

Smoking and Smoking Cessation During Pregnancy. An Analysis of a Hospital Based Cohort of Women in Romania

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Abstract Perinatal smoking is associated with a wide range of negative reproductive and pregnancy outcomes. The aim of the current study was to examine the prevalence and characteristics of women who report smoking prenatally and quit during pregnancy in a large sample of Romanian women. Understanding which women are more likely to quit will contribute to public health knowledge that will help more women stop smoking prior to or during pregnancy and prevent relapse postpartum. This cross-sectional analysis was conducted based on cross-sectional data collected between May 2012 and April 2015 as part of a cohort study of pregnancy implemented in six clinical settings in central Romania (N=2370). Approximately 28 % of the sample reported smoking in the 6 months prior to learning they were pregnant. Half of the women who

reported smoking 6 months before learning of their pregnancy, also reported that they stopped smoking by the time of the interview. Overall, tobacco consumption decreased from a sample mode of 10 cigarettes/day (range: 1–30) before pregnancy, to a sample mode of 5 cigarettes/day (range: 1–25) at the time of the interview. Women who quit had a higher socioeconomic position, were more likely to live in urban areas, partnered, primigravid, nulliparous, and reported lower anxiety and more social support. The combination of a socioeconomic gradient, less anxiety, and more social support suggests that efforts should be increased to target lower income, less educated, multi-gravid, and multiparous women and to develop programs that heighten social support and alleviate anxiety.

Keywords Tobacco · Smoking · Pregnancy · Romania

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Introduction

Tobacco use significantly impacts reproductive health before pregnancy by increasing the risk of infertility [1] and delaying conception [2], and during pregnancy by inducing a wide range of adverse outcomes, including serious chronic health and developmental conditions [3]. A consistent finding in the literature is that smoking has a significant, dose-response effect on infant birthweight [4]. Other adverse perinatal complications associated with tobacco consumption include, but are not limited to, preterm delivery; fetal growth restriction; stillbirths; sudden, unexpected infant death; spontaneous abortion; and child developmental and health conditions, including cognitive delay and asthma [4, 5]. Most prior studies have not distinguished between women who never smoked, those who smoked prior to pregnancy, and those who quit during pregnancy. The few

studies that have accounted for quitting have found reduced risk for low birthweight, small gestational age, and preterm delivery [6–8]. Much of the literature on pregnancy does not adequately measure such constructs as stress, depression, anxiety, and social support. Our study used multiple measures of stress and distress, state and trait anxiety, depression, and social support, along with smoking, quitting, and number of cigarettes smoked per day.

Despite clear adverse implications for health, smoking rates in Europe are the highest in the world (28% among adults), including smoking among women of reproductive age and increasing rates among youth [9]. There is evidence that smoking during pregnancy is particularly high in southeastern Europe. In Romania, as many as one-quarter of women of reproductive age smoke [10] and evidence shows smoking prevalence among women in eastern European countries ranging from 24% in Romania and Poland, and up to 33% in Bulgaria [11]. Women from Eastern Europe are two times more likely to smoke before pregnancy than their western European counterparts and have 1.5 the odds of smoking during pregnancy when compared with northern European women [12]. However, few studies report on smoking prevalence and covariates in Eastern Europe. Some of these studies rely largely on national data reports, which are subject to limitations related to how each country collects its data. Other studies are relatively small or subjected to measurement bias.

This study is among the first to report on smoking and quitting among pregnant women in Romania. We also describe key variables associated with quitting and continued smoking during pregnancy. Smoking is one of the most preventable risks during pregnancy, and pregnancy is acknowledged as a critical period when women are more likely to quit smoking because of known risks to the fetus. Unfortunately, many women who quit during pregnancy relapse after childbirth [13]. Thus, smoking prevention programs should focus not only on the antenatal period, but also on the postnatal period. This study contributes to the literature by identifying important socioeconomic and other covariates that are associated with smoking that can help identify higher risk women and target programs specifically to their needs. Although smoking during pregnancy is a modifiable maternal risk factor, only limited efforts are made in Eastern Europe to reduce smoking.

Methods

The article reports on cross-sectional data extracted from a large, hospital-based cohort study of pregnancy known as the MAIA study [14] implemented in six Romanian clinical settings between May 2012 and April 2015. The study was approved by the Center for Health Research Institutional

Review Board (IRB0007643, FWA00016890). All participating subjects provided written informed consent before enrollment in the study.

Study Setting and Population

Data were collected in three large ($n=2125$) and two small ($n=236$) state clinical settings, as well as one private clinic ($n=6$), all located in central Romania. The study population was defined as all women attending antenatal care in the six hospitals, in any week of gestation, age 18 or older, Romanian or Hungarian speaking. The recruitment process consisted of a combination of pre-established days and timeframes in the three largest clinics and continuous enrollment in the smaller ones. A total of 2752 women were approached in all clinical settings and 2370 women (86.1%) were eligible and gave consent to participate in the study.

