Review

Psikiyatride Güncel Yaklaşımlar-Current Approaches in Psychiatry 2022; 14(2):152-164

DOI: 10.18863/pgy.898127

Smoking Cessation in Pregnancy within the Framework of Health Behavioral Theories: A Current Review

Sağlık Davranış Kuramları Çerçevesinden Hamilelikte Sigara Bırakma: Güncel Bir Derleme

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ABSTRACT

Since smoking during pregnancy affects both health of the mother and the baby, smoking cessation during pregnancy is an important health behavior and is one of the important issues of health psychology. The aim of this article is to review descriptive studies which handle smoking cessation during pregnancy within the framework of "health behavioral theories" and theory-based intervention studies conducted after 2000 about this topic. For this purpose, several databases were scanned with the "smoking cessation in pregnant women", "health behavior models", "theory-based interventions" keywords between February-March 2021. Approximately 70 related articles were accessed, but only 9 of them were evaluated within the scope of theory-based interventions. It was seen that achieved studies were handled within the scope of social cognitive theory, planned behavior theory and transtheoretical model, and self-efficacy as a trans-theoretical concept was the important predictor of intention to quit smoking among pregnant women. Although it is difficult to mention clear findings about the effectiveness of theory-based interventions on this topic, studies have pointed out that interventions based on stages of change can be supportive.

Keywords: Pregnancy, smoking cessation, health behavioral theories

ÖZ

Hamilelikte sigara kullanımı hem anne hem de bebeğin sağlığını etkilediğinden hamilelikte sigara bırakma önemli bir sağlık davranışı olup sağlık psikolojisinin de önemli konularından biridir. Bu makalenin amacı, hamilelikte sigara bırakma davranışını "sağlık davranış kuramları" çerçevesinde ele alan betimsel çalışmaların ve bu konuda 2000 yılından sonra yürütülmüş kuram temelli müdahale çalışmalarının gözden geçirilmesidir. Bu amaçla çeşitli veri tabanları Şubat-Mart 2021 tarihleri arasında "gebelerde/hamilerde sigara bırakma", "sağlık davranış modelleri", "teori temelli müdahaleler" anahtar kelimeleri ile taranmıştır. Bu kapsamda konuyla ilgili yaklaşık 70 makaleye erişilmiş ancak kuram temelli müdahaleler kapsamında sadece 9 çalışma değerlendirmeye alınmıştır. Ulaşılan çalışmaların sosyal bilişsel kuram, planlı davranış teorisi ve transteoretik model kapsamında ele alındığı ve hamilelerde sigarayı bırakma niyetinin önemli yordayıcısının kuramlar üstü bir kavram olan öz-etkinlik olduğu görülmüştür. Konuyla ilgili yürütülen kuram temelli müdahalelerin etkililiklerine dair net bulgulardan bahsetmek zor olsa da, çalışmalar değişim evrelerine uygun müdahalelerin destekleyici olabileceğine işaret etmiştir.

Anahtar sözcükler: Hamilelik, sigara bırakma, sağlık davranış kuramları

Introduction

Smoking, which is one of the causes of preventable deaths and many diseases, is an important health problem (Çelik 2015). According to data from the World Health Organization (WHO 2020) smoking causes the death of approximately 8 million people per year in addition to many health problems. If smoking continues in a similar way, it is predicted that this amount will reach 10 million by 2030 (WHO 2011). Together with the increasing rate of tobacco use in the world, this rate for individuals aged 15 and over, which was 26.5% in 2016, reached 28% in 2019 in Turkey. While the rate of tobacco use for women was 13.3% in 2016, it was reported as 14.9% in 2019. In addition, 14.9% of women report that they use tobacco every day (TUIK 2019).

Although smoking was traditionally seen as male behavior in the past, this situation started to change during the 1960s where the smoking rates of men and women reached similar levels (Groner et al. 2000). Since the increase in smoking in women is associated with the increase in pregnancy problems, smoking during pregnancy is an important public health problem that concerns both the mother and her baby. In addition to problems such as pregnancy loss, premature rupture of membranes, placental abruption, placenta previa hypertension, developmental

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retardation, and polymonary effect smoking during pregnancy causes problems that continue after birth such as sudden infant death syndrome, low birth weight baby, psychiatric, cognitive, and behavioral consequences during childhood, mental retardation, and childhood cancers (Dempsey and Benowitz 2001). Despite these known health risks, it is known that 26% of pregnant women in England smoked during pregnancy or at a certain point in the year before pregnancy, and 12% of them smoked during pregnancy (McAndrew et al. 2012). In the United States, this rate was found to be approximately 10% (Osterman et al. 2011). According to the Turkey Demographic and Health Survey (TDHS) Report, one in ten pregnant women also smokes in our country (TNSA 2008). Smoking frequency during pregnancy is affected by many factors including age, race, education, and socio-economic status. For instance, it has been reported that smoking is more common in younger pregnant women (Murin et al. 2011). Based on 2005 data, it was shown that the highest prevalence of smoking during pregnancy was among Alaska Natives (36.3%) and Native Americans (20.6%), the lowest prevalence was among Hispanic women (4.0%) and Asian/Pacific Islanders (5.4%). The prevalence has been observed as 18.5% among non-Hispanic white women and 10.1% among non-Hispanic black women (Tong et al. 2009). High rate of smoking during pregnancy has been associated with not only low socio-economic status and lack of education (Murin et al. 2011, Dias-Dame and Cesar 2015), it has also been associated with a lack of prenatal care (Mohsin and Bauman 2005).

