

Tobacco Consumption and Spontaneous Quitting at the First Trimester of Pregnancy

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ABSTRACT

Introduction: The purpose of this study was to examine the association between pregnant women's socio-demographic characteristics, smoking-related variables and psychological symptoms (anxiety and depression) and both tobacco consumption and spontaneous quitting at the first trimester of pregnancy. In particular, we wished to examine the contribution of depressive symptoms to tobacco consumption and spontaneous quitting, while controlling for anxiety symptoms, socio-demographic and smoking-related variables.

Methods: The sample was comprised of 901 Spanish pregnant women. Assessment included an ad hoc questionnaire with socio-demographic and tobacco consumption information, the *Edinburg Postnatal Depression Scale* (EPDS), and *The State-Anxiety Inventory* (STAI-S). Two multiple logistic regression analyses were performed, respectively to predict tobacco consumption and to predict spontaneous quitting.

Results: Having a partner who smokes (OR = 5.578), not having a college education (OR = 2.803), higher scores on the EPDS (OR = 1.073) and higher scores on the STAI-S (OR = 1.027) increase the probability of continuing smoking. Being primiparous (OR = 2.463), having a college education (OR = 2.141), smoking fewer cigarettes before pregnancy (OR = 1.175), and lower scores on the STAI-S (OR = 1.045) increase the probability of spontaneously quitting smoking at the first trimester of pregnancy.

Conclusions: Depressive symptoms were a predictor of tobacco consumption but not of spontaneous quitting; spontaneous quitting was better predicted by anxiety symptoms. These findings support recommendations that women with depressive symptoms are at risk for smoking during pregnancy and highlight that anxious symptoms should be targeted in interventions for smoking cessation during pregnancy.

Keywords: Pregnancy; Tobacco consumption; Smokers; Smoking cessation; Quitters;
Spontaneous quitting.

ACCEPTED MANUSCRIPT

1. Introduction

Tobacco is one of the most commonly used drugs, and cigarette smoking during pregnancy has serious health consequences for both the pregnant woman and her offspring. In fact, several medical and psychological problems were reported in the offspring from gestation (Stroud et al., 2009; USDHHS, 2014; Vardavas et al., 2010) to several years after childbirth (Wakschlag et al., 2011), and were associated with the mother tobacco consumption during pregnancy. Despite policies implemented to reduce smoking and efforts to increase awareness of the detrimental effects of smoking during pregnancy, the prevalence of tobacco consumption namely in Europe is still quite high during pregnancy (Smedberg, Lupattelli, Mardby, & Nordeng, 2014; Smedberg, Lupattelli, Mardby, Overland, & Nordeng, 2015). Reported ranges varied from 7% to 37%, depending on the European country (Dupraz et al., 2013; Krstev, Marinkovic, Simic, Kocev, & Bondy, 2012; Lauria, Lambertiand, & Grandolfo, 2012; Mateos et al., 2014; Tappin et al., 2010). Nevertheless, some women spontaneously quit smoking after learning that they are pregnant. Schneider, Huy, Schüz, & Diehl (2010) reported international rates of spontaneous smoking cessation ranging from 27% to 47% in Europe, 23% to 43% in the U.S., 62% to 70% in Japan, and 4% to 47% in other countries.

Literature in the field has associated smoking during pregnancy with certain mother's socio-demographic characteristics such as age (Maxson, Edwards, Ingram, & Miranda, 2012), low socioeconomic status and, therefore, lower household incomes (Krstev et al., 2012; Maxson et al., 2012), low educational level (De Wilde et al., 2013; Goedhart, van der Wal, Cuijpers, & Bonsel, 2009; Krstev et al., 2012; Linares-Scott, Heil, Higgins, Badger, & Bernstein, 2009; Maxson et al., 2012; Smedberg et al., 2015), not having or not cohabiting with a partner (Dupraz, et al., 2013; Goedhart et al., 2009; Maxson et al., 2012) and having children previously (Maxson et al., 2012). Smoking during pregnancy was also associated

with variables related to smoking consumption, in particular, living with smokers, especially having a partner who smokes (De Wilde et al., 2013; Dupraz et al., 2013; Scheneider et al., 2010), and a high level of tobacco use or years of consumption (Eiden et al., 2011; Goedhart et al., 2009; Linares et al., 2009; Scheneider et al., 2010). From a strict psychological point of view, some studies have associated mother's psychological problems with tobacco consumption during pregnancy, including lack of social support (Maxson et al., 2012; Meghea et al., 2012), anxiety (Goedhart et al., 2009; Linares et al., 2009; Varescon, Leignel, Gérard, Aubourg, & Detilleux, 2013) and depressive symptoms (De Wilde, 2013; Goedhart et al., 2009; Linares et al., 2009; Ludman et al., 2000; Maxson et al., 2012; Munafò, Heron, & Araya, 2008; Smedberg et al., 2015). Depression in particular has been strongly linked with smoking at all stages of life (Becoña & Míguez, 2004). During pregnancy, depressed women are twice more likely to smoking, and this association is observed across different European countries (Smedberg et al., 2015).

The body of research on the role of anxiety in tobacco consumption during pregnancy is quite sparse, when compared to the depression. Taking in account the high comorbidity between depression and anxiety symptomatology during pregnancy (Figueiredo & Conde, 2011; Vesga-López et al., 2008), questioning how much of the effect of depression on tobacco consumption can be due to the effect of co-morbid anxiety, when anxiety is not controlled, is relevant.