Data Collection

Women were approached by trained data collectors in waiting rooms while attending antenatal care. If eligible, based on initial screening, they were invited to participate and sign an informed consent form. Those who consented were asked to complete a web-based or paper-based version of the study questionnaire, depending on their preference and clinic arrangements. Women completed the web-based on a computer installed in a private area of the clinic that was connected to internet. All completed questionnaires were automatically submitted via a secured internet connection [15]; no data were stored in the clinics. Informed consent forms and paper-based questionnaires were retrieved by the study team during regular visits throughout the data collection period. All paper-based questionnaires were double-entered manually in the database, to identify and reduce error.

Measures

The questionnaire included information on socio-demographics, obstetric history, depression, state-trait anxiety, pregnancy-related experience and stress, social support, and health behaviors, including smoking, alcohol and substance abuse, and physical activity.

Smoking and Quantity of Tobacco Use

Smoking during and prior to pregnancy was measured at the time respondents completed the questionnaire. Women were asked if they smoked in the 6 months prior to learning they were pregnant and at the time they completed the

questionnaire. Prior and current smoking was dichotomized as smokers and non-smokers. Quantity of tobacco use was assessed by asking women to report how many cigarettes they used to smoke in an average day 6 months before learning they were pregnant and how many they were smoking at the time of the interview.

Covariates

Socio-Demographics

Women reported on socio-demographic information, including date of birth, which we used to calculate age and categorized into three groups (18–26, 27–35, and 35+ years old); highest level of attained education, dichotomized as high school education or less and university degree or more; marital status, dichotomized as married/living with a partner or single; residence grouped as urban or rural; ethnicity, grouped as Romanian or non-Romanian, occupational status dichotomized as manual (non-office), non-manual (office/administrative position), or inactive (homemakers, students, unemployed); and monthly net family income, categorized into five groups: (1) 0–700 RON, (2) 701–1500 RON, (3) 1501–3000 RON, (4) 3001–5000 RON, and (5) 5001 + RON (1 RON≈\$0.25).

Reproductive History

Respondent groups were categorized by: trimester of gestation at the time of the interview, using the self-reported week of gestation as <12 weeks (first trimester), 13–27 weeks (second trimester), >28 weeks (third trimester); number of previous pregnancies (primigravida/subsequent pregnancies); and parity (prior pregnancy >28 weeks).

Depression Symptoms

We used the Edinburgh Postnatal Depression Scale-Romanian version (EPDS-R) [15] to assess depression symptoms. We computed a score based on the 10-item scale and used the >12 cut-off point validated in our previous study [16] to classify respondents into two groups: those with depressive symptoms and those without. The internal consistency of the scale was strong ($\alpha=0.85$) and consistent with our previous study ($\alpha=0.89$).

Perceived Stress

Perceived stress was measured using Cohen's 10-item Perceived Stress Scale (PSS) [16]. A summative score was computed from the ten items; these ten items demonstrated strong internal consistency ($\alpha=0.83$), which was comparable to previously published alpha coefficients of 0.78 and 0.91 [17].

State Anxiety

We evaluated state anxiety using the 20-item Y-Scale of the State Trait Anxiety Inventory (STAI) Y1 [18], which measured current feelings of nervousness, apprehension, tension, and worry on a four-point Likert scale (from *not at all=0* to *very much so=3*). State anxiety items were summed into a total score for this study. The scale demonstrated excellent internal consistency ($\alpha=0.93$), comparable to original coefficients of 0.86 and 0.95 [18].

Social Support

Social support was measured using a six-item scale we developed for a previous study of pregnant women in Romania asking about the number of persons in the respondent's life [19, 20]: who offer a feeling of friendship; to whom they can go to for advice or guidance; who offer a feeling of comfort and well-being; on whom they can count on for help regardless of the situation; who recognize their talents and abilities; and who offer them a feeling of closeness and emotional stability. Respondents reported their answers on a four-point scale (*nobody=1*, *1–2 persons=2*, *3–4 persons=3*, and *5 or more persons=4*). Responses were summed and reported as a total score. The scale demonstrated excellent internal consistency ($\alpha=0.89$).

Analysis

We computed descriptive statistics for all variables of interest and assessed the point prevalence of tobacco consumption before pregnancy, by trimester of reporting, and by covariates. To ensure reliability, we evaluated the internal consistency of the scales used to measure psychological dimensions using Cronbach's alpha coefficient. Where applicable, missing values in the scales were replaced with individual means of each item and scores were computed. Where appropriate, scale items were summed and dichotomized using established cut-off points or grouped as categorical variables. We used crosstabulations with Chi square tests and prevalence odds ratios (POR) to assess the relationships between categorical variables and independent sample *t* tests to examine differences between groups on continuous variables. PORs are calculated based on non-missing data only. Data were analyzed using SPSS Statistical Software version 13.0 (SPSS Inc., Chicago, IL, USA).