Considering the reported adverse health outcomes and prevalence rates, it is important to stop or reduce smoking before and during pregnancy (Vaz et al. 2014). Research indicates that approximately 50% of women reduce or quit smoking when they plan to become pregnant or as soon as they learned that they were pregnant (Solomon and Quinn 2004, Tong et al. 2008). According to the 2010 Infant Feeding Survey data, 14% of women quit smoking before or during pregnancy, 4% of these women quit smoking one year before pregnancy, 9% of them quit smoking when they found out they were pregnant and 1% of them quit smoking after pregnancy (McAndrew et al. 2012). A review that brought together empirical studies about smoking cessation during pregnancy (n=19) showed that the smoking cessation rate ranged from 4 to 69.7% in population-based studies and from 26.5 to 47% in clinic-based studies (Schneider et al. 2010). The same study pointed out that pregnant women with low social status, a smoking partner, a high degree of addiction and multiple former pregnancies have more difficulty in quitting smoking (Schneider et al. 2010).

One of the factors that make quitting smoking difficult is the intensity of smoking. Accordingly, in a study, pregnant women (n=215) were classified into four groups as light, nonpersistent moderate, moderate and chronic smokers. The results of the study indicated that moderate and chronic smokers continued to smoke at different levels during pregnancy, moderate smokers showed a gradual decrease during pregnancy, and although chronic smokers showed a decrease after learning of their pregnancies they showed an increase in the number of cigarettes smoked in the second and third trimester. The study indicated that chronic and moderate smokers may experience problems in quitting smoking (Eiden et al. 2013). A systematic review of qualitative studies investigating the psychological and social factors among women who try to quit smoking during pregnancy also showed that women are aware of the health risks to the fetus due to smoking, but this information does not provide sufficient motivation for smoking cessation (Ingall and Cropley 2010). For these reasons, the recommending of effective preventive health services and intervention programs, by health personnel, to women who have difficulty in quitting smoking before and during pregnancy is important for public health.

In literature, many studies investigate the effects of clinic and hospital-based interventions on smoking cessation and reduction among pregnant women (Lawrence et al. 2003). Although smoking appears to be an individual behavior, it is facilitated or reinforced by certain factors for the individual (e.g. income, education, acculturation, psychological stress) and environmental (e.g. tobacco advertisements, the price of tobacco products and the ease of purchase) level (Lawrence et al. 2003). In this regard, it is known that smoking cessation interventions are applied at different levels including individual (behavioral support therapy, financial incentives, and pharmacotherapy) and social (smoking bans, increasing the social label, and tax) (Scherman et al. 2018). The methods used especially in individual interventions vary in the different types such as face-to-face counseling (Bowden et al. 2010, Everett-Murphy et al. 2010, Hennrikus et al. 2010, McGowan et al. 2010), telephone-based counseling (McGowan et al. 2010, Bullock et al. 2009, Keten and Gölbaşı 2013), telephone messages (Kong et al. 2014), video-based counseling (Tsoh et al. 2010, Windsor et al. 2011), motivational interviews (Heckman et al. 2014), and financial incentives (Boyd et al. 2016, Tappin et al. 2015).

Although studies point to different types of interventions, Ask, Advise, Assess, Assist, and Arrange (5A) intervention which points to five components and is recommended in maternal care frequently, is often used as a control group in intervention studies (WHO 2010, Patten et al. 2010, ACOG 2017). However, determination of beliefs underlying the decision to quit smoking, antecedents and predictors of this behavior among pregnant women is important in order to talk about the effectiveness of interventions and to develop interventions and it is seen that there is no clarity on this issue in the literature (Roberts 2006).

Although there are many theories and models that explain "smoking cessation" health behavior in the literature, it is striking that most of the studies investigating smoking cessation in pregnant women within the framework of both descriptive and intervention effectiveness are conducted independently of the theory and model (Lawrence et al. 2003). For example, 24 intervention studies were accessed in the review that tested smoking cessation interventions in pregnant women and evaluated the studies published between 2000 and 2013 and the theoretical frameworks of 16 studies were not reported (Kintz et al. 2014). However, it is reported that interventions

are more effective when they are based on evidence and theory (Bartholomew et al. 2016). Because theory-based interventions determine the variables that predict behavioral intention and associate these variables with evidence-based behavior change methods by framing with theory (Foy et al. 2007). Therefore, in this study, it is aimed to review the studies that handle smoking cessation behavior in pregnant women within the framework of "health behavior theories", that is one of the important issues of health psychology and theory-based intervention studies on this topic performed after 2000. In this context, we expect to find answers to the following questions:

1. Which health behavior theories handle quitting smoking among pregnant women?
2. What are the salient predictors of quitting smoking behavior among pregnant women within the framework of health behavior theories?
3. What are the theory-based interventions of quitting smoking behavior among pregnant women?
4. What are the effects of theory-based smoking cessation programs on quitting smoking behavior?

