoppen-met-roken ondersteuning bij zwangere vrouwen' in Noord-Nederland. Zeven verloskundig samenwerkingsverbanden (VSV's) hebben ervoor gekozen om de optie uit de richtlijn te implementeren om zwangere vrouwen door te verwijzen naar een coach van Verslavingszorg Noord-Nederland (VNN) voor stoppen met roken ondersteuning. In totaal hebben 21 van de 50 verloskundigenpraktijken (42%) die aangaven zwangere vrouwen te willen doorverwijzen naar VNN en twee van de vijf afdelingen obstetrie en gynaecologie (40%) daadwerkelijk vrouwen doorverwezen naar VNN. Van de 558 vrouwen die rookten tijdens de zwangerschap in de zeven VSV's in 2021 zijn er 73 (13%) doorverwezen naar VNN, waarvan 58 vrouwen begonnen zijn met een coachingstraject, 48 vrouwen dit traject hebben afgerond, waarvan er uiteindelijk 12 vrouwen gestopt zijn met roken. Op basis van deze resultaten concluderen we dat een minderheid van de zorgverleners zwangere vrouwen heeft doorverwezen naar een coach van VNN, en dat een klein percentage zwangere vrouwen daadwerkelijk gestopt is met roken met de ondersteuning van een coach.

In **hoofdstuk 7** hebben we de resultaten van deze these bediscussieerd in relatie tot andere onderzoeken. Ter conclusie is het aanpakken van stoppen met roken onder zwangere vrouwen een veelzijdige uitdaging die wordt beïnvloed door verschillende factoren. De implementatie van de optie om zwangere vrouwen door te verwijzen naar VNN is een mogelijkheid om de stoppen met roken ondersteuning te verbeteren. De stoppen met roken ondersteuning voor zwangere vrouwen kan verder worden geoptimaliseerd door ervoor te zorgen dat elk VSV een beleid voor stoppen met roken heeft en volgens dit beleid werkt. Zorgprofessionals, studenten verloskunde en gynaecologen in opleiding zouden extra training moeten krijgen in motiverende gespreksvoering om de vaardigheden te hebben om het rookgedrag van zwangere vrouwen op een juiste manier te bespreken. Toekomstig onderzoek zou zich moeten richten op het gebruik van financiële beloningen, de koolmonoxide meter (CO-monitor) en de e-sigaret in de ondersteuning van stoppen met roken bij zwangere vrouwen.

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About the author



Stella Weiland was born on 31 October 1995 in Assen, the Netherlands. She grew up together with her twin sister Renate. After completing secondary education (VWO) at the CSG Liudger in Drachten in 2012, she started with the Bachelor Psychology at the University of Groningen. During her studies Stella taught Statistics to other Bachelor students. After finishing her Bachelor in 2016 (Cum Laude), she went to the Wageningen University for the two-year Master program Communication, Health and Life Sciences. During her research internship in the Medical Center Leeuwarden, she discovered the fun of performing research in a medical setting. After obtaining her Master's degree (2018), she successfully applied for a PhD position in the UMCG on the project 'Together we'll quit smoking!'.

The PhD was supervised by Prof. Dr. Marjolein Berger, Prof. Dr. Jan Jaap Erwich, Dr. Danielle Jansen and Dr. Lilian Peters. In the project, Stella collaborated with multidisciplinary healthcare professionals to improve the smoking cessation support for pregnant women in the north of the Netherlands. She wrote two quantitative papers, one qualitative paper and a mixed-methods paper focused on the smoking and healthcare use of pregnant women. She obtained the SHARE Top Publication award for her first paper. Furthermore, Stella is the second author of two papers about e-cigarette use during pregnancy. Stella presented her work at various national and international conferences and hosted a quiz together with her co-promotor Dr. Lilian Peters at the Noorderzon festival in Groningen. Together with Dr. Lilian Peters she organized a symposium in the Thialf Stadion in Heerenveen about practical tips for the provision of smoking cessation support for maternal care professionals. Stella also supervised bachelor students from the Midwifery Academy Amsterdam Groningen, a master student Health Sciences of the VU Amsterdam and a student from the GGD Fryslân. During her PhD she was a member of the organizing committee of the annual PhD day for all PhDs in the Netherlands in 2021. As of the 1st of January, Stella continued her academic career as a Postdoc at the University of Groningen, performing interviews with patients with anorexia nervosa to investigate the role of disgust in the disease.

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