Results

Descriptive Statistics

Demographic statistics are displayed in Table 1. The mean age of the sample was 28.7 years (SD: 5.0; range: 18–45

years). Most respondents were married or were living with a partner (96.4%) and most reported living in urban areas (59.7%). Most women self-identified as Romanian (81.7%), while the remainder were Hungarian (13.4%), Roma (2.7%), or other ethnicities (0.3%). More than half had completed a university degree or higher (50.4%) and 47% finished only high school or another form of primary or secondary education. Most women were employed, with 59.7 reporting an administrative or other non-manual job; 6.3% worked in a non-office (manual) job; and 14.0% self-identified as homemakers, students, or unemployed. Income categories are shown in Table 1, indicating that about 75.6% earned up to 3000 RON/month (~750 USD) and the remainder earning \geq 3000 RON/month.

Reproductive History

Over half of women who completed the study questionnaire were in their first (28.5%) or second pregnancy trimester (27.5%), 43.9% were at their first pregnancy, and 37.3% were primi- or multiparous.

Pre-Pregnancy Smoking

From our total sample, 28.4% of the women reported smoking in the 6 months prior to learning they were pregnant, 60.6% identified themselves as never smokers, and 10.9% did not report their smoking status. Among those who smoked, the mean number of smoked cigarettes was of 9.3 (SD: 6.2, Mode=10, range: 1–30)/average day. Prevalence of smoking was highest among women aged 26–35 (59.2%) and lowest for women \geq 35 (8.8%); 33.5% out of the women aged 18–25 enrolled in our sample reported smoking 6 months before finding out about their pregnancy ($\chi^2=23.61$; $p=0.001$).

Among women with a high school education or less, smoking prevalence was 33.6% as compared to 23.5% among women with a completed university degree ($\chi^2=108.75$; $p=0.000$). The prevalence of smoking among women married or living with partners was 27.8%, compared to non-partnered women's prevalence of 65.9% ($\chi^2=65.12$; $p=0.000$). Women identifying as non-Romanian were less likely to smoke (26.7%) in the 6 months prior to their pregnancy than Romanian women (29.0%) ($\chi^2=53.03$; $p=0.000$). Smoking was more prevalent in women living in urban areas (56.7%) than in women living in rural areas (36.9%) ($\chi^2=65.81$; $p=0.000$), and in women holding a manual job (37.3%) than in women working in a non-manual job (27.6%) or in inactive women 34.9% ($\chi^2=114.65$; $p=0.000$). We report significant differences in smoking prevalence across income groups, with 34.5% smoking in the lowest income category as compared to 31.2% in the highest category, respectively ($\chi^2=47.2$; $p=0.000$).

Smoking was also less likely among those women with at least one prior birth (60.1 vs. 38%; $\chi^2=481.37$; $p=0.000$), suggesting that multiparity could be a confounder for age and for the relationship between age and smoking status. Multigravid women reported slightly more smoking more before pregnancy (50.3%) as compared to primigravid women (48.7%) ($\chi^2=1346.06$; $p=0.000$).

Smoking and Quitting During Pregnancy

All results listed here are available in Table 2. 8 (1.2%) out of the 674 women who reported smoking 6 months before learning they were pregnant did not report their smoking status at the time of the interview. All results reported in this section were calculated using all the cases with valid information on the pre-pregnancy and during pregnancy smoking status variables ($n=666$). Half of the women (50%) who reported smoking 6 months before learning of their pregnancy reported that they stopped smoking by the time of the interview. Women who continued to smoke during pregnancy reported reduced amount of tobacco use in an average day, from a mode of 10 cigarettes/day (range: 1–30) in the 6 months before pregnancy, to a mode of 5 cigarettes/day (range: 1–25) at the time of the interview.

Higher participant age was associated with a non-linear decrease in smoking, from 35.1% in the 18–26 age group, to 55.6% in the 27–35 age group, and 9.3% in the 35+ age group ($\chi^2=4.29$; $p=0.117$). Women attaining a university degree were less likely to continue smoking during pregnancy (55.9%), as compared to their counterparts with a high school education or less (44.1%) ($\chi^2=42.67$, $p=0.000$; POR: 0.34; CI: 0.25–0.47).

Women living in urban settings were less likely to continue smoking (68%) as compared to 32% of those living in rural areas, respectively ($\chi^2=13.96$, $p=0.000$; POR: 0.53; CI: 0.38–0.74). Among those who continued smoking during pregnancy, 5.5% were single and 94.5% had a stable partner. However, fewer single women quit smoking during pregnancy (37.9%) as compared to partnered women (50.6%) ($\chi^2=1.79$, $p=0.181$; POR: 1.67; CI: 0.78–3.61).

There was no statistically significant difference between Romanian and non-Romanian ethnicity women in terms of smoking during pregnancy (50% Romanian vs. 52.4% non-Romanian) or quitting (50% Romanian vs. 47.6% non-Romanian) ($\chi^2=1.69$; $p=0.194$; POR: 1.1; CI: 0.60–1.10).