Method

In this context, studies that assessed smoking cessation among pregnant women and were published between 2000 and 2020 were reviewed. Searches on this topic was made by using the keywords "smoking cessation among pregnant women", "health behavior models", "theory-based interventions" in *PubMed*, *Google Scholar*, and *TÜBİTAK ULAKBİM* databases between February and March 2021 in Turkish and English. As a result of the searches, 70 articles on this topic were found. Since the study will review health behavior theories, studies which didn't provide a theoretical basis on this topic weren't considered. Both descriptive and intervention studies whose outcome variable was smoking cessation or reduction were considered. Moreover, attention was paid to the fact that the sample of studies consisted of pregnant women. This review did not include studies published outside of 2000-2020. Finally, although 12 theory-based intervention studies were accessed in total, 3 studies in which smoking cessation interventions were tested on expectant fathers (Xia et al. 2020), and breastfeeding was handled as an outcome variable (Jeihooni et al. 2019, Arshad et al. 2017) were not included in this review.

Results

Theories and Models Explaining Smoking Cessation in Pregnancy

In literature, quitting smoking during pregnancy has been often handled within the scope of Social Cognitive Theory-SCT (Bandura 1977), Theory of Reasoned Action-TRA (Ajzen 1980), Theory of Planned Behavior-TPB (Ajzen 1991) and Transtheoretical Model-TTM (Prochaska and Diclemente 1982).

Social Cognitive Theory (SCT)

SCT considers attitudes, beliefs, and environmental impacts in the examining of behavior (Bandura 1977) and asserts that outcome expectations, self-efficacy, and intentions are important determinants of the behavior (Bandura 1986). It is stated that self-efficacy, that is the most supported and remarkable notion of the theory, is related to health behaviors and if a person has the higher self-efficacy for a behavior they have the higher probability for performing it successfully (Bandura 1977). For smoking, *outcome expectations* are considered as advantages or disadvantages of smoking, *intentions* are considered as the motivation or readiness to quit, *self-efficacy* is also considered as resistance to smoking despite distracting situations (Van Zundert et al. 2009). Moreover, SCT defines the relationship between beliefs and behaviors as a mutual learning process and argues that people can choose their experiences, react to them, and gain knowledge from them (Bandura 2001). However, the theory has been criticized for being comprehensive and not specifying the nature of how all its components interact (Noar 2004). Although no research has been found that directly examines SCT among pregnant women, it has been seen that the theory has been considered in intervention studies.

Theory of Planned Behavior (TPB)

Intention is the most important determinant of behavior for TRA (Ajzen 1980) and TPB which is the expanded version of this theory (Ajzen 1991). TRA emphasizes that the intention of a person to perform the behavior is influenced by two main factors: attitudes and subjective norms. *Attitudes* consist of judgments about whether performing a behavior will be good for a person (behavioral beliefs) and evaluations about value of results of the behavior. *Subjective norms* consist of beliefs about whether other individuals confirm the behavior (normative beliefs) and one's motivation to adjust (motivation of adjustment). Model suggests that the more conceptualization of these four components (behavioral beliefs, evaluation, normative beliefs, motivation to comply) are compatible with one's attitudes and subjective norms, the more a person has the likelihood of intention to perform a health behavior. Although TPB includes the same components as TRA, it has been expanded with the addition of perceived behavioral control. *Perceived behavioral control* corresponds to the individual perception about the ease and difficulty of performing a behavior (Fishbein and Ajzen 1975). Perceived behavioral control shows a similarity with Bandura's self efficacy that corresponds to a belief about how well a behavior can be performed under prohibitive conditions (Gwaltney et al. 2009). All in all, the theory argues that more positive attitude towards the behavior, having more effective subjective norms, and greater perceived control lead to the occurence of the behavior by strengthening intention (Ajzen 2002).

In literature, it is seen that smoking cessation behavior among pregnant women is handled within the framework of TPB, which is more comprehensive than TRA. In one of the studies conducted within the framework of TPB, variables that predicted intention to abstain from smoking were examined in the

general population (n=346) and a group of pregnant women (n=136) (Godin et al. 1992). As a result attitude, subjective norm, and perceived behavioral control explained 54% of non-smoking intention during pregnancy. Moreover, it was stated that perceived behavioral control and intention significantly predicted non-smoking and perceived behavioral control was an independent predictor of the study (Godin et al. 1992). Similarly, it was shown that perceived behavioral control was the most important predictor of quitting smoking during pregnancy in another study (Roberts 2006). Behavior was evaluated as well as intention in another study conducted with 144 pregnant women within the framework of TPB. Accordingly, attitude, social impact and self-efficacy were associated with intention (r = 0.45, r = 0.47, r = 0.32) and behavior (r = 0.32, r = 0.32, r = 0.52) of quitting smoking during pregnancy. Stepwise multiple regression analysis showed that the most important determinant of intention was attitude with 20% variance (with the contribution of 6% self-efficacy, 2% social impact) (De Vries and Backbier 1994). The results of another study in which TPB components were tested in 72 women who were in early pregnancy seem to support these findings (Moore et al. 1996). Although reported studies indicate that self-efficacy is an important predictor of intention to quit smoking among pregnant women, the cross-sectional nature of these studies prevents clear information about whether high self-efficacy leads to less smoking or quitting, or whether self-efficacy increases due to less smoking or quitting (Moore et al. 1996).