Quitting smoking during pregnancy was also associated with both the mother's socio-demographic characteristics and smoking-related variables. Among the factors that have been reported to increase the chances of spontaneous quitting during pregnancy, the most cited are primiparity (Krstev et al., 2012; Torrent et al., 2004), having a planned pregnancy (Fang et al., 2004), a higher educational level (Higgins et al., 2009; Krstev et al., 2012; Vaz et al., 2014), a non-smoking partner (Torrent et al., 2004), and lower pre-pregnancy use and/or a lower level

of nicotine dependence (Higgins et al., 2009; Morasco, Dornelas, Fischer, Oncken, & Lando, 2006; Torrent et al., 2004; Vaz et al., 2014). Other studies also linked the decision to quit smoking during pregnancy with the awareness of the risks of smoking on the fetus, on health and with the guilt resulting from smoking (Fang et al., 2004; Smerdberg, et al., 2015).

Nevertheless, less attention has been paid to the relationship between quitting smoking during pregnancy and the mother's psychological symptoms. Prior research indicates that women with high levels of depressive symptoms present a decreased likelihood of quitting smoking during pregnancy (Smerdberg, et al., 2015) and tend to be less confident in their ability to quit smoking (Hauge, Torgensen, & Vollrath, 2011; Prusakowski, Shofer, Rhodes, & Mills, 2011). Moreover, although psychological symptoms during pregnancy are more prevalent among smokers, and less prevalent among spontaneous quitters (Solomon et al., 2006), no previous studies have differentiated the effects of anxiety and depression symptoms on smoking behavior during pregnancy.

The aim of the present study was, firstly, to analyze the association between Spanish pregnant women's socio-demographic characteristics, smoking-related variables and psychological symptoms (anxiety and depression) with both tobacco consumption and spontaneous quitting in the first trimester of pregnancy. And secondly, to examine how much depressive symptoms contribute to tobacco consumption and spontaneous quitting, after controlling for socio-demographics characteristics, smoking-related variables and anxiety symptoms. The research questions addressed were: Are the characteristics that differentiate women who continue smoking from those who spontaneously quit during pregnancy in Spain similar to the ones found in other countries? Do depressive symptoms contribute to tobacco consumption and spontaneous quitting during pregnancy?

The questions asked in the present study regarding the characteristics that differentiate women who continue smoking from those who spontaneously quit in pregnancy is a relevant

one, in order to provide a more adequate intervention to those women at risk of not quitting smoking during pregnancy.

2. Method

2.1. Participants

Pregnant women attending a primary health public care center in two health areas of Galicia (Northern Spain) were consecutively recruited, until the sample size to insure representativeness was reached¹. Inclusion criteria were: having 18 years or more, less than 20 weeks pregnant and speaking and reading Spanish. A total of 915 women were invited to enroll in the study, 11 pregnant women declined the participation, and three could not be enrolled, as they were not proficient in Spanish. The study sample was comprised of 901 pregnant women at the first trimester of pregnancy, with an average of 10.02 weeks of gestation ($SD = 4.27$).

The age range of the sample was between 18 to 46 years, with a mean age of 32.73 years ($SD = 4.36$). More than half of the participants were over 30 years old (72.3%), were employed at the time the survey was carried out (71.0%), were primiparous (66.3%), had university studies (53.2%) and earned a maximum 2000 euros net per month and household (63.5%). Likewise, the majority of the participants were married or cohabiting (83.7%).

2.2. Procedure

This study received approval from the General Directorate of Research, Teaching and Research Ethics Committee of Clinical Research of Galicia. It took place between December 2012 and February 2014. The sample was recruited in the first trimester of pregnancy, while the participants were waiting for their first or second midwife consultation at their local health

¹ A mathematical formula, which took into account the number of births in Galicia in the year preceding the study according to official data, with a confidence level of 95 % and an accuracy of 3.4%, was used to calculate the sample size to insure representativeness

centers. Participants were firstly informed about the objectives of the study and their cooperation was requested.

Once informed consent was signed, two psychologists especially trained for that purpose carried out the interviews individually. The time for individual assessment of each participant was between 15 and 20 minutes on average. No pregnant women withdraw her participation after signing the informed consent and 98.5% of the pregnant women completed all the study measures. Self-reports of smoking abstinence were biochemically verified through cotinine concentration in urine.

2.3. Measures

2.3.1. Socio-demographic and consumption information

A questionnaire regarding socio-demographic characteristics (e.g., age, marital and employment status, number of children, education, occupation and household income), psychological (e.g., participant's psychological diagnose) and pregnancy-related variables (e.g., parity, number of gestational weeks and planned pregnancy) was developed for this study. Smoking status was assessed by the following questions: "Have you ever smoked cigarettes regularly?" "Did you smoke before pregnancy?" (if yes, "How many cigarettes did you smoke each day on average?" if no, "Since how many months before pregnancy?") "Have you smoked any cigarettes in the past seven days?" (if yes, "How many cigarettes did you smoke each day on average?" if no, "Since when did you stopped smoking and why?").

Women who reported smoking no cigarettes in the past seven days, but had smoked at least one cigarette per day in the three months prior to learning of their pregnancy, and who reported quit when they suspected /confirmed they were pregnant were classified as "spontaneous quitters". Other variables related to pre-pregnancy smoking included the number of daily cigarettes smoked and the number of years consuming tobacco. We also

asked about the perception of how tobacco consumption affects health by the following question: Do you believe that smoking seriously affects health?, and partner's smoking status.