Women in non-manual jobs were more likely to quit (79.2%) as compared with women in manual jobs (6.3%) or inactive women (14.5%) ($\chi^2=25.75$; $p=0.000$). In terms of income, smoking during pregnancy was more prevalent in lower income levels group women (income level 1–23.5%; income level 2–27.9%; income level 3–32.5%) as opposed to higher level income women (income level 4–11.8%, income level 5–4.3%) ($\chi^2=19.84$; $p=0.001$).

Table 1 Sample description by pre-pregnancy smoking status

	Never smoker (n = 1437)		Smoker (n = 674)		Missing smoking status (n = 259)		Total sample (n = 2370)		χ^2 (p)
	n	%within smoking status	n	%within smoking status	n	%within smoking status	n	% of total sample	
Age									
18–25	342	23.8	214	31.8	82	31.7	638	26.9	$\chi^2 = 23.61$ (p = 0.0001)
26–35	936	65.1	399	59.2	141	54.4	1476	62.3	
>36	154	10.7	59	8.8	34	13.1	247	10.4	
Missing	5	0.3	2	0.3	2	0.8	9	0.4	
Total	1437	100.0	674	100.0	259	100.0	2370	100	
Ethnicity									
Romanian	1166	81.1	561	83.2	210	81.1	1937	81.7	$\chi^2 = 53.03$ (p = 0.0000)
Non-Romania	255	17.7	104	15.4	30	11.6	389	16.4	
Missing	16	1.1	9	1.3	19	7.3	44	1.9	
Total	1437	100.0	674	100.0	259	100.0	2370	100	
Education									
High-school or less	588	40.9	374	55.5	151	58.3	1113	47	$\chi^2 = 108.75$ (p = 0.0000)
Univ. degree or more	827	57.6	281	41.7	86	33.2	1194	50.4	
Missing	22	1.5	19	2.8	22	8.5	63	2.6	
Total	1437	100.0	674	100.0	259	100.0	2370	100	
Marital status									
With partner	1411	98.2	634	94.1	239	92.3	2284	96.4	$\chi^2 = 65.12$ (p = 0.0000)
Without partner	11	0.8	29	4.3	4	1.5	44	1.9	
Missing	15	1.0	11	1.6	16	6.2	42	1.8	
Total	1437	100.0	674	100.0	259	100.0	2370	100	
Residence									
Rural	477	33.2	249	36.9	97	37.5	823	34.7	$\chi^2 = 65.81$ (p = 0.0000)
Urban	909	63.3	382	56.7	123	47.5	1414	59.7	
Missing	51	3.5	43	6.4	39	15.1	133	5.6	
Total	1437	100.0	674	100.0	259	100.0	2370	100	
Occupation									
Manual	80	5.6	56	8.3	14	5.4	150	6.4	$\chi^2 = 114.65$ (p = 0.0000)
Non-manual	925	64.4	391	58.0	100	38.6	1416	59.7	
Inactive	182	12.7	116	17.2	34	13.1	332	14	
Missing	250	17.4	111	16.5	111	42.9	472	19.9	
Total	1437	100.0	674	100.0	259	100.0	2370	100	
Family income (RON) ^a									

Table 1 (continued)

	Never smoker (n = 1437)		Smoker (n = 674)		Missing smoking status (n = 259)		Total sample (n = 2370)		χ^2 (p)		
	n	%within smoking status	%within variable category	n	%within smoking status	%within variable category	n	% of total sample			
0-700	176	12.2	50.6	120	17.8	34.5	52	20.1	14.9	$\chi^2 = 95.29$ (p = 0.000)	
701-1500	347	24.1	57.6	175	26.0	29.1	80	30.9	13.3		
1501-3000	541	37.6	64.3	228	33.8	27.1	73	28.2	8.7		
3001-5000	267	18.6	69.9	96	14.2	25.1	19	7.3	5.0		
>5001	77	5.4	61.6	39	5.8	31.2	9	3.5	7.2		
Missing	29	2.0	40.8	16	2.4	22.5	26	10.0	36.6		
Total	1437	100.0	NA	674	100.0	NA	259	100.0	NA		
Gravidity											
Privigravida	683	47.5	65.6	328	48.7	31.5	30	11.6	2.9		$\chi^2 = 1346.06$ (p = 0.000)
Multigravida	725	50.5	65.6	339	50.3	30.7	42	16.2	3.8		
Missing	29	2.0	13.0	7	1.0	3.1	187	72.2	83.9		
Total	1437	100.0	NA	674	100.0	NA	259	100.0	NA		
Parity											
Nulliparous	818	56.9	59.9	405	60.1	29.6	143	55.2	10.5	$\chi^2 = 481.37$ (p = 0.000)	
Primi- or multiparous	596	41.5	67.4	256	38.0	29.0	32	12.4	3.6		
Missing	23	1.6	19.2	13	1.9	10.8	84	32.4	70.0		
Total	1437	100.0	NA	674	100.0	NA	259	100.0	NA		