In a study in which three constructs of TPB were evaluated, measurement of 44 women who smoked during pregnancy were compared with measurement of 21 women who quit smoking in the early stages of pregnancy. In terms of attitudinal beliefs, results showed that when compared with women who quitted smoking, women who continue to smoke underestimated the damage of smoking to the health of baby but believed that an increase in low birth weight and labour pain may occur due to smoking. In terms of social norms, it was found that smoking cessation was predominantly wished by friends, but the perceived beliefs of the partner and the family did not cause any difference between the two groups. In terms of control beliefs, the results showed that women who continue to smoke during pregnancy think that they have stronger smoking habits and therefore they believe that they will have more difficulty in quitting smoking during pregnancy (Bennett and Clatworthy 1999). In a recent study that tested factors affecting intention in 201 Israeli women who smoked during pregnancy, it was pointed out that women who have a more negative attitude towards smoking during pregnancy, will intend to quit smoking more. Moreover, it was found out that behavioral beliefs, behavioral attitudes, normative beliefs, subjective beliefs, and perceived control influenced intention to quit smoking in future pregnancies and model explained intention to quit smoking with a 61% variance (Natan et al. 2010). Also, it was reported that perceived control which is the most determinant of intentions, is affected by exposure to a smoking environment such as a smoking partner and friend, whom women do not have control over. Therefore, a decrease in the perceived behavioral control of women exposed to secondhand smoke is an expected situation. In a study that examines the intention to quit smoking among African American pregnant women in accordance with TPB beliefs, qualitative and quantitative data were accessed in two stages.

Qualitative data was collected from a focus group which consisted of pregnant women (n=49) accessed through an infant health program from San Bernardino in the first stage and a TPB-based questionnaire was developed with this data. This questionnaire was answered by 156 women whose ages were between 18-52. While the majority of the participants (71%) stated that they had quit smoking at least once in the last year, 29% reported that they had never tried to quit smoking during this period. When the participants were asked about their seriousness in quitting smoking, it was seen that 53% of the participants thought to quit within 30 days, 37% within 6 months, and 10% did not think of quitting at all. While perceived behavioral control was the strongest predictor of smoking cessation intention, attitude followed it in the study (Modeste et al. 2004). Data were collected from smokers (n=102) and ex-smokers (n=184) in the study that examine the association between smoking cessation beliefs and intention among Flemish women within the scope of TPB. After controlling for education and age, there was no significant difference betwen smoking cessation beliefs of participants with high or low intention to quit smoking. Accordingly, results showed that attitude, subjective norms, especially spousal support, and perceived behavioral control were associated with actual smoking behavior among pregnant women, but not with smoking cessation intention. In this context, researchers suggested that other factors such as depression and stress should be considered (De Wilde et al. 2017). For the inconsistency of this data with the findings of Natan et al. (2010), it was suggested that the participants of the other study were not pregnant and the answers based on their previous pregnancies may have increased the likelihood of recall bias and the measurement of intentions with hypothetical questions may have been affected by social desirability (De Wilde et al. 2017).

Recently, it is seen that, factors that are thought to affect the TPB structures have begun to attract attention as well as the TPB structures. Accordingly, the effect of a partner's smoking status on TPB structures was investigated in women (n=288) who reported smoking during their first prenatal visit (Middlestadt et al. 2020). As a result of the study, it was shown that perceived behavioral control and perceived norm are significantly associated with intention to quit smoking. In the study, there was no significant effect of attitude, age, nicotine addiction, or partner's smoking on intention. However, the main effect of the perceived norm was modified according to the smoking status of the partner. In conclusion, the effect of perceived norm was significant in women whose spouse or romantic partner smoked, but not in women who did not have a partner. In this context, study indicates that perceived norm in women whose partners smoke is important target for change in the smoking cessation interventions as well as perceived control (Middlestadt et al. 2020).

Transtheoretical Model (TTM)

TTM, (Prochaska and Diclemente 1982) based on social learning theories, is called a stage paradigm (Noar 2004) because it offers a different perspective for understanding health behaviors and it emphasizes that individuals go through 5 stages of change until they change their negative behaviors. These stages of change, that are important concepts of the model, are precontemplation (e.g. not planning to quit smoking in the next 6 months), contemplation (thinking about quitting in the next 6 months), preparation (planning to quit within the next 30 days and have quit for at least 24 hours in the last year), action (stopped smoking for 0–6 months), and maintenance (cessation has taken place for 6 months plus) (Slade et al. 2006). Also, the model suggests that people need different cognitive/experiential (consciousness raising, emotional arousal, environmental reevaluation, social liberation, and self-reevaluation) and behavioral (stimulus control, supportive relationships, counterconditioning, empowerment, and self-conciliation) strategies in different stages of change (Prochaska et al. 1992). As the model is an integration of the processes and principles of change from different theories of intervention, it is transtheoretical. TTM describes the change process as cyclical. Accordingly, individuals can progress through the stages as well as experience declines and then continue to progress through the stages of change. Returning to unhealthy behaviors in this process is considered as a natural part of the change process in the model (Prochaska et al. 1992). The model, whose each stage is time-limited (Wedeles 2014), is also criticized on the grounds that it is not a true stage model (Bandura 1998) and longitudinal study data is needed to support some of the model's proposals (Joseph et al. 1999).

