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Personality and its relation to the use of alcohol and cigarettes during pregnancy: A multinational study

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Abstract

This study explored the impact of women's personality on drinking and smoking habits before and during pregnancy, using a multinational perspective. Data on maternal personality traits, background information, and alcohol and cigarette smoking before and during pregnancy were collected from 9187 women from more than 18 countries. High conscientiousness and agreeableness resulted as protective factors against alcohol consumption during pregnancy; trait-specific associations were apparent on individual region level. Highly extrovert women were more likely to consume medium/high amount of alcohol (10%–17% increased odds). High neuroticism conferred a 16 percent increased odds for continued smoking during pregnancy. Personality and nationality are important factors for adequate pre- and postnatal health care.

Keywords

alcohol, multinational, personality, pregnancy, smoking

Introduction

Pregnancy is a major event in any woman's life, which may (or may not) trigger maternal lifestyle changes in relation to alcohol and smoking habits. A substantial body of research (Alvik et al., 2006; Crozier et al., 2009) has examined how external factors relate to women's smoking and drinking habits during pregnancy. For example, women with lower education, lower income, or women who are exposed to passive smoking in their home or work environment are at higher risk of smoking during pregnancy (Cnattingius, 2004; Solomon and Quinn, 2004).

With regard to alcohol, women who continue drinking during pregnancy seem to be older, more likely to have given birth before, or have experienced abuse or violence, and report a higher level of alcohol consumption before pregnancy (Nilsen et al., 2008; Skagerström et al., 2011). Beijers et al. (2014) have shown in a population of 1340 women that alcohol consumption

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in early pregnancy is associated with higher levels of openness and lower levels of conscientiousness. A Norwegian study (Ystrom et al., 2012) with 835 women also found that women who consumed alcohol during pregnancy were more likely to score low on conscientiousness and high on extraversion than women who quit alcohol use. Scoring high on neuroticism was associated with increased likelihood of quitting smoking during pregnancy. Apart from these studies, knowledge about the role of personality when it comes to smoking and drinking habits during pregnancy is still limited.

Personality structures seem to be quite stable across time, situations, and age groups (Borghuis et al., 2017; McCrae and Terracciano, 2005), and a large body of research has documented that personality is related to health behavior in the general population (John et al., 2008). The literature shows that certain personality traits may be more favorably related to health behavior than others (Kuntsche et al., 2008; Vollrath et al., 1999). Particularly, the combination of high scores on the traits of extraversion, neuroticism, and openness combined with low scores on the agreeableness and conscientiousness domains seems to render a personality profile prone to engaging in unfavorable health habits, such as smoking and drinking (Beijers et al., 2014; Bogg and Roberts, 2004). The causal links between personality traits and healthy behaviors are, however, complex and not well elucidated, and country seems to explain partly the variation in effects. It is possible that smoking, for instance, is more socially acceptable in specific countries, and so a higher proportion of smokers can likely have positive personality profiles (Friedman et al., 2014; Malouff et al., 2006). However, whether this scenario also applies to pregnant women, and across different countries, remains unresolved.

Since the use of alcohol and cigarettes poses a major threat to maternal–fetal health (Babor et al., 2010; Cnattingius, 2004), knowledge of underlying factors that may contribute to these poorer maternal health behaviors during pregnancy are of vital importance for the formulation of prenatal intervention programs (Ystrom et al., 2012). To date, such knowledge is scarce and non-existent in relation to specific countries.

The primary aim of the present study was to examine the relationship between women's personality and their drinking and smoking habits before and/or during pregnancy. The secondary aim was to investigate whether women's country of residency may be an effect modifier of the association between personality traits and consumption of alcohol during pregnancy. We hypothesized that personality traits would be associated with cigarette smoking before and during pregnancy and drinking habits during pregnancy.

Methods

Study design and data collection

This was a cross-sectional, multinational, web-based study. Data were collected with an anonymous online questionnaire administered by Quest Back on national websites and/or social networking sites commonly consulted by pregnant women and new mothers (Lupattelli et al., 2014). The questionnaire was originally developed in Norwegian and then translated into English and the remaining, relevant languages. In September 2011, a pilot study was carried out ($n=47$) that elicited no major changes to the questionnaire. Data were collected between the 1 October 2011 and the 29 February 2012. The questionnaire was accessible for a period of 2 months in each country. The complete questionnaire and further details about the main study methodology has previously been published in Lupattelli et al. (2014).