*1 RON ≈ \$0.25

Table 2 Sample description by smoking status during pregnancy

	Former smoker (n = 333)				Smoker (n = 333)				Total sample (n = 666)				χ^2 (p), POR (CI)/t(p)	
	%within smoking status		%within variable category		%within smoking status		%within variable category		%of total sample		%of total sample			
	n	%	%within variable category	n	%	n	%	%within variable category	n	%	n	%		
Age														
18–25	95	28.7	44.8	14.3	117	35.1	55.2	17.6	212	31.9			$\chi^2=4.29$ (p=0.117)	
26–35	210	63.4	53.2	31.6	185	55.6	46.8	27.9	395	59.5				
>36	26	7.9	45.6	3.9	31	9.3	54.4	4.7	57	8.6				
Total	331	100	NA	49.8	333	100	NA	50.2	664	100				
Ethnicity														
Romanian	277	85	50.0	42.2	277	83.7	50.0	42.2	554	84.4			$\chi^2=1.69$ (p=0.194); POR: 0.84 (CI: 0.6–1.10)	
Non-Romanian	49	15	47.6	7.5	54	16.3	52.4	8.2	103	15.7				
Total	326	100	NA	49.7	331	100	NA	50.4	657	100				
Education														
High-school or less	142	44.1	38.6	21.9	226	69.5	61.4	34.9	368	56.8			$\chi^2=42.67$ (p=0.000); POR: 0.34 (CI: 0.25–0.47)	
Univ. degree or more	180	55.9	64.5	27.8	99	30.5	35.5	15.3	279	43.1				
Total	322	100	NA	49.8	325	100	NA	50.2	647	100				
Marital status														
With partner	317	96.6	50.6	48.4	309	94.5	49.4	47.2	626	95.6			$\chi^2=1.79$ (p=0.181); POR: 1.67 (CI: 0.78–3.61)	
Without partner	11	3.4	37.9	1.7	18	5.5	62.1	2.7	29	4.4				
Total	328	100	NA	50.1	327	100	NA	49.9	655	100				
Residence														
Rural	101	32	41.4	16.2	143	46.6	58.6	23	244	39.2			$\chi^2=13.96$ (p=0.000); POR: 0.53 (CI: 0.38–0.74)	
Urban	215	68	56.7	34.5	164	53.4	43.3	26.3	379	60.8				
Total	316	100	NA	50.7	307	100	NA	49.3	623	100				
	M	SD		M	SD	M	SD		M	SD				
Occupation														
Manual	18	6.3	32.7	3.2	37	13.8	67.3	6.6	55	9.8			$\chi^2=25.75$ (p=0.000)	
Non-manual	228	79.2	58.8	40.9	160	59.5	41.2	28.7	388	69.6				
Inactive	42	14.5	36.8	7.5	72	26.7	63.2	12.9	114	20.4				
Total	288	100	NA	51.6	269	100	NA	48.2	557	99.8				
Family income (RON)^a														

Table 2 (continued)

	Former smoker (n = 333)			Smoker (n = 333)			Total sample (n = 666)			χ^2 (p), POR (CI)/t(p)	
	n	%within smoking status	%within variable category	%of total sample	n	%within smoking status	%within variable category	%of total sample	n		%of total sample
0-700	39	11.9	33.9	6	76	23.5	66.1	11.7	115	17.7	$\chi^2 = 19.84$ (p=0.001)
701-1500	85	26.1	48.6	13.1	90	27.9	51.4	13.8	175	26.9	
1501-3000	122	37.3	53.7	18.8	105	32.5	46.3	16.2	227	35	
3001-5000	56	17.1	59.6	8.6	38	11.8	40.4	5.8	94	14.4	
>5001	25	7.6	64.1	3.8	14	4.3	35.9	2.2	39	6	
Total	327	100	NA	50.3	323	100	NA	49.7	650	100	
Gravidity											
Privigravida	190	57.4	58.5	28.8	135	41	41.5	20.5	325	49.3	$\chi^2 = 17.68$ (p=0.000); POR: 0.51 (CI: 0.37-0.70)
Multigravida	141	42.6	42.1	21.4	194	59	57.9	29.4	335	50.7	
Total	331	100	NA	50.2	329	100	NA	49.9	660	100	
Parity											
Nulliparous	226	68.7	56.5	34.6	174	53.7	43.5	26.6	400	61.2	$\chi^2 = 15.45$ (p=0.000); POR: 1.89 (CI: 1.37-2.60)
Primi- or multiparous	103	31.3	40.7	15.8	150	46.3	59.3	23	253	38.8	
Total	329	100	NA	50.4	324	100	NA	49.6	653	100	
Depressive symptoms											
No	235	71.4	51.1	35.8	225	68.6	48.9	34.2	460	70	$\chi^2 = 0.62$ (p=0.428); POR: 1.14 (CI: 0.81-1.59)
Yes	94	28.6	47.7	14.3	103	31.4	52.3	15.7	197	30	
Total	329	100	NA	50.1	328	100	NA	49.9	657	100	
	M	SD		M	SD		M	SD	M	SD	
STAI scores	38.55	11.32		40.24	11.92		39.39	11.64	39.39	11.64	t(628)=-1.82, (p=0.069)
PSS scores	16.79	6.39		17.54	6.29		17.17	6.34	17.17	6.34	t(627)=-1.48, (p=0.139)
Social support scores	3.26	0.64		3.2	0.68		3.23	0.66	3.23	0.66	t(661)=1.23, (p=0.217)