A study examining how TTM constructs differ between pregnant and non-pregnant smokers showed that there was no difference between the groups in terms of pre-action phases (precontemplation, contemplation, and preparation), and both groups were predominantly in the precontemplation phase for smoking cessation (Ruggiero et al. 2000). This study indicates that pregnant and non-pregnant women are similar in their readiness to quit smoking. Moreover, pregnant smokers evaluated the negative aspects of smoking as less important compared to the normal population and used consciousness raising, dramatic relief, and environmental reevaluation less frequently (Ruggiero et al. 2000). In another study, it was found that pregnant women who smoked had lower fetal health locus of control than non-smokers (Haslam and Lawrence 2004). Accordingly, the low motivation of women to quit smoking can be explained by feeling low personal responsibility for the health of their unborn infant. In addition, the study also showed that pregnant women in precontemplation were less likely to increase their folic acid, vitamin, and iron intake during pregnancy. This finding suggests that babies of pregnant women who smoke may also be at a nutritional disadvantage (Haslam and Lawrence 2004).

In a study assessing the process of change according to the stages in addition to the similarity and differences between pregnant smokers and never smokers, 245 pregnant or parenting women were reached. The results of the study conducted within the scope of TTM indicated that 38.8% of the participants were in the cessation stages and 42.5% were in the contemplation or preparation to quit smoking. Consistently with the model, results showed that behavioral strategies were lowest in the precontemplation and highest in the preparation. In terms of phases and processes of change, it was seen that counterconditioning reached its peak in action; reinforcement management reached the highest levels in preparation; stimulus control reached its highest in action and maintenance. Also, the study showed that pregnant and non-pregnant teens who quit smoking had higher self-efficacy and lower smoking tendencies compared to smokers and non-pregnant teens (Sussex 2004). A similar study was conducted with 657 women classified according to the stages of change, and measurements were taken for self-efficacy, attachment to fetus and processes of change (Slade et al. 2006). The results showed that while experiential processes were mostly used by women in contemplation and preparation, behavioral processes were used by women in preparation and action. While self-efficacy levels of pregnant smokers did not change in the first three stages of TTM, it was found that the self-efficacy levels of women in action were higher. Moreover, it was stated that women in preparation showed more attachment to the fetus compared to women who had never smoked and women in the precontemplation (Slade et al. 2006). Buja et al. (2011) reported that pregnant smokers experienced higher levels of temptation which make them feel more social and emotional pressure in the early stages of TTM, and the social acceptability of smoking was higher at this stage. In another study, assessing the predictive power of cognitive variables and health-enhancing behaviors for the process of smoking cessation (Zycinska 2009), it was found that maternal beliefs concerning her infant's health were more effective than the mother's expectations about the results of her behavior in the transition from the contemplation to the preparation stage. Also it was found that transition from the preparation stage to the action stage was determined by the perceived effect of smoking on the infant's health. Accordingly, the study indicated that cognitive variables had more of an effect on smoking cessation compared to behavioral variables. The researcher suggested that these findings confirmed her criticism that TTM may not be a real stage model (Zycinska 2009). Finally, when general health behaviors were added, it was observed that self-efficacy decreased in consecutive TTM stages, contrary to expectations. This finding was explained by the role of other types of self-efficacy (e.g. recovery self-efficacy) increases when intention to change emerges (Zycinska 2009).

Reported studies indicate that the health risks of smoking have a significant effect on the intention to quit smoking, and women in the early stages of TTM care about these risks less therefore it may be beneficial to raise awareness by explaining the risks of smoking among pregnant women during prenatal visits. Considering that women in the contemplation and preparation stage are more aware of the health risks, it was suggested that interventions which develop skills rather than knowledge may be effective for them and giving practical advice on how to quit smoking to women who want to move from preparation

to action stage may be effective (Haslam and Draper 2000). In addition, since studies have shown that self-efficacy beliefs are an important predictor of intention to quit smoking, it is thought that it may be important to increase self-efficacy beliefs especially among pregnant women in the preparation stage of TTM.

Theory-Based Interventions for Smoking Cessation among Pregnant Women

Although there are many intervention studies about smoking cessation for pregnant women in literature, a limited number of theory-based studies have been reached. The theoretical framework of accessed studies were SCT and TTM. The details of the intervention studies are presented in Table 1.

One of the two intervention studies considered in the framework of SCT (Patten et al. 2010) compared standard interviews provided to pregnant women with videos, smoking cessation guides, and telephone counseling; and the other study compared it with biomarker feedback (Patten et al. 2019). In the study of Patten and colleagues, the video display included a woman as a role model to increase self-efficacy and reinforce the positive outcome expectancies of quitting tobacco. The telephone counseling included four telephone calls after a face-to-face meeting at the first prenatal visit. The biomarker feedback intervention included meetings with pregnant women where they shared their cotinine levels. In these meetings, counselors shared information about risk exposure and how to reduce the harmful consequences of quitting smoking to strengthen behavior change. Counselors helped participants to set short-term goals (e.g. reducing exposure to second-hand smoke) within the scope of their goals and values (e.g. healthy baby, healthy family) in order to increase self-efficacy. Although feasibility and acceptability of the biomarker feedback intervention has been demonstrated, neither intervention has been found to be effective in increasing smoking cessation rates. The ineffectiveness of the interventions was explained by low participation rates (Patten et al. 2010) and the fact that the women in the control group were concerned about the effect of smoking on fetus (Patten et al. 2019). Accordingly, researchers emphasized the need for interventions tailored to the women's stages of change and their readiness to quit.