Self-reports of smoking abstinence were biochemically verified through urinary cotinine by Cotinine Test Medi-marketing (cut-off 200 ng/mL). This biochemical measure was selected instead of carbon monoxide as the cotinine remains for a longer period of time in the human body than the later. The use of cotinine was particularly helpful as the pregnant women were assessed in the morning and previously to a medical appointment, so it was expected that they would not have smoked. Cotinine measurement and self-report were combined to establish smoking status. Pregnant women who reported not smoking performed a cotinine urine test and were classified as smokers when the result was positive.

2.3.2. *Edinburg Postnatal Depression Scale (EPDS)*

The EPDS (Cox, Holden, & Sagovsky, 1987) is a self-reported questionnaire designed to detect postpartum depressive states. This scale includes 10 items with four response options, each having a single value between 0 and 3, the higher the value the more severe the symptom. As a consequence, the scale scores range from 0 to 30. This is the most internationally used questionnaire for detection of postpartum depressive symptoms, but it is also used for assessments during pregnancy (Figueiredo & Conde, 2011). The cut-off score of the scale is country dependent, ranging between 9 and 13. The EPDS Spanish version of the scale (García-Esteve, Ascaso, Ojuel, & Navarro, 2003) proposed a cut-off of 10 / 11; so scores of 10 or more are indicative of probable depression. In the present study, the EPDS showed good internal consistency (Cronbach's $\alpha = .85$).

2.3.3. *State Anxiety Scale of State-Trait Anxiety Inventory (STAI)*

The State Anxiety Scale (S-Anxiety) of STAI (Spielberger, Gorsuch, & Lushene, 1970; Spanish version TEA, 1982) evaluates the current state of anxiety, asking how respondents feel "right now". It consists of 20 items, whose responses are coded using a

Likert scale of 4 points. The score for subscale ranges from 0 to 60, higher scores indicating higher levels of anxiety. In the Spanish adaptation of the questionnaire a score of 31 has been suggested as a clinical cutoff point for the female population (Sarasua, Zubizarreta, Echeburúa, & Corral, 2007). In this sample, the internal consistency of the STAI-S was excellent (Cronbach's $\alpha = .94$).

2.4. Data Analysis

Data were analyzed with SPSS Statistics version 20. The significance level was at $p < .05$. To test differences between smokers and all non-smokers (never smokers and quitters) and smokers and quitters, chi-square test for discrete variables and Student's t -tests for continuous variables were respectively performed. Cramers's V coefficients and Cohen's d were calculated to estimate the effect size².

To predict tobacco consumption and quitting smoking at the first trimester of pregnancy, two forward binary logistic regressions were performed, respectively on two different samples. First, to predict current tobacco consumption, the total sample ($N= 901$) was used, using tobacco consumption (Yes vs. No) as dependent variable (VD). The sub-samples utilized for the analysis were smokers and non-smokers (quitters and never smokers). Next, to predict spontaneous quitting the sub-sample of 268 smokers before pregnancy was used, and the VD was tobacco abstinence (Yes vs. No). In both models, socio-demographic, health and psychological variables (age, marital and occupational status, parity, educational level, income, planned pregnancy, smoker partner and STAI-S) were used as predictors in the first step and the score of the EPDS was used as predictor in the second step.

3. Results

² $d = (\bar{X}_1 - \bar{X}_2) / [(S_1^2 + S_2^2) / 2]^{1/2}$

In this sample ($N = 901$), 70.3% ($n = 633$) of pregnant women had never smoked or had given up smoking before pregnancy, 12.3% ($n = 111$) spontaneously quit in the first trimester of pregnancy, and 17.4% ($n = 157$) continued smoking. Of the women smoking previously to pregnancy ($n = 268$, 29.7%), 41.4% ($n = 111$) spontaneously quit in the first trimester of pregnancy and 58.6% ($n = 157$) continued smoking. Of the pregnant women smoking, 60.5% report to have reduced the number of cigarettes per day ($M = 10.35$; $SD = 4.51$), and the mean reported consumption was of 5.82 cigarettes per day ($SD = 3.47$).

3.1. Socio-demographic Characteristics and Smoking Status

Tobacco consumption in the first trimester of pregnancy was significantly associated with all the studied socio-demographics variables, with the only exception for age and parity (Table 1). Smoking was associated with not cohabiting ($p < .001$), being unemployed ($p = .009$), lower educational level ($p < .001$) and lower monthly income ($p = .006$).

Spontaneously quitting smoking in the first trimester of pregnancy was associated with being primiparous ($p = .018$), higher educational level ($p < .001$) and higher monthly income ($p = .007$).

Insert here Table 1

3.2. Health and Psychological Factors and Smoking Status

Furthermore, to analyze the relationship between smoking status with different health and psychological variables (Table 2), it was found that tobacco consumption in the first trimester of pregnancy was significantly associated with all the studied variables. Smoking was associated with not having planned the pregnancy ($p = .036$), living with a partner who smokes ($p < .001$), lower health risk perceptions associated to smoking ($p < .001$), had been

diagnosed previously with a psychological disorder ($p = .025$), higher anxiety ($p < .001$) and higher probable depression ($p < .001$), i.e., EPDS ≥ 10 .

Comparing mean scores on the EPDS between smokers and non-smokers, it was found that smokers had statistically significant [$t(197.75) = -5.32, p < .001, d = 0.50$] higher mean scores [$M = 7.09 (SD = 5.28)$ vs. $M = 4.71 (SD = 4.11)$]. Also, significant differences were found in the mean scores from the STAI-S [$t(196.22) = -4.98, p < .001, d = 0.47$], smokers having higher scores [$M = 19.27 (SD = 12.65)$ vs. $M = 13.95 (SD = 9.67)$].