Participants

Pregnant women at any gestational week and mothers with a child less than 1 year of age could participate. Data were collected from women in 18 eligible countries (i.e. Australia, Austria, Canada, Croatia, Finland, France, Iceland, Italy, the Netherlands, Norway, Poland, Russia, Serbia, Slovenia, Sweden, Switzerland, the United Kingdom, the United States), and in

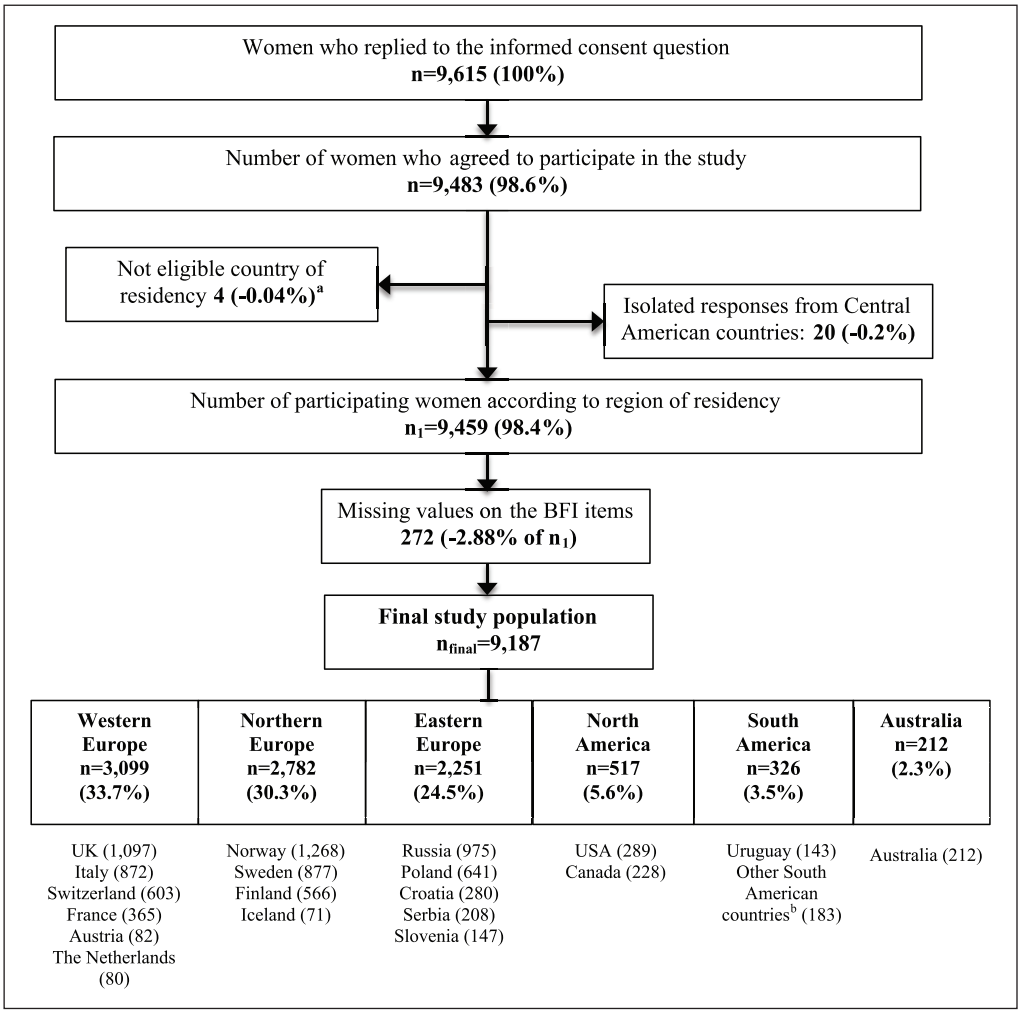

Figure 1. Flowchart to achieve the final sample.
BFI: big five inventory.
[a]Indicates countries outside the 18 eligible countries or the South American region.
[b]Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Paraguay, Peru, Venezuela.

one aggregated region (i.e. South America). For further analysis, all participants were aggregated into six regions: Western Europe, Northern Europe, Eastern Europe, North America, South America, and Australia. The data selection process to achieve the final study sample of 9187 women is illustrated in Figure 1.