In three of the intervention studies carried out within the framework of TTM, a motivational interview which is supporting Prochaska and DiClemente's (1982) stages of change and developed for addictive behaviors was evaluated. Tappin et al. (2005) investigated the effect of motivational interviews provided by nurses, held 2-5 times at home and lasting 30 minutes each, versus general care. Although the results of the study showed that 4.8% of the intervention group and 4.6% of the control group quit smoking, it was found that the motivational interviews did not increase smoking cessation among pregnant women. This finding was explained by the fact that the number of motivational interviews received by each participant was different (Tappin et al. 2005). In addition, although the motivational interview was stage-based, it was thought that the fact that participant's stages of change were not assessed before the study may have affected smoking cessation rates by preventing the suitability of the advice to be given to individuals in the interviews.

In another study in which motivational interviews (lasting 8 weeks) based on TTM were compared with standard care provided by doctors and nurses who advised pregnant women to quit smoking (Stotts et al. 2004), it was found that stage change did not differ according to the interventions, but the women who received motivational interviews used all of the change processes more, increased their self-efficacy beliefs to abstain from smoking more and decreased their reported temptation to smoke compared to women who received standard care. Moreover, it was observed that all participants decreased their level of importance given to the positive aspects of smoking pre to post-intervention (Stotts et al. 2004).

In the study of Karatay and colleagues (2010), assessments with 1-month interval and motivational interviews were carried out during home visits. Since it was determined that all of the women in the study were at the "intention stage", home visits consisted of informing about perceived advantages and disadvantages of smoking, requesting that study participants write down their reasons for smoking, leaving a brochure explaining the harm of active and passive smoking, creating awareness about the harms of smoking, motivating women to quit smoking, preparing women to quit smoking, deciding the method and date of quitting smoking, preventing passive smoking, and teaching to cope with stress associated with non-smoking. Results showed that 39.5% of women quit smoking, more than 47% of them reduced their smoking rate by 60%. Also, self-efficacy beliefs of women who continued, reduced or quit smoking did not differ in the first assessment but it was observed that self-efficacy beliefs of women who quit smoking increased after 3 months of assessment. Finally, it was reported that all women participating in the study moved from the intention stage to other (preparation, action) stages. Although the lack of a control group in the study limits interpretation of the results, findings indicate that motivational interviews can be effective among pregnant women. In another study conducted with home visits (Pletsch 2002), researchers compared the effect of the intervention that includes stage-based tobacco control counseling, a 10-minute video display of the physiological effects of smoking, and progressive relaxation exercises for stress management with general care. In the counseling given in two home visits and carried out with two week intervals, a supportive attitude was exhibited without being judgmental considering the guilt that pregnant women may experience because of smoking (Pletsch 2002). Results showed that 3% of the women in the intervention group and 17% of them in the control group were in the action stage after the study, but there was no difference between these groups. Moreover, it was observed that women did not move from the action stage to the maintenance stage (avoiding tobacco smoke for at least 6 months) during the study. Researchers reported that the intervention might not have been powerful enough to effect additional changes in smoking behavior, or a type II error could have occurred. In both of the intervention studies carried out based on TTM, it was observed that the self-help

Table 1. Theory-based smoking cessation intervention studies among pregnant women

Authors / Year	N	Inclusion criteria	Interventions	Measurements	Time of measurements	Theoretical framework	Conclusion
Patten et al. 2010	35	≥18 years old, Being pregnant (≤24 weeks), Having access to a phone and DVD player, Planning to quit in the next 30 days	Intervention group including video, smoking cessation guide and telephone counseling (n = 17) Control group including 5-minute interview consisting of 5A1 questions (n=18)	Self-report and salivary cotinine level	At baseline and follow-up (60 days later)	SCT	*Intervention was not effective *Smoking abstinence was observed in 6% of the control group and 0% of the intervention group. *Low enrollment rate showed that the program was not feasible and acceptable.
Patten et al. 2019	60	≥18 years old, Being pregnant (≤28 weeks), Self-reported smoking (use in the last 7 days)	Biomarker feedback intervention group (n=30) Control group including the standard interview consisting of 5A questions (n=30)	Self-report and urinary cotinine level	At baseline, after intervention (5 weeks later) and birth time before leaving hospital	SCT	*Study supported acceptability and feasibility of biomarker feedback *When compared to standard care, intervention did not increase smoking cessation rate during pregnancy.
Pletsch 2002		≥18 years old, Being pregnant (≤20 weeks) Free from illicit substance or excessive alcohol use for the previous year, Smoked at least 10 cigarettes per day prior to pregnancy	Counseling on stage-based tobacco control, video display, home visits including progressive relaxation exercises (n=31) Control group including standard care (n=43)	Self -report	At baseline, 2 weeks after intervention, the last month of pregnancy	TTM	*Although 3% of women in the intervention group and 17% of those in the control group were in the action stage to quit smoking after entering the study, no difference was found between the groups The intervention had no effect on reducing environmental tobacco smoke.
Lawrence et al. 2003	918	≥16 years old, Being pregnant, Self-reported smoking	Standard care Self-help handbook suitable for each phase of change, use of an interactive computer program with individualized smoking cessation advice	Self-report and urinary cotinine level	At baseline, 28-30th weeks of birth, 10 days after birth	TTM	*Statistically, intervention did not lead to improvement in smoking cessation rates *Little difference was found for smoking rates between the intervention and control groups *3% of the intervention group succeeded in quitting smoking.