Spontaneously quit smoking in the first trimester of pregnancy was significantly associated with not having smoking partners ($p = .016$), lower anxiety ($p = .023$) and lower depression ($p = .018$). Also, pregnant quitters showed mean scores on the EPDS significantly lower [$t(256.62) = -3.38, p < .001, d = 0.41$] than women who continue to smoke [$M = 5.06 (SD = 4.51)$ vs. $M = 7.09 (SD = 5.28)$]. This also happens with mean scores on the STAI-S [$t(255.56) = 2.93, p < .01, d = 0.36$], [$M = 15.04 (SD = 10.92)$ vs. $M = 19.27 (SD = 12.65)$].

Moreover, it was found that quitters obtained significantly lower mean scores on the number of years of tobacco consumption [$t(266) = 6.71, p < .001, d = .32$] than smokers [$M = 12.68 (SD = 4.75)$ vs. $M = 14.27 (SD = 5.15)$]; and a lower [$t(263.54) = 52.93, p < .001, d = .93$] number of daily cigarettes smoked before pregnancy [$M = 7.54 (SD = 5.41)$ vs. $M = 13.14 (SD = 6.99)$].

Insert here Table 2

3.3. Predictors of Smoking Status

The results of the logistic regression analyses (Table 3) showed that not having a college education (OR = 2.803), having a smoking partner (OR = 5.578), higher scores on the STAI-S (OR = 1.027) and higher scores on the EPDS (OR = 1.073) determine a higher

probability of smoking during early pregnancy. The model adjustment increases significantly from the first to second step (R^2 Cox and Snell = 0.158 vs. R^2 Cox and Snell = 0.162). The regression model presented an adequate goodness of fit, Hosmer and Lemeshow's $\chi^2 = 6.340$, $p = 0.609$ ($\chi^2 = 144.668$, $p < .001$).

Otherwise, being primiparous (OR = 2.463), having a college education (OR = 2.141), smoking less cigarettes before pregnancy (OR = 1.175) and lower scores on the STAI-S (OR = 1.045) determines a higher probability that women spontaneously quit smoking. Likewise, the regression model presented an adequate goodness of fit, Hosmer and Lemeshow's $\chi^2 = 5.850$, $p = .664$, and was statistically significant, $\chi^2 = 69.289$, $p < .001$.

Insert here Table 3

4. Discussion

In this sample of Spanish pregnant women, the prevalence of smoking in the first trimester was high (17.4%) and similar to rates observed in other studies (Maxson et al., 2012; Meghea et al., 2012; Smedberg et al., 2015). The pregnant smoker profile found in the present study corroborate that smokers tend not to cohabit with or have a partner (Dupraz, et al., 2013; Goedhart et al., 2009; Maxson et al., 2012), are more likely to have a lower household income or lower socioeconomic status (Krstev et al., 2012; Maxson et al., 2012) and a lower educational level (De Wilde et al., 2013; Goedhart et al., 2009; Krstev et al., 2012; Linares et al., 2009; Maxson et al., 2012; Smedberg et al., 2015). Additionally, and consistent with prior research (De Wilde et al., 2013; Dupraz et al, 2013), pregnant smokers are more likely to have a partner who smokes, which indicates that household smoking is a significant risk factor for smoking, an assumption that is valid for the general smoking population. However, findings concerning age and parity in the current study do not match all results from the literature since

no differences were found between smokers and non-smokers in age or in parity.

Furthermore, from a psychological point of view, higher percentages of depression and/or anxiety were also reported among pregnant smokers by previous studies (De Wilde, 2013; Eiden et al, 2011; Goedhart et al., 2009; Linares-Scott et al., 2009; Ludman et al., 2000; Varescon et al., 2013).

Our data also showed that a high percentage of women quit smoking on their own initiative once their pregnancy is confirmed. One hundred eleven (41.4%) out of the 268 women who reported smoking before pregnancy spontaneously quit smoking in the first of pregnancy, which coincides with data reported by Schneider et al. (2010) of 27-47% quitters in European studies

The results in the present study seem to corroborate the fact that pregnancy motivates women to quit tobacco consumption (Hepper et al., 2011) because about half of smokers in the sample spontaneously quit smoking after they found out they were pregnant. However, these optimistic data must be analyzed carefully because the literature also notes that smoking relapse in the postpartum period occurs at high rates (Su & Bottenheim, 2014).

Likewise, differential characteristics were observed in women who spontaneously quit smoking once their pregnancy was confirmed. Those who quit were more likely to be primiparous, have a higher educational level, have higher socioeconomic status and have a non-smoking partner, have a lower number of years of tobacco consumption, smoke a lower number of cigarettes daily before pregnancy, and have lower anxiety and depressive symptoms. These are characteristics consistent with the literature. For instance, Krstev et al. (2012) noted that women who are primiparous and have a higher educational level and socioeconomic status are more likely to spontaneously quit smoking. Likewise Torrent et al. (2004) pointed out that being primiparous and having a non-smoking partner were factors

related to smoking cessation during pregnancy. Additionally, Smedberg et al., (2015) reported that 32.5% of the women that continued smoking during pregnancy were depressed.