Ethics approval and informed consent

In order to gain access to the online questionnaire, each participant had to read the study description detailing the study objectives and had the right to withdraw from the study at any time. All participants provided informed consent by answering "Yes" to the question, "Are you willing to participate in the study?" The South-East Regional Ethics Committee (REC) in Norway granted an ethical approval exemption for the original multinational research survey because of anonymity. As required by the national legislation, in the United Kingdom, the original research survey received ethical approval from the University of East Anglia's

Faculty of Medicine and Health Research Ethics Committee. In Italy, the Ethic Board of the health district of Trento was notified about the original research survey. In the remaining European countries, the research survey was exempt from ethical approval because of anonymity. All data were handled and stored anonymously. Quest Back's privacy policy ensures anonymity of the study participants, their identity, email, and IP addresses.

Personality

Personality was assessed with the Big Five Inventory (BFI) consisting of 44 statements, developed by John, Donahue, and Kentle (John et al., 2008). The BFI is designed to capture the core elements of the Big Five personality dimensions of neuroticism (N), extraversion (E), openness to experience (O), agreeableness (A), and conscientiousness (C). Participants were asked to rate the 44 statements on a scale from (1) disagree strongly to (5) agree strongly (see Supplementary Table S1). We used translated and validated versions of the BFI, whenever available. This was the case for the following languages: Dutch, German, Italian, Norwegian, Polish, Slovenian, Spanish, and Swedish (Supplementary Table S1). Back-to-back translations of the BFI were carried out for the following languages: Croatian, Finnish, Icelandic, Russian, and Serbian.

Alcohol consumption

Alcohol consumption was assessed with the following question: "Did you drink any alcohol after finding out that you were pregnant?" Participants could choose one of the following alternatives: yes; no; cannot remember. The alternative "cannot remember" was treated as a missing value in the regression models. Women reporting alcohol consumption during pregnancy were additionally questioned about the amount (in units) consumed during pregnancy. Five answer alternatives were available, based on which women were categorized as having had a low ("1–2 units during the pregnancy"), medium ("1–4 units per month"), or high ("1–2 units per week" or ">1–2 units per week") consumption of alcohol during pregnancy.

Cigarette smoking

Cigarette smoking before and after awareness of pregnancy was assessed with the following three questions: (1) "Did you smoke cigarettes before becoming pregnant?" Participants could choose one of the following alternatives: "yes, regularly"; "yes, occasionally"; "no, never"; (2) (If yes regularly/occasionally) "Do you/did you smoke during pregnancy?" Participants could choose one of the following alternatives: "yes, more than before"; "yes, approximately the same"; "yes, but less"; "no." We defined, among the women smoking before pregnancy, two mutually exclusive groups: women who smoked less during pregnancy than before (reduced smoking) and women smoking the same or more than before pregnancy (continued smoking).

Sociodemographic characteristics

Maternal sociodemographic characteristics relevant for the analysis were age, country of residency, higher educational attainment, marital status, having previous children, and whether the women were pregnant at the time of the research. These characteristics were classified as presented in Table 1.

Statistical analysis

All statistical analyses were performed by using the Statistical Package for the Social Sciences (SPSS) version 21 (IBM SPSS Statistics). Data were preliminary analyzed by performing descriptive statistics as appropriate, and missing data were excluded from the analysis via listwise deletion. Scores on the BFI were grouped and reversed, if necessary, under each of the five personality dimensions. Mean scores across each dimension were calculated. For further analysis, standardized Z scores of the Big Five variables were used. The BFI had good Cronbach's alpha

Table 1. Characteristics of the study population ($n = 9187$).[a]

Characteristics	Values
Age (years; mean ± *SD*)	29.65 ± 5.14
Age range (in years)	
≤20	310 (3.4%)
21–30	5033 (54.8%)
31–40	3657 (39.8%)
≥41	187 (2.0%)
Gestational week (mean ± *SD*)	22.43 ± 10.25
Region of residency	
Western Europe (%)	3099 (33.7%)
Northern Europe (%)	2782 (30.3%)
Eastern Europe (%)	2251 (24.5%)
North America (%)	517 (5.6%)
South America (%)	326 (3.5%)
Australia (%)	212 (2.3%)
Pregnant at time of the study (%)	4942 (53.8%)
Previous children	
No	4578 (49.8%)
Yes	4609 (50.2%)
Marital status	
Married/cohabiting (%)	8618 (93.8%)
Single/divorced/others (%)	569 (6.2%)
Educational attainment	
Less than high school (%)	432 (4.7%)
High school (%)	2618 (28.5%)
More than high school (%)	5100 (55.5%)
Other education (%)	1037 (11.3%)
Working status	
Employed (%)	6687 (72.8%)
Student (%)	826 (9.0%)
Housewife (%)	805 (8.8%)
Job seeker (%)	416 (4.5%)
Other (%)	453 (4.9%)
Alcohol consumption during pregnancy	
No	7726 (84.1%)
Yes	1461 (15.9%)
Amount of alcohol consumed[b]	
Low, 1–2 units during pregnancy	873 (9.5%)
Medium, 1–4 units per month	447 (4.9%)
High, more than 1–2 units per week	141 (1.5%)
Smoking before pregnancy	
No	5938 (64.6%)
Yes	3249 (35.4%)
Smoking during pregnancy[c]	
No	2378 (25.9%)
Reduced smoking	741 (8.1%)
Continued smoking	125 (1.4%)