^a1 RON ≈ \$0.25

Regarding reproductive history, 57.4% of the women who quit smoking were primigravid, whereas only 42.6% of the women with prior pregnancies ceased smoking by the time of the interview ($\chi^2 = 17.68$; $p = 0.000$; POR: 0.51; CI: 0.37–0.70). In addition, we found statistically significant differences in smoking cessation rates by parity, with quitting rates of 56.5% in nulliparous women and 40.7% in primi- or multiparous women ($\chi^2 = 15.45$, $p = 0.000$; POR: 1.89; CI: 1.37–2.60).

We found a 30% prevalence of depression symptoms within our sample of smokers and quitters, with those who continued smoking during pregnancy reporting a slightly higher, but not statistically significant, prevalence of depression symptoms (31.4%) as compared to those who quit (28.6%) ($\chi^2 = 0.63$; $p = 0.42$). Similarly, stress scores were higher among current smokers ($M = 17.6$, $SD: 6.29$) than among quitters ($M = 16.8$, $SD: 6.39$), but the difference between the two groups was not statistically significant ($t(627) = -1.48$, $p = 0.139$).

On the other hand, our analyses showed that the association between anxiety and smoking during pregnancy was statistically significant ($t(628) = -1.82$, $p = 0.069$), with anxiety levels slightly higher among those who smoked during pregnancy ($M = 40.2$, $SD: 11.92$) as compared with those who quit smoking ($M = 38.5$, $SD: 11.32$). Similarly, ex-smokers in the sample reported benefiting from more social support ($M = 3.7$, $SD: 0.64$) than their current smoker counterparts ($M = 3.2$, $SD: 0.68$), but these differences were not statistically significant ($t(661) = 1.23$, $p = 0.217$).

Discussion

The objective of this study was to contribute to the literature on smoking by reporting on the prevalence of smoking before and during pregnancy and associations with factors related to smoking and quitting. Women in the sample reported a high prevalence of smoking before pregnancy (28.4%), the point prevalence of tobacco consumption decreasing to 14.2% during the gestational period. Approximately half of those who smoked before becoming pregnant quit smoking upon finding out about their pregnancy. This quit rate is consistent with the 55% quit rate during pregnancy reported by the US Centers for Disease Control and Prevention (CDC) [21]. However, as the majority of those who quit smoking during pregnancy relapse early in the postpartum period [13], we expect many of these women to resume smoking after giving birth.

6 months before pregnancy, self-reported tobacco use was less likely among older women, those holding a university or higher degree, those reporting higher income levels, and among those who had a stable partner and lived in rural areas. Similarly, women having at least one subsequent

child and those in their first pregnancy reported less smoking 6 months before the current pregnancy. On the other hand, single women had increased odds of smoking before pregnancy than women who were married or living with a partner. These results are consistent with the previous literature on the socio-demographic characteristics of women who smoke [22, 23].

Among those who did not quit smoking during pregnancy, the average number of smoked cigarettes per day decreased; this finding is consistent with the previous literature [24]. The sociodemographic characteristics of women who continued smoking during pregnancy were similar to those of women reporting smoking in the pre-pregnancy period. However, we found that even though the prevalence of pre-pregnancy smoking was lower among women in rural areas, these women were less likely to quit during pregnancy. We believe that older women in our sample were less likely to smoke both before and during pregnancy because they were multiparous, had more time to obtain a university degree, and may have quit smoking in an earlier pregnancy. Thus, age could act as a confounder, mediating the relationship between smoking and other socio-demographic variables such as education, residence, and income.

Similar to previous reports in the literature [25], we found differences in quit rates between single and partnered women, with single women being more likely to continue smoking during pregnancy. In addition, quitting was more likely during the gestational period among women who were pregnant for the first time and in nulliparous women, this finding converging with previous research on the role of reproductive history in women's smoking behavior [26].

We also evaluated associations with psychosocial covariates such as depression, anxiety, stress, and social support and found that smokers have higher levels of anxiety and benefit less from social support than those who quit before becoming pregnant or early in the gestational period. Our results are in line with previous studies suggesting smoking as a coping mechanism for anxiety and lack of social support [27, 28].

Implications for Public Health Practice and Research

Half of women who smoke in the pre-pregnancy period are able to make behavioral changes and quit smoking upon finding out about their pregnancy. However, most of these will relapse in the postpartum period. In this context, the issue at stake is to assess and support quitters' motivation to remain smoke-free after birth. Qualitative findings in the field of post-partum smoking relapse suggest that intervention "should build on mothers' intentions to be responsible partners" [29].