Having a lower educational level, having a partner who smokes and higher scores on anxiety and depression (even when controlling for anxiety symptoms) were predictors of tobacco consumption. Being primiparous, having a college education, consuming fewer cigarettes before pregnancy and having lower scores for anxiety, but not for depression, were factors that predicted smoking abstinence. Depressive symptoms seem to be a major predictor of tobacco consumption but not of quitting smoking in the first trimester of pregnancy, when anxiety symptoms are considered. Nevertheless, anxiety predicted both consumption and spontaneous cessation. One possible explanation for the present findings suggests that smokers use cigarettes to regulate negative affect and other mood states (self-medication hypothesis), and that it is precisely these symptoms that maintain tobacco consumption during pregnancy (Bullock et al., 2001; Ludman et al., 2000; Munafò et al., 2008). The belief that smoking is an effective method of coping with negative affect and potential stressors during pregnancy (e.g., health concerns) provides women who experience emotional difficulties the motivation to continue smoking despite social pressure and awareness of the health risks.

Some studies note that women with higher depressive symptoms continue smoking and present a decreased likelihood of quitting (Hauge et al., 2011; Smedberg et al., 2015). Anxious symptoms were not considered in these studies and depression symptoms can bias the effect of anxious symptoms due to high comorbidity between depression and anxiety symptoms, especially in women during pregnancy (Figueiredo & Conde, 2011; Vesga-López et al., 2008). Nevertheless, the present study examined how much women's depressive symptoms contribute to tobacco consumption and spontaneous quitting after controlling for anxiety symptoms. As a consequence, we consider it essential to analyze depression alongside with anxiety while studying tobacco consumption and spontaneous quitting during pregnancy.

Limitations in the present study indicate that our results should be interpreted with some caution. This study was cross-sectional, which means it is difficult to establish a causal relationship between the different variables under analysis. Furthermore, no pre-pregnancy psychological assessments were carried out, which does not allow us to know how pre-pregnancy status affected the process of quitting due to anxious and depressive symptoms. Depression and anxiety symptoms were self-reported in questionnaires and subject to social desirability bias.

Despite these limitations, this study has several strengths. This includes testing simultaneously and in a large sample all the relevant factors (namely psychological factors) that previous research has found to be related with smoking in pregnancy, and adding a confounding factor, anxiety. The most important strength of this study is that it considers the effects of both depression and anxiety symptomatology on tobacco consumption during pregnancy, testing if previous reported effects of depression on tobacco consumption may result from the effect of comorbid anxiety. Another strength is that previous studies (e.g., Orr, Blazer & Orr, 2012) compared women who smoked during pregnancy with women who did not (thereby combining pregnancy quitters with non-smokers). Others (e.g., Linares-Scott et al., 2009; Massey, & Compton, 2013) compared those who smoked during pregnancy with quitters (only women who quit smoking during pregnancy). This study compared smokers with both non-smokers and quitters, because these are groups with different characteristics, and to our knowledge provides new data on the association between depression and smoking or quitting with adjustment for potential confounders. Moreover, the pregnant women's self-reports of smoking abstinence were biochemically validated to control for social desirability bias. This is particularly relevant during pregnancy when higher social pressure for women not smoking is present.

In summary, smoking during pregnancy is a significant public health issue that endangers both the mother's and fetus's current and future health. It is therefore vital to achieve abstinence from tobacco in this period of life, as soon as the first trimester of pregnancy. In fact, major adverse effects of tobacco consumption in the fetus occur as early as from the first trimester of gestation (USDHHS, 2014; Vardavas et al., 2010). Most pregnant women seem to be aware of these health risks, but awareness alone is not sufficient to prompt all of them to quit smoking. On the other hand, most women who stop smoking spontaneously do so in the first trimester of their pregnancy (Fingerhut, Kleimman, & Kendrick, 1990). In our sample, 87.2% of the participants self-reported tobacco abstinence around their first month of pregnancy. This indicates that early pregnancy is the appropriate time to develop and improve interventions for smoking cessation because of the emergence of new motivational factors that have the potential to support behavior change.

Depressive symptoms were a predictor of tobacco consumption but not of spontaneous quitting; spontaneous quitting was better predicted by anxiety symptoms. These findings support recommendations that women with depressive symptoms are at risk for smoking during pregnancy and highlight that anxious symptoms should be targeted in interventions for smoking cessation during pregnancy. The main clinical implications of our results concern the relevance of certain factors, mainly women's anxiety levels and the presence of a smoking partner, in the screening of women at risk of continued smoking during pregnancy. Also, reinforce the idea that prenatal smoking cessation interventions must take into account their emotional factors, and get smoking partners involved in the treatment. Further research is needed to understand the complex relationship between pregnancy and smoking across different cultures and countries.

References

- Becoña, E. & Míguez, M.C. (2004). Smoking and depressive symptoms among children ages 11 to 16 years. *Psychological Reports, 94*, 953-956. doi: 10.2466/pr0.95.3.953-956
- Bullock, L. F., Mears, J. L. C., Woodcock, C., & Record, R. (2001). Retrospective study of the association of stress and smoking during pregnancy in rural women. *Addictive Behaviors, 26*, 405-413. doi: 10.1016/S0306-4603(00)00118-0
- Cnattingius, S., Lindmark, G. & Meirik, O. (1992). Who continues to smoke while pregnant? *Journal of Epidemiology and Community Health, 46*, 218-221.
- Cox, J.L., Holden, J.M. & Sagovsky, R. (1987). Detection of postnatal depression. Development of the 10-item Edinburgh Postnatal Depression Scale. *The British Journal of Psychiatry, 150*, 782-786. doi: 10.1192/bjp.150.6.782
- De Wilde, K., Trommelmans, L., Laevens, H., Maes, L., Temmerman, M. & Boudrez, H. (2013). Smoking patterns, depression and sociodemographic variables among Flemish women during pregnancy and the postpartum period. *Nursing Research, 62*, 394-404. doi: 10.1097/NNR.0b013e3182a59d96.
- Dupraz, J., Gradd, V., Barasche, J., Etter, J.F. & Boulvain, M. (2013). Tobacco and alcohol during pregnancy: prevalence and determinants in Geneva in 2008. *Swiss Medical Weekly, 143*, w13795. doi: 10.4414/smw.2013.13795.
- Eastwood, P. (2011). *Infant feeding survey 2010: Early results* (S. S. Department of Health, Trans.): Health and Social Care Information Centre, BMRB Social Research, Great Britain. Department of Health, Social Services.
- Eiden, R., Leonard, K., Colder, C., Homish, G., Schuetze, P. Gray, T. & Huestis, M. (2011). Anger, hostility and aggression as predictors of persistent smoking during pregnancy. *Journal of Study on Alcohol and Drugs, 72*, 926-932.