[a]Numbers may not add up due to missing values. Missing values are less than 5 percent of the total.
[b]Only women who consumed alcohol during pregnancy provided information about the amount.
[c]Only women who smoked before pregnancy provided information about smoking status during pregnancy.

reliabilities (internal consistency): 0.82 for neuroticism, 0.81 for extraversion, 0.74 for agreeableness, 0.78 for conscientiousness, and 0.79 for openness.

In order to examine the associations of personality with women's consumption of alcohol and cigarette smoking during pregnancy, binomial logistic or multinominal logistic regression analyses were carried out. Possible confounding variables were region of residency, maternal age, marital status, educational level, having previous children, and whether the women were pregnant at the time of the study. Four different analysis sets were conducted: (1) Women who smoked before pregnancy were compared to women who did not smoke before pregnancy; (2) Women who smoked during pregnancy were compared with women who quit smoking during pregnancy. The latter was used as a reference group to investigate how personality traits were associated with continued cigarette smoking during pregnancy; (3) Women who consumed alcohol during pregnancy were compared to women who abstained from alcohol during pregnancy; (4) Women who consumed alcohol in high or medium amount were, respectively, compared with those having low consumption during pregnancy. A p value of <0.05 was considered statistically significant.

To shed additional light on the variability across countries in terms of guidelines, culture, and attitudes toward alcohol consumption in pregnancy, we specifically investigated, in the regression model, the interaction effects between consumption of alcohol during pregnancy (as "use vs abstaining," "middle vs low amount," and "high vs low amount"), regions of residency, and personality traits.

Smoking rates before and during pregnancy and alcohol consumption during pregnancy in the 15 European countries are presented elsewhere (Mårdby et al., 2017; Smedberg et al., 2014). For subanalyses, two interaction effect models were tested with regard to consumption of alcohol and cigarettes during pregnancy: (1) interaction effects between the five personality traits and (2) interaction effects between region of residency and personality traits. Next, in order to select the regression models (main effect or interaction effect) that provide the best approximation to the data, Akaike's information criterion (AIC) (i.e. $\Delta\chi^2 - 2\Delta df$) was applied (Akaike, 1987). AIC allows one to rank and compare multiple competing models and, thus, provides an estimate for which of them is the best approximation to the underlying phenomenon. The best model fitting the data is the model that minimizes AIC (Symonds and Moussalli, 2011).

Results

Population characteristics

Overall, the study included 9187 women, of whom 4942 (53.8%) were pregnant and 4245 (46.2%) had already given birth. Sociodemographic, lifestyle, and maternal baseline characteristics are presented in Table 1. The mean age was 29 years (range: 15–51 years), and most women were between 21 and 30 years (54.8%). The overall educational level in the sample was high, with 55.5 percent of the women having completed university or college and 72.8 percent of the women were employed at the time of pregnancy. Most women (88.5%) were of European residency.

Associations between women's personality and alcohol consumption during pregnancy

In the adjusted models, the traits of agreeableness, conscientiousness, and openness were significantly associated with women's alcohol consumption during pregnancy (Table 2). Each standardized score increase on the agreeableness and conscientiousness reduced the odds of drinking alcohol during pregnancy by 10 and 12 percent, respectively. Each standardized score increase on the openness yielded a 6 percent increased odds that the women would drink alcohol during pregnancy. In the analysis

Table 2. Associations between women's personality and alcohol consumption during pregnancy.