The women included our sample reported high pre-pregnancy and during pregnancy smoking rates. Thus, one

implication of our findings is that Romania is lacking smoking cessation programs targeted towards women of reproductive age in general, and pregnant women, in particular. The national STOP smoking program, in its current form, does not provide specific services for pregnant women. Also, national guidelines do not allow use of pharmacotherapy for smoking cessation during pregnancy [30]. Furthermore, in the last few years, the program has become more difficult to access even for non-pregnant users, due to the introduction of a 100 RON (\$25) program fee. In this context, Romanian pregnant women who are willing to quit smoking but are in need of additional, specialized support, rely on their social network, online resources and/or forums for advice. One possible alternative to meet the smoking cessation needs of these women would be to adjust the current STOP smoking program by incorporating the recommendations recently put forward by the World Health Organization [31] into the STOP smoking program's service offer.

In our sample, women more likely to smoke during pregnancy meet the socio-demographics characteristics of the most vulnerable population groups—they live in rural areas, are single, and have a low education and socio-economic level [32], suggesting the presence of socio-economic disparities in smoking [33]. The development and availability of free smoking cessation programs specifically targeted to pregnant women could significantly increase the number of women who cease smoking around and during pregnancy, which in turn will translate into improved maternal health outcomes and lower infant mortality and morbidity rates.

Future research should explore the development of such smoking cessation programs by taking into account the socio-economic context of former communist, Eastern European countries, in order to lower the high infant mortality and mortality rates specific to this region in general, and Romania in particular [34].

Strengths and Limitations

Methodological strengths of this study include the large sample size and the use of instruments validated in Romania to screen for psychosocial covariates. The main limitation of this study includes potential reporting bias in smoking rates: women may report that they did not smoke or that they quit smoking during pregnancy because they do not want to admit to a risky behavior. The fact that many women skipped the smoking questions likely indicates their reluctance in reporting smoking before or during pregnancy due to social desirability. Also, the high quit rate and significantly lower prevalence of smoking during pregnancy may suggest an underreporting of current smoking; other studies refer to the validity of the self-reported data regarding smoking, which they also find to be under-reported, especially during pregnancy [35]. It is also impossible for us to

determine exactly when women quit smoking, whether it was early or later in pregnancy.

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Compliance with Ethical Standards

Conflict of Interest The authors declare that no competing financial interests exist.

References

1. Augood, C., Duckitt, K., & Templeton, A. A. (1998). Smoking and female infertility: A systematic review and meta-analysis. *Human Reproduction (Oxford, England)*, 13(6), 1532–1539.
2. Baird, D. D., & Wilcox, A. J. (1985). Cigarette smoking associated with delayed conception. *JAMA*, 253(20), 2979–2983.
3. Keegan, J., Parva, M., Finnegan, M., Gerson, A., & Belden, M. (2010). Addiction in pregnancy. *Journal of Addictive Diseases*, 29(2), 175–191.
4. Goldenberg, R. L., Culhane, J. F., Iams, J. D., & Romero, R. (2008). Epidemiology and causes of preterm birth. *Lancet*, 371(9606), 75–84.
5. Behrman, R. E., Butler, A. S. (2007). *Preterm birth: Causes, consequences, and Prevention*. US: National Academies Press. Retrieved from <http://www.ncbi.nlm.nih.gov/books/NBK11362/>.
6. Jaddoe, V. W. V., Troe, E.-J. W. M., Hofman, A., et al. (2008). Active and passive maternal smoking during pregnancy and the risks of low birthweight and preterm birth: The Generation R Study. *Paediatric and Perinatal Epidemiology*, 22(2), 162–171.
7. McCowan, L. M. E., Dekker, G. A., Chan, E., et al. (2009). Spontaneous preterm birth and small for gestational age infants in women who stop smoking early in pregnancy: Prospective cohort study. *BMJ (Clinical Research Ed.)*, 338, b1081.
8. Polakowski, L. L., Akinbami, L. J., & Mendola, P. (2009). Prenatal smoking cessation and the risk of delivering preterm and small-for-gestational-age newborns. *Obstetrics and Gynecology*, 114(2 Pt 1), 318–325.
9. WHO. (2015). WHO report on the Global Tobacco Epidemic. Retrieved July 1, 2016, from <http://www.euro.who.int/en/health-topics/disease-prevention/tobacco/data-and-statistics>.
10. Irimie, S. (2011). Global Adult Tobacco Survey Romania. Retrieved August 2, 2016 from http://www.who.int/tobacco/surveillance/survey/gats/gats_romania_report_2011.pdf.
11. Zatoński, W., Przewoźniak, K., Sulkowska, U., West, R., & Wojtyła, A. (2012). Tobacco smoking in countries of the European Union. *Annals of Agricultural and Environmental Medicine: AAEM*, 19(2), 181–192.
12. Smedberg, J., Lupattelli, A., Mårdby, A.-C., & 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.