- Fang, W.L., Goldstein, A., Butzen, A., Hartsock, A., Hartmann, K., Helton, M. & Lohr, J. (2004). Smoking cessation in pregnancy: a review of postpartum relapse prevention strategies. *The Journal of the American Board of Family Practice*, *17*, 264-275.
- Figueiredo, B., & Conde, A. (2011). Anxiety and depression in women and men from early pregnancy to 3-months postpartum. *Archives of Women's Mental Health*, *14*, 247-255. doi: 10.1007/s00737-011-0217-3
- Fingerhut, L. A., Kleinman, J. C., & Kendrick, J. S. (1990). Smoking before, during, and after pregnancy. *American Journal of Public Health*, *80*, 541-544.
- García-Esteve, L., Ascaso, C., Ojuel, J. & Navarro, P. (2003). Validation of the Edinburgh Postnatal Depression Scale (EPDS) in Spanish mothers. *Journal of Affective Disorders*, *75*, 71-76. doi: 10.1016/S0165-0327(02)00020-4
- Goedhart, G., Van der Wal, M., Cuijpers, P., & Bonsel, G. (2009). Psychosocial problems and continued smoking during pregnancy. *Addictive Behaviors*, *34*, 403-406. doi: 10.1016/j.addbeh.2008.11.006
- Hauge L, Torgersen L., & Vollrath M. (2011). Associations between maternal stress and smoking: findings from a population-based prospective cohort study. *Addiction*, *107*, 1168-1173.
- Hepper, W., Ji, L., Reitzel, R., Castro, Y., Correa-Fernández, V., Vidrine, J., Li, Y., Dolan-Mullen, P., ... Wetter, D. (2011). The role of prepartum motivation in the maintenance of postpartum smoking abstinence. *Health Psychology*, *30*, 736-745. doi: 10.1037/a0025132
- Higgins, S., Heil, S., Badger, G., Skelly, J., Solomon, L., & Bernstein, I. (2009). Educational disadvantage and cigarette soking during pregnancy. *Drug and Alcohol Dependence*, *104S*, 100-105. doi: 10.1016/j.drugalcdp.2009.03.013.

- Krstev, S., Marinkovic, J., Smic, S., Kocev, N. & Bondy, S. (2012). Prevalence and predictors of smoking and quitting during pregnancy in Serbia: results of a nationally representative survey. *International Journal of Public Health*, 57, 875-883. doi: 10.1007/s00038-011-0301-5.
- Linares-Scott, T., Heil, S., Higgins, S., Badger, G. & Bernstein, I. (2009). Depressive symptoms predict smoking status among pregnant women. *Addictive Behaviors*, 34, 705-708. doi: 10.1016/j.addbeh.2009.04.003.
- Lauria, L. Lamberti, A. & Grandolfo, M. (2012). Smoking behaviour before, during and after pregnancy: the effect of breastfeeding. *The Scientific World Journal*, 2012, 154910. doi: 10.1100/2012/154910
- Ludman, E., McBride, C., Nelson, J.C., Curry, S., Grothaus, L., Lando, H. & Pirie, P. (2000). Stress, depressive symptoms and smoking cessation among pregnant women. *Health Psychology*, 19, 21-27. doi: 10.1037/0278-6133.19.1.21
- Massey, S.H. & Compton, M.T. (2013). Psychological differences between smokers who spontaneously quit during pregnancy and those who do not: A review of observational studies and directions for future research. *Nicotine & Tobacco Research*, 15, 307-319. doi: 10.1093/ntr/nts142
- Mateos, P., Aranda, J.M., Diaz, G., Mesa, P., Gil, B., Ramos, M., Moreno, P., ... Luna, J.D. (2014). Prevalencia de tabaquismo durante el embarazo y factores asociados en Andalucía 2007-2012 [Smoking Prevalence and Associated Factors During Pregnancy in Andalucía 2007-2012]. *Revista Española de Salud Pública*, 88, 369-381. doi: 10.4321/S1135-57272014000300007.
- Maxson, P., Edwards, S., Ingram, A. & Miranda, M.L. (2012). Psychosocial differences between smokers and non-smokers during pregnancy. *Addictive Behaviors*, 37, 153-159. doi: 10.1016/j.addbeh.2011.08.011.