Personality	Alcohol consumption					
	Use vs abstaining		Medium vs low use		High vs low use	
	cOR (95% CI)	aOR (95 % CI)[a]	cOR (95% CI)	aOR (95 %CI)[a]	cOR (95% CI)	aOR (95 %CI)[a]
Extraversion	1.05 (1.00–1.09)	1.04 (0.99–1.09)	1.09 (0.99–1.18)	1.10 (1.01–1.21)*	1.12 (0.98–1.28)	1.17 (1.02–1.35)*
Agreeableness	0.88 (0.84–0.91)*	0.90 (0.86–0.94)*	0.95 (0.87–1.04)	0.92 (0.83–1.01)	0.93 (0.81–1.06)	0.86 (0.74–0.99)*
Conscientiousness	0.92 (0.88–0.96)*	0.88 (0.85–0.92)*	1.01 (0.93–1.10)	0.97 (0.88–1.06)	0.95 (0.83–1.08)	0.89 (0.77–1.03)
Neuroticism	1.02 (0.98–1.06)	1.01 (0.97–1.06)	0.91 (0.84–1.00)	0.91 (0.83–1.00)	1.00 (0.87–1.15)	0.96 (0.83–1.12)
Openness	1.09 (1.05–1.14)*	1.06 (1.02–1.11)*	0.95 (0.88–1.03)	0.97 (0.89–1.06)	1.09 (0.96–1.24)	1.11 (0.96–1.28)

cOR: crude odds ratio, CI: confidence interval, aOR: adjusted odds ratio.
[a]Adjusted for educational level, previous children, currently pregnant, marital status, maternal age, and region of residency.
*$p < 0.05$.

Table 3. Associations between cigarette consumption before and during pregnancy according to personality traits.

Smoking before pregnancy				
Personality	Occasionally vs non-smokers		Regularly vs non-smokers	
	cOR (95% CI)	aOR (95% CI)[a]	cOR (95% CI)	aOR (95% CI)[a]
Extraversion	1.21 (1.16–1.27)*	1.19 (1.13–1.25) *	1.22 (1.17–1.27)*	1.20 (1.15–1.26)*
Agreeableness	0.92 (0.88–0.96)	0.96 (0.91–1.00)	0.89 (0.85–0.92)*	0.90 (0.87–0.94)*
Conscientiousness	0.88 (0.84–0.92)	0.90 (0.86–0.95)*	0.84 (0.80–0.87)*	0.88 (0.84–0.91)*
Neuroticism	1.10 (1.05–1.15)*	1.09 (1.04–1.14)*	1.14 (1.10–1.19)*	1.10 (1.06–1.15)*
Openness	1.08 (1.03–1.13)*	1.06 (1.01–1.11)*	0.99 (0.95–1.0)	1.00 (0.96–1.04)
Smoking during pregnancy				
Personality	Reduce vs quitting		Continue vs quitting	
	cOR (95% CI)	aOR (95% CI)[a]	cOR (95% CI)	aOR (95% CI)[a]
Extraversion	0.99 (0.93–1.06)	1.01 (0.94–1.08)	0.97 (0.84–1.12)	1.00 (0.86–1.15)
Agreeableness	1.06 (1.00–1.12)	1.04 (0.98–1.11)	0.96 (0.85–1.10)	0.95 (0.84–1.09)
Conscientiousness	0.91 (0.86–0.97)*	0.93 (0.88–0.99)*	0.97 (0.85–1.10)	1.01 (0.89–1.16)
Neuroticism	1.00 (0.95–1.07)	0.99 (0.92–1.05)	1.18 (1.03–1.35)*	1.16 (1.01–1.33)*
Openness	0.90 (0.85–0.95)*	0.91 (0.85–0.97)*	0.97 (0.85–1.11)	0.99 (0.87–1.13)

cOR: crude odds ratio, CI: confidence interval, aOR: adjusted odds ratio.
[a]Adjusted for educational level, previous children, currently pregnant, marital status, maternal age and region of residency.
*$p < 0.05$.

by amount of alcohol consumed, higher extraversion was positively associated with consuming alcohol in medium or high amounts (Table 2).

Association between women's personality and smoking before, and during pregnancy

All personality traits except openness were significantly related to regular smoking before pregnancy in the adjusted model (Table 3). Each standardized score increase on the trait of extraversion and neuroticism conferred approximately a 20 and 10 percent increase in the odds of smoking both occasionally and regularly before pregnancy. Higher agreeableness and conscientiousness reduced the odds of smoking regularly before pregnancy by 10–12 percent per standardized unit increase. The trait of neuroticism was the only one significantly related with continued smoking during pregnancy (Table 3). Each standardized score increase on this trait conferred a 16 percent increased odds for continued smoking during pregnancy. Each standardized score increase on the conscientiousness and openness traits yielded a 7 and 9 percent decreased odds for smoking less during pregnancy.