Table 1. Continued

Authors / Year	N	Inclusion criteria	Interventions	Measurements	Time of measurements	Theoretical framework	Conclusion
Tappin et al. 2005	762		Intervention group receiving motivational interview (lasting 30 minutes; n=351) Control group (n=411)	Self-report, plasma and salivary cotinine level	At baseline, in the 25-31th week, in late pregnancy	TTM	*It was observed that 4.8% of the intervention group and 4.6% of the control group stopped smoking. *Motivational interviews did not increase smoking cessation.
Stotts et al. 2004	54	≥16 years old, Being pregnant (≤28 weeks), Reported smoking in the past 7 days	Intervention group including a face-to-face motivational interview session, three telephone consultations, personalized feedback letter (totally 8 weeks) Control group including standard care	Self-report and salivary cotinine level	Pre-intervention and post-intervention	TTM	*It was seen that change of stage did not differ according to the interventions, women who received motivational interviews used all process of change more, self-efficacy beliefs for smoking abstinence increased more, temptation to smoke decreased more than women in usual care.
Aveyard et al. 2006	918	Being pregnant (12 weeks), Self-reported smoking	Stage based training on TTM concepts, stage based self-help booklet (B) In addition to the stage-based self-help booklet training on use of this booklet and utilization from computer program including information about this booklet and usage of it (C) Standard advices about smoking given by midwives and self-help leaflet on smoking cessation (A)	Self-report	In the 30th weeks of pregnancy and 10 days after birth	TTM	*Participants who received TTM-based intervention (B, C) moved further in stages of change compared to control group who received standard care * Women in C group experienced this change 60% more than women in condition A. *The TTM intervention was more effective for women in precontemplation and contemplation phase than women in preparation phase.

Table 1. Continued

Authors / Year	N	Inclusion criteria	Interventions	Measurements	Time of measurements	Theoretical framework	Conclusion
Rigotti et al. 2006	442	Being pregnant (26 weeks) Reported smoking at least one cigarette in the last 7 days, ≥18 years old	Intervention group including leaflet on smoking cessation, Theory-based telephone counseling with 5 steps of smoking cessation guidance provided by trained consultants, Focusing on cognitive strategies, cognitive behavioral and relapse prevention interventions according to the needs of individuals Control group who received a smoking cessation leaflet and 5-minutes counseling in addition to standard care	Self-report and salivary cotinine level	At baseline, at the end of pregnancy (up to 28th weeks) and 3 months postpartum by telephone interview	TTM, Health Belief Model	*Telephone counseling was not effective in all groups, but it was effective for people who smoked less and attempted to quit during pregnancy.
Karatay et al. 2010	38	Not completing the 16th week of pregnancy, Smoking at least once a day	Motivational interview, giving informative leaflet about smoking, writing diary, 5 home visits including information on second-hand smoke protection and 3 assessment visits	Self-report, carbon monoxide level in exhaled air, cotinine level	Measurement at every home visit	TTM	* 39.5% of women quitted smoking. * More than 47% of women reduced their smoking rate by 60% compared to their beginning rate. *Self-efficacy scores increased by 27% after intervention.

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handbooks given in accordance with the stages of change were evaluated. Lawrence and colleagues (2003) compared standard care (A) with TTM-based self-help handbook (B) and the interactive computer program that provides individualized smoking cessation advice in addition to the TTM-based self-help handbook (C). While standard care included the delivery of the "Think about quitting" brochure with information on how to quit smoking, phase-based handbooks included information and exams about each stage of change, exercises for participating in proper phase processes and individualized smoking cessation strategies. The interactive computer program included women asking questions, and receiving feedback about the stage they were in, decision balance, temptations, change processes, and going through the stages. According to the results of the measurement, although 1.7% of the participants in condition A, 4.3% of those in condition B and 5.7% of those in condition C quit smoking, no significant difference was found between these conditions. While no difference was observed between the interventions at follow-up measurement 18 months after birth, it was observed that 7 out of 54 women who quit smoking after pregnancy continued to abstain from smoking (Lawrence 2004). The ineffectiveness of TTM-based interventions compared with general care can be explained by the failure of the assessment of reduction in smoking or passing the stages of change. Because TTM emphasizes that not only outcome changes but also changes in the intervention process should be measured (Miller and Rollnick 2002). In a study in which a similar experimental design was tested on 918 smokers at 12 weeks of pregnancy (Aveyard 2006), unlike the studies of Lawrence and colleagues (2003, 2004), measurements were also taken regarding the change between the stages of smoking cessation. The results of the study showed that participants who received TTM-based intervention (B, C) moved further in the stages of change compared to participants who were in the control condition receiving general care. Also women in condition C experienced this change 60% more than women in condition A. In addition, the study indicated that the intervention was more effective for women in the preparation stage than for women in the precontemplation and contemplation stages. Although this finding brings into disrepute the knowledge that TTM-based interventions can benefit individuals in pre-action stages (Aveyard 2006), more research on this topic and about interventions is needed.