- Meghea, C.I., Rus, D., Rus, I.A., Holtrop, J.S. & Roman, L.A. (2012). Smoking during pregnancy and associated risk factors in a sample of Romanian women. *European Journal of Public Health*, 22, 229-233. doi: 10.1093/eurpub/ckq189.
- Morasco, B., Dornelas, E., Fishcher, E., Oncken, C. & Lando, H. (2006). Spontaneous smoking cessation during pregnancy among ethnic minority women: a preliminary investigation. *Addictive Behaviors*, 31, 203-210. doi: 10.1016/j.addbeh.2005.04.022
- Munafò, M.R., Heron, J. & Araya, R. (2008). Smoking patterns during pregnancy and postnatal period and depressive symptoms. *Nicotine & Tobacco Research*, 10, 609-620. doi: 10.1080/14622200802412895.
- Orr, S. T., Blazer, D. G., & Orr, C. A. (2012). Maternal prenatal depressive symptoms, nicotine addiction, and smoking-related knowledge, attitudes, beliefs, and behaviors. *Maternal and Child Health Journal*, 16, 973-978. doi:10.1007/s10995-011-0822-9
- Prusakowski, M.K., Shofer F.S., Rhodes K.V., & Mills A.M. (2011). Effect of depression and psychosocial stressors on cessation self-efficacy in mothers who smoke. *Maternal and Child Health Journal*, 15, 620-626. doi: 10.1007/s10995-010-0640-5.
- Sarasua, B., Zubizarreta, I., Echeburúa, E., & Corral, P. (2007). Perfil psicopatológico diferencial de las víctimas de violencia de pareja en función de la edad [Psychopathological profile of battered women according to age]. *Psicothema*, 19, 459-466.
- Schneider, S., Huy, C., Schütz, J., & Diehl, K. (2010). Smoking cessation during pregnancy: a systematic literature review. *Drug and Alcohol Review*, 29, 81-90. doi: 10.1111/j.1465-3362.2009.00098.x
- Smedberg, J., Lupattelli, A., Mardby, A., & Nordeng, H. (2014). Characteristics of women who continue smoking during pregnancy: a cross-sectional study of pregnant women

- and new mothers in 15 European countries. *BMC Pregnancy and Childbirth*, 14:213. doi: 10.1186/1471-2393-14-213
- Smedberg, J., Lupattelli, A., Mårdby, A.C., Øverland, S., & Nordeng, H. (2015). The relationship between maternal depression and smoking cessation during pregnancy: a cross-sectional study of pregnant women from 15 European countries. *Archives of Women's Mental Health*, 18, 73-84. doi: 10.1007/s00737-014-0470-3.
- Solomon, L.J., Higgins, S.T., Heil, S.H., Badger, G.J., Mongeon, J., Bernstein, I.M. (2006). Psychological symptoms following smoking cessation in pregnant smokers. *Journal of Behavioral Medicine*, 29, 151–160.
- Spielberger, C.D. Gorsuch, R.L. & Lushene, R.E. (1970). *Manual for the State-Trait Anxiety Inventory*. Palo Alto, CA. Consulting Psychologist Press (Spanish version, Madrid, Ediciones TEA, 1982).
- Stroud, L., Paster, R., Goodwin, M., Shenassa, E., Buka, S., Niaura, R., Rosenblith, J. & Lipsitt, L. (2009). Maternal Smoking during pregnancy and neonatal behavior: A large- Scale community study. *Pediatrics*, 123, 842-848. doi: 10.1542/peds.2008-2084
- Su, A., & Buitenen, A. M. (2014). Maintenance of smoking cessation in the postpartum period: Which interventions work best in the long-term? *Maternal and Child Health Journal*, 18, 714-728. doi:10.1007/s10995-013-1298-6
- Tappin, D.M., MacAskill, S., Bauld, L., Eadie, D., Shipton, D., & Galbraith, L. (2010). Smoking prevalence and smoking cessation services for pregnant women in Scotland. *Substance Abuse Treatment, Prevention, and Policy*, 5. doi: 10.1186/1747-597X-5-1.
- Torrent, M., Sunyer, J., Cullinan, P., Basagaña, X., Harris, J., García, O., Antó, J.M. on behalf of the AMICS study group (2004). Smoking cessation and associated factors during pregnancy. *Gaceta Sanitaria*, 18, 184-189.

- U.S. Department of Health and Human Services (2014). The health consequences of smoking-50 years of progress: A Report of the Surgeon General. U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health.
- Vardavas, C.L., Chatzi, L., Patelarou, E., Plana, E., Sarri, K., Kafatos, A, Koutis, A.D. & Kogevinas, M. (2010). Smoking and smoking cessation during early pregnancy and its effect on adverse pregnancy outcomes and fetal growth. *European Journal of Pediatrics*, 169, 741-748. doi: 10.1007/s00431-009-1107-9.
- Varescon, I., Leignel, S., Gérard, C., Aubourg, F & Detilleux, M. (2013). Self-esteem, psychological distress and coping styles in pregnant smokers and non-smokers. *Psychological Reports*, 113, 935-947. doi: 10.2466/13.20.PR0.113x31z1
- Vaz, L., Leonardi-Bee, J., Aveyard, P., Cooper, S., Grainge, M., Colean, T. on behalf of the SNAP trial team. (2014). Factor associated with smoking cessation in early and late pregnancy in the smoking, nicotine and pregnancy trial: A trial of nicotine replacement therapy. *Nicotine & Tobacco Research*, 16, 381-389. doi: 10.1093/ntr/ntt156
- Vesga-López, O., Blanco, C., Keyes, K., Olfson, M., Grant, B.F., & Hasin, D.S. (2008). Psychiatric disorders in pregnant and postpartum women in the United States. *Archives of General Psychiatry*, 65(7), 805-815. doi:10.1001/archpsyc.65.7.805
- Wakschlag, L.S., Henry, D., Blair, R.J.R., Dukic, V., Burns, J. & Pickett, K. (2011) Unpacking the association: Individual differences in the relation of prenatal exposure to cigarettes and disruptive behavior phenotypes. *Neurotoxicology and Teratology*, 33, 145-154. doi:10.1016/j.ntt.2010.07.002