Region of residency, personality, and drinking during pregnancy

Table 4 describes the main and additional effects of personality traits on drinking during pregnancy by region of residency. Contrary to the main effect, high levels of neuroticism and agreeableness for Australian women were positively related (31%–64% increased odds) to drinking alcohol during pregnancy compared

Table 4. Association between personality and drinking during pregnancy according to region of residency.

	Drinking alcohol during pregnancy					
	Main effect	Additional effects				
	Western Europe	Northern Europe[a]	Eastern Europe[a]	North America[a]	South America[a]	Australia[a]
	OR, 95% CI					
	Use vs abstaining					
Extraversion	1.02 (0.95–1.10)	1.09 (0.97–1.21)	1.08 (0.96–1.21)	0.87 (0.72–1.05)	0.97 (0.78–1.22)	1.04 (0.79–1.36)
Agreeableness	0.89 (0.83–0.96)*	0.95 (0.85–1.07)	0.98 (0.89–1.09)	0.85 (0.70–1.04)	1.06 (0.84–1.34)	1.64 (1.23–2.15)*
Conscientiousness	0.92 (0.86–0.99)*	1.06 (0.95–1.18)	0.92 (0.83–1.02)	1.11 (0.92–1.33)	1.03 (0.83–1.27)	1.04 (0.80–1.35)
Neuroticism	0.99 (0.92–1.07)	1.13 (1.00–1.27)*	1.04 (0.93–1.16)	0.76 (0.63–0.92)*	1.05 (0.84–1.32)	1.31 (1.00–1.71)*
Openness	1.01 (0.94–1.08)	1.19 (1.07–1.31)*	1.02 (0.91–1.14)	1.17 (0.97–1.41)	1.08 (0.83–1.33)	1.29 (0.73–1.71)
	Medium vs low use					
Extraversion	1.09 (0.96–1.24)	1.07 (0.81–1.43)	0.92 (0.75–1.14)	1.28 (0.84–1.94)	0.91 (0.48–1.73)	1.21 (0.63–2.32)
Agreeableness	0.99 (0.87–1.13)	0.85 (0.63–1.15)	0.91 (0.74–1.11)	1.24 (0.79–1.95)	0.78 (0.41–1.48)	0.72 (0.40–1.30)
Conscientiousness	0.99 (0.87–1.14)	1.11 (0.85–1.45)	1.03 (0.84–1.27)	0.99 (0.67–1.48)	1.18 (0.68–2.02)	0.85 (0.51–1.42)
Neuroticism	1.02 (0.87–1.17)	0.90 (0.67–1.22)	0.82 (0.67–1.01)	1.18 (0.77–1.80)	0.56 (0.27–1.17)	0.58 (0.32–1.05)
Openness	0.97 (0.86–1.10)	0.95 (0.74–1.23)	0.92 (0.76–1.13)	1.03 (0.68–1.55)	0.99 (0.56–2.58)	1.44 (0.80–2.58)
	High vs low use					
Extraversion	1.16 (0.95–1.42)	1.03 (0.66–1.60)	1.03 (0.73–1.46)	1.05 (0.53–2.09)	0.79 (0.45–1.40)	0.78 (0.36–1.70)
Agreeableness	0.88 (0.72–1.07)	0.79 (0.52–1.22)	1.19 (0.86–1.64)	1.40 (0.67–2.92)	0.83 (0.44–1.60)	1.19 (0.55–2.58)
Conscientiousness	0.85 (0.69–1.05)	1.21 (0.82–1.80)	1.31 (0.93–1.83)	1.40 (0.71–2.76)	0.88 (0.51–1.51)	0.91 (0.47–1.74)
Neuroticism	1.08 (0.87–1.34)	0.88 (0.55–1.41)	0.76 (0.55–1.07)	1.46 (0.71–3.01)	1.35 (0.75–2.45)	0.81 (0.39–1.65)
Openness	1.20 (0.98–1.46)	0.87 (0.59–1.29)	0.70 (0.51–0.97)*	0.76 (0.39–1.47)	1.33 (0.76–2.33)	1.59 (0.73–3.46)

[a]Reference group: Western Europe.
*$p < 0.05$.

to Western European women. Neuroticism, together with openness, were also positively associated with drinking during pregnancy in Northern Europe (13%–19% magnitude), while the opposite trend was evident in North America; here, higher scoring on neuroticism was related to lower likelihood (24% magnitude) to drink alcohol during pregnancy. In the analysis by amount of alcohol consumed, high levels of openness in women in Eastern Europe were protective against consuming high amounts of alcohol, relative to Western Europeans.