13. Lopez, E. N., Simmons, V. N., Quinn, G. P., et al. (2008). Clinical trials and tribulations: Lessons learned from recruiting pregnant ex-smokers for relapse prevention. *Nicotine & Tobacco Research*, *10*(1), 87–96.
14. Center for Health Policy and Public Health. (2011). MAIA—Advancing Maternal and Child Health in Romania: An integrated assessment of the determinants of pregnancy outcomes. Retrieved August 2, 2016, from http://publichealth.ro/index.php/maia_en/.
15. Qualtrics. (2016). Retrieved August 9, 2016 from <https://www.qualtrics.com/>.
16. Wallis, A., Fernandez, R., Oprescu, F., Cherecheș, R., Zlati, A., & Dungy, C. (2012). Validation of a Romanian scale to detect antenatal depression. *Open Medicine*, *7*(2), 216–233.
17. Cohen, S., & Janicki-Deverts, D. (2012). Who's Stressed? Distributions of psychological stress in the United States in probability samples from 1983, 2006, and 2009. *Journal of Applied Social Psychology*, *42*(6), 1320–1334.
18. Spielberger, C. D., Gorsuch, R. L., Lushene, R., Vagg, P. R., & Jacobs, G. (1983). *Manual for the State-Trait Anxiety Inventory*. Palo Alto: Consulting Psychologists Press.
19. Wallis, A. B., Brînzaniuc, A., Cherecheș, R., et al. (2008). Reliability and validity of the Romanian version of a scale to measure infant feeding attitudes and knowledge. *Acta Paediatrica, International Journal of Paediatrics*, *97*(9), 1194–1199.
20. Wallis, A. B., Brînzaniuc, A., Oprescu, F., Cherecheș, R. M., Mureșan, M., & Dungy, C. I. (2011). A structured public health approach to increasing rates and duration of breastfeeding in Romania. *Breastfeeding Medicine*, *6*(6), 429–432.
21. CDC. (2016). Tobacco use and pregnancy, Reproductive health, CDC. Retrieved August 9, 2016, from <http://www.cdc.gov/reproductivehealth/maternalinfanthealth/tobaccousepregnancy/>.
22. Huisman, M., Kunst, A. E., & Mackenbach, J. P. (2005). Inequalities in the prevalence of smoking in the European Union: Comparing education and income. *Preventive Medicine*, *40*(6), 756–764.
23. Giskes, K., Kunst, A. E., Benach, J., et al. (2005). Trends in smoking behaviour between 1985 and 2000 in nine European countries by education. *Journal of Epidemiology and Community Health*, *59*(5), 395–401.
24. Cnattingius, S. (2004). The epidemiology of smoking during pregnancy: Smoking prevalence, maternal characteristics, and pregnancy outcomes. *Nicotine & Tobacco Research*, *6* Suppl 2, S125–140.
25. Spencer, N. (2006). Explaining the social gradient in smoking in pregnancy: Early life course accumulation and cross-sectional clustering of social risk exposures in the 1958 British national cohort. *Social Science & Medicine*, *62*(5), 1250–1259.
26. Graham, H., Hawkins, S. S., & Law, C. (2010). Lifecourse influences on women's smoking before, during and after pregnancy. *Social Science & Medicine*, *70*(4), 582–587.
27. Elsenbruch, S., Benson, S., Rütke, M., et al. (2007). Social support during pregnancy: Effects on maternal depressive symptoms, smoking and pregnancy outcome. *Human Reproduction (Oxford, England)*, *22*(3), 869–877.
28. Dunkel Schetter, C., & Tanner, L. (2012). Anxiety, depression and stress in pregnancy: Implications for mothers, children, research, and practice. *Current Opinion in Psychiatry*, *25*(2), 141–148.
29. Orton, S., Coleman, T., Lewis, S., Cooper, S., & Jones, L. L. (2016). “I Was a Full Time Proper Smoker”: A qualitative exploration of smoking in the home after childbirth among women who relapse postpartum. *PLoS One*, *11*(6), e0157525.
30. Antigona, T. (2010). *Guide for smoking cessation and specialized assistance for smokers* (2nd ed.). Iasi: Tehnopress.
31. World Health Organization. (2013). WHO recommendations for the prevention and management of tobacco use and second-hand smoke exposure in pregnancy. Retrieved August 9, 2016, from <http://www.who.int/tobacco/publications/pregnancy/guidelinestobaccosmokeexposure/en/>.
32. US Department of Health and Human Services. (2014). *2014 Surgeon General's Report: The Health Consequences of Smoking—50 Years of Progress*. Rockville. Retrieved August 9, 2016, from <http://www.surgeongeneral.gov/library/reports/50-years-of-progress/full-report.pdf>.
33. Pampel, F. C., Krueger, P. M., & Denney, J. T. (2010). Socioeconomic Disparities in Health Behaviors. *Annual Review of Sociology*, *36*, 349–370.
34. Eurostat. (2016). Mortality and life expectancy statistics—Statistics explained. Retrieved August 9, 2016, from http://ec.europa.eu/eurostat/statistics-explained/index.php/Mortality_and_life_expectancy_statistics.
35. Klebanoff, M. A., Levine, R. J., Clemens, J. D., DerSimonian, R., & Wilkins, D. G. (1998). Serum cotinine concentration and self-reported smoking during pregnancy. *American Journal of Epidemiology*, *148*(3), 259–562.