Table 1
Socio-demographic Variables and Smoking Status

			Non Smokers (n= 744)	Smokers (n = 157)	Total (N = 901)	χ^2	Cramer's V	Quitters (n= 111)	Smokers (n = 157)	Total (N = 268)	χ^2	Cramer's V
Age (years)	> 30	n	547	104	651	3.427		29	104	82	1.784	
		%	73.5	66.2	72.3							
	≤ 30	n	197	53	250							
		%	26.5	33.8	27.7							
Partner	Yes	n	637	117	754	11.691	0.103	91	117	208	2.082	
		%	85.6	74.5	83.7							
	No	n	107	40	147							
		%	14.4	25.5	16.3							
Occupational status	Work	n	542	98	640	6.853	0.094	80	98	178	2.716	
		%	72.8	62.4	71.0							
	No Work	n	202	59	261							
		%	27.2	37.6	29.0							
Parity	Primiparous	n	490	107	597	0.305		90	107	197	5.581	0.144
		%	65.9	68.2	66.3							
	Multiparous	n	254	50	304							
		%	34.1	31.8	33.7							
Educational level	College	n	438	41	479	55.865	0.247	58	41	99	19.071	0.267
		%	58.9	26.1	53.2							
	No College	n	306	116	422							
		%	41.1	73.9	46.8							
Monthly income ***	> 2000	n	265	33	298	7.491	0.096	31	33	64	10.040	0.119
		%	38.5	25.8	36.5							
	≤ 2000	n	424	95	519							
		%	61.5	74.2	63.5							

*p ≤ .005; **p ≤ .001; ***Note: The total number of pregnant women in this variable is N = 227 (quitters = 99 and smokers = 128).

Table 2
Health and Psychological Variables and Smoking Status

		Non smokers	Smokers	Total	χ^2	Cramer's V	Quitters	Smokers	Total	χ^2	Cramer's V	
Planned pregnancy	Yes	n	661	130	791	4.415 *	84.7	94	130	224	0.168	
		%	88.8	82.8	87.8			82.8	83.6			
	No	n	83	27	110			17	27	44		
		%	11.2	17.2	12.2			15.3	17.2	16.4		
Smoker partner	Yes	n	178	101	279	99.016 **	49.5	55	101	156	5.841 *	0.148 *
		%	23.9	64.3	31.0			64.3	58.2			
	No	n	566	56	622			56	56	112		
		%	76.1	35.7	69.0			50.5	35.7	41.8		
Perceived seriousness of smoking	Serious	n	599	90	689	38.734 **	58.6	65	90	155	0.041	
		%	80.5	57.3	76.5			57.3	57.8			
	Others	n	145	67	212			46	67	113		
		%	19.5	42.7	23.5			41.4	42.7	42.2		
Psychological disorder	Yes	n	92	30	122	5.035 *	15.3	17	30	47	0.647	
		%	12.4	19.1	13.5			19.1	17.5			
	No	n	652	127	779			94	127	221		
		%	87.6	80.9	86.5			84.7	80.9	82.5		
Anxiety	STAI \geq 32	n	39	26	65	24.812 **	7.2	8	26	34	5.136 *	0.138 *
		%	5.2	16.6	7.2			16.6	12.7			
	STAI < 32	n	705	131	836			163	131	234		
		%	94.8	83.4	92.8			92.8	83.4	87.3		
Depression	EPDS \geq 10	n	94	50	144	35.638 **	18.9	21	50	71	5.581 *	0.142 *
		%	12.6	31.8	16.0			31.8	26.5			
	EPDS < 10	n	650	107	757			90	107	197		
		%	87.4	68.2	84.0			81.1	68.2	73.5		

*p \leq .005; **p \leq .001

Table 3

Predictors of Smoking Status

		β	Wald	p	OR	95% C I	
Predictors of tobacco consumption						Lower	Upper
1 Step	Educational level	1.057	21.839	<0.001	2.876	1.847	4.480
	Partner smokes	1.722	62.379	<0.001	5.595	3.649	8.577
	STAI-S	0.049	25.913	<0.001	1.050	1.030	1.070
2 Step	Educational level	1.031	20.619	<0.001	2.803	1.796	4.374
	Partner smokes	1.719	61.541	<0.001	5.578	3.630	8.569
	STAI-S	0.027	3.745	0.053	1.027	1.000	1.056
	EPDS	0.070	4.642	0.031	1.073	1.006	1.144
Predictors of spontaneous quitting							
1 Step	Parity	0.901	5.813	0.016	2.463	1.184	5.125
	Educational level	-0.761	5.659	0.017	0.467	0.250	0.8705
	Cigarettes smoked before pregnancy	-0.161	31.564	<0.001	0.851	0.804	0.900
	STAI-S	-0.044	9.629	0.002	0.957	0.931	0.984

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Conflict of Interest

All authors declare that they have no conflicts of interest.

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Highlights

- Characteristics that differentiate women smokers from quitters in pregnancy were assessed.
- The effect of depression and anxiety on tobacco consumption in pregnancy was examined.
- Depression was a predictor of smoking but not of spontaneous quitting.
- Spontaneous quitting was better predicted by anxiety symptoms.
- Smoking cessation interventions in pregnancy must take into account emotional factors.