Results for AIC showed that the main model was a better fit to the data, indicating no interaction effects (1) between the five personality traits and (2) between region of residency and personality traits (see Supplementary Table S2).

Discussion

To the best of our knowledge, this is the first study addressing the relationship between personality traits and smoking and drinking patterns during pregnancy from a multinational perspective. Several findings are important for pre- and postnatal health care, as they point to the importance of personality in shaping maternal unfavorable health habits across different regions. Likewise, our results uncovered an important distinction: smoking cigarettes during pregnancy may be influenced by different personality traits than drinking alcohol during pregnancy.

High conscientiousness emerged as the sole protective factor against smoking cigarettes and drinking alcohol during pregnancy. Highly conscientious women were more likely to quit smoking altogether instead of merely reducing consumption, and similarly they abstained completely from alcohol use after awareness of pregnancy. These findings are in line with previous research showing a positive relationship between high conscientiousness and beneficial health habits, spanning from refraining from smoking, excessive alcohol (Beijers et al., 2014; Bogg and Roberts, 2004) or substance use, to higher engagement in self-care (Hakulinen et al., 2015; Malouff et al., 2006, 2007; Vollrath et al., 1999). The detected protective effect of the trait against smoking both regularly and occasionally before the pregnancy period further corroborates the literature, also in terms of effect sizes (Hakulinen et al., 2015). However, as also shown by the current study, high conscientiousness does not seem to influence the amount of alcohol consumed (Beijers et al., 2014; Malouff et al., 2007).

We noted that high openness positively related to consuming alcohol during pregnancy in the overall sample and in Northern Europe. Yet, high neuroticism and high agreeableness did so in Australia, and the effect of neuroticism was divergent in Northern Europe and North America. This inter-region variability may indicate that the behavioral correlates of personality are nationally sensitive. Social norms for acceptable behavior in pregnant women can indeed be conditioned by cultural factors and country-specific alcohol policies. However, as also corroborated by prior research in pregnancy (Beijers et al., 2014), openness did not emerge as an important correlate of a high alcohol consumption. Taken together, these findings may suggest that openness to experience leads to consuming some alcohol once pregnant, but does not lead to other types of alcohol involvement (Malouff et al., 2007). Women who are more open may likely question the debate on the risks posed by minimal alcohol exposure, and thus consume alcohol minimally in pregnancy. The oversampling of more educated women in Eastern Europe may explain the divergent association for the trait. It is possible that the openness profile in this region entails in higher degree intellectual curiosity and reflection, which in turn can hinder women from consuming elevated amounts of alcohol that can be of harm to the unborn child.

In line with studies among non-pregnant individuals (Cook et al., 1998; Hussong, 2003; Malouff et al., 2007), high extraversion emerged as a factor associated with medium or high alcohol consumption during pregnancy. One can hypothesize that drinking alcohol may be part of an underlying psychopathology, revealing itself

independently of pregnancy. Indeed, disorders on the externalizing spectrum, such as substance use, are closely associated with disinhibitory personality traits (Krueger et al., 2007). Yet, the effect size of our association was negligible (10%–17% increased odds). This, coupled with the protective effect of high agreeableness on elevated alcohol consumption during pregnancy, suggests that neglecting norms and alcohol policies, rather than tackling anxious/depressed perinatal symptoms with alcohol, likely contributes to unfavorable drinking practices during pregnancy.

A key finding of this study was that high neuroticism was the sole trait significantly associated with continued smoking during pregnancy. The magnitude of this association was in the range 1–33 percent increased odds, and thereby of small effect size. Nevertheless, its implications for maternal–fetal health may still be considerable given the substantial number of women smoking during pregnancy (Smedberg et al., 2014) and the detrimental effect posed by cigarette smoking on the health of both the mother and child (Pereira et al., 2017). This finding is not only in line with two meta-analyses among non-pregnant individuals but also in contrast to the study by Ystrom et al. (2012), conducted specifically in a pregnant population. Differences in the choice of comparison groups, study population and design, or country-specific variations may partly explain this disparity. In a nicotine replacement study, cigarette smokers with high levels of neuroticism had greater difficulties in maintaining abstinence, due to the trait's correlation with difficulties in coping with stressful situations and to resist cravings (Cosci et al., 2009). It is possible that the emotional instability and impulsivity within women scoring high on neuroticism may be a crucial barrier against quitting smoking during pregnancy. However in this study, high neuroticism increased the odds of smoking regularly even before pregnancy, which may point to the substantial role of maternal psychopathology in governing smoking habits both before and during pregnancy (Hakulinen et al., 2015; Malouff et al., 2006).