Another method assessed in studies conducted within the framework of TTM and can be considered as a proactive intervention is telephone counseling. In a study conducted on this topic (Rigotti et al. 2006), in addition to the standard care, participants in the control group received a smoking cessation brochure as an e-mail and counseling not exceeding 5 minutes was provided during the record of the study. Participants in the intervention group got a series of phone calls in addition to written material sent by e-mail. Trained counselors called participants according to their need and the 5-step smoking cessation counseling guide and they drew on the principles of social learning theory, TTM, the health belief model, and motivational interviewing principles in this counseling. After each call, participants received a summary letter. Moreover, while cognitive strategies were given to participants who were not ready to quit, cognitive behavioral and relapse prevention interventions were given to participants who were ready to quit. However, the results showed that telephone counseling was not effective in all groups, but was effective in those who smoked less and attempted to quit during pregnancy (Rigotti et al. 2006).

Conclusion

Smoking during pregnancy is an important health problem as it affects the health of both the mother and baby. This review confirms that the studies testing smoking cessation in pregnant women within the framework of health behavior theories are limited. Studies in which especially TPB and TTM variables among health behavior theories were tested, indicate that the important predictor of smoking cessation behavior in pregnant women is self-efficacy, which is a transtheoretical variable. In addition, studies show that smokers during pregnancy care about the negative effects of smoking less. Pregnant women whose readiness to quit smoking does not differ from the normal population (Ruggerio et al. 2000) experience higher levels of temptation in the early stages of change (Buja et al. 2011) and their transitions from these stages with low self-efficacy to other phases are determined by the beliefs of pregnant women about their infants' health (Zycinska 2009). When smoking cessation interventions for pregnant women are reviewed, it is seen that these interventions were tested within the scope of SCT and TTM. However, it has been shown that the combined use of videos, smoking cessation guides and telephone counseling within the scope of SCT and biomarker feedback are not more effective than the general care provided to pregnant women (Patten et al. 2010, 2019). In this context, attention is drawn to the fact that failure to assess the readiness of women in SCT-based interventions limits the results of the studies. In the intervention studies performed within the framework of TTM, in which the stages of change are considered, it is seen that especially the stage-based motivational interview, self-help handbooks or brochures and telephone counseling are used. Although it is difficult to mention that the clear findings about the effectiveness of interventions and the results of the study indicate that the assessing stage of change for pregnant women during prenatal visits and ensure stage based interventions are supportive (Rigotti et al. 2006, Karatay et al. 2010).

When the studies were considered in general, it was remarkable that the outcome variables of the interventions were not clarified, but more than one outcome variable (quitting smoking, reducing smoking, and stage change) were evaluated. However, in order to increase the effectiveness of interventions, it is thought that it may be important to have a clear target health behavior as well as the target population. In addition, it was seen that the limited number of studies (Lawrence et al. 2003, Stotts et al. 2004) considered temptations for smoking cessation behavior. However, since smoking is affected by different variables at the individual and environmental level (Lawrence et al. 2003), it is considered that including barriers to quitting smoking in

interventions are important. It is thought that it is important to include spouses in intervention programs and to teach them to support their pregnant spouses in these processes, especially since the preventive effect of smoking spouses is emphasized in the literature on this topic (Schneider et al. 2010). Finally, only one of the reported studies included relapse-prevention intervention (Rigotti et al. 2006). In this context, it is thought that determining the theory-based variables that will affect the reduction of relapse and taking them into account in the content of the interventions will contribute to effectiveness of the interventions.

It should be noted that this review, which evaluates the studies on smoking cessation behavior among pregnant women within the framework of health behavioral theories, has some limitations. First, the study was completed by performing the three reported keywords and databases. In this context, it may be possible to extend this review by enhancing the database and keywords. Second, since there was no research that directly examined Health Belief Model (Galvin, 1992) which is used to explain smoking cessation behaviors, as a descriptive or intervention study for pregnant women, this model did not fall under this review. Third, the outcome variable in this review is limited with studies that only handle smoking cessation, reduction, or these behavioral processes. It may be possible to extend the outcome variable of the study by inclusion of relapse too. Finally, a review of theory-based studies testing the effects of smoking on different outcomes (e.g. breastfeeding) among pregnant women may also be helpful.

Authors Contributions: *The authors attest that she has made an important scientific contribution to the study and has assisted with the drafting or revising of the manuscript.*

Peer-review: *Externally peer-reviewed.*

Conflict of Interest: *No conflict of interest was declared by the authors.*

Financial Disclosure: *The authors declared that this study has received no financial support.*

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