Trait-specific associations emerged on individual region level, even though region of residency did not seem to act as effect modifier. Aggregation of countries into regions may have contributed to this finding and masked any country-specific effect. As suggested by a meta-analysis (Malouff et al., 2006) in non-pregnant individuals, and applicable in the context of this study, language differences and availability of validated versions of the BFI may partly explain the variation in effect sizes across the regions. Whether the social acceptability of unfavorable maternal habits, in concert with the varying distribution of smokers and drinkers during pregnancy, may differentially shift the personality profiles of women across the countries remains to be determined (Friedman et al., 2014; Malouff et al., 2006).

Strengths and limitations

This study has several strengths and limitations. An important strength is that data were collected with the same questionnaire across all participating countries. This allows for inter-country comparisons as well as aggregation of the findings. A further strength is that personality was measured with a validated scale with reliable psychometric properties and good internal consistency. This makes it possible to review the findings in light of the relevant body of research. Furthermore, data were collected anonymously. Perceived confidentiality and anonymity are important factors for counteracting social desirability bias (Bordens and Abbott, 2008). The utilization of an Internet-based questionnaire made it possible to reach a large, multinational population of pregnant women and new mothers. Recent epidemiological studies have indicated reasonable validity of web-based recruitment methods (Ekman et al., 2006; Van Gelder et al., 2010). Several areas of research have shown that the information provided in a web-based questionnaire is equivalent, of quality, and as reliable as that collected via traditional methods (Ritter et al., 2004; Whitehead, 2011). Although the Internet penetration rate in households or at work is

relatively high among women of childbearing age in Europe, North America, and Australia (Australian Bureau of Statistics (ABS), 2018; Bureau, 2011; Seybert, 2011), a selection of more educated women and/or women with easier access to the Internet cannot be ruled out. Furthermore, since women have been shown to use the Internet in a very high extent during pregnancy to seek pregnancy-related information (Bert et al., 2013; O'Higgins et al., 2014), this population is probably a suitable target group for web-based studies. To appraise the representativeness of the sample in each participating country, we have previously compared the sociodemographic and lifestyle characteristics of the sample in each country, with those of the general birthing population in the same country (Lupattelli et al., 2014). Generalizability of the findings for the countries with few participants should be done cautiously. Also, the countries included in the study, except the South American region, are not so culturally divergent from one another. Finally, the study did not include potentially important determinants, such as alcohol consumption before pregnancy, income, and the presence of other household smokers. Our results should be interpreted with these strengths and limitations in mind.

Implications of the study and areas for further research

Given the significance of the maternal–fetal risks posed by both smoking cigarettes and drinking alcohol during pregnancy, the findings of this study are relevant for the antenatal care of pregnant women. Health care providers need to be informed about the importance of specific maternal correlates linked to more favorable health behaviors during pregnancy. In this regard, the present study has highlighted some significant aspects: personality plays an important role for smoking cigarettes and drinking alcohol during pregnancy. Awareness about maternal personality traits and their behavioral correlates might be a vital cornerstone for pre- and postnatal health care. This is particularly important since these sets of factors, for instance, neuroticism and smoking habits, significantly relate to a potential underlying maternal psychopathology. Indeed, high levels of neuroticism may often manifest as overly anxiety whereas low levels of conscientiousness may reveal itself through poor self-discipline and organization skills (Ystrom et al., 2012). Another important aspect is the influence of country of residency on our observed associations. Behavioral correlates of personality, it seems, are sensitive to the inherent national context, and this should therefore guide tailored health care information and interventions. Further studies of personality and health-related behavior during pregnancy are needed to have a better understanding of the workings of every woman's unique personal make-up when trying to adhere to health advice.

Conclusion

The findings of this study point to the importance of personality and country of residence with regard to providing adequate pre- and postnatal health care. High levels of conscientiousness and agreeableness acted as protective factors against alcohol consumption during pregnancy. Conscientiousness was also positively related to pregnant women quitting smoking altogether instead of merely reducing consumption. High levels of neuroticism were a risk factor for continued smoking during pregnancy. Women scoring high on openness were more likely to quit smoking but had a tendency to drink alcohol.

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Supplemental Material

Supplementary material for this article is available online.

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