Substance use during pregnancy and personality dimensions

Consumo de substancias durante el embarazo y dimensiones de personalidad

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Abstract

Our aim was to assess personality traits associated with substance use during pregnancy in a population-based, multicentre study of 1804 pregnant women. On day 2-3 postpartum, participants completed a semi-structured interview, including self-reported drug use (alcohol, tobacco, caffeine, cannabis, cocaine, opioids) during pregnancy, and socio-demographic, reproductive and obstetric variables, personal and family psychiatric history, social support, and the Eysenck personality questionnaire, short version (EPQ-RS). Logistic regression models were conducted. Fifty per cent of women reported substance use during pregnancy: 40% caffeine, 21% tobacco, 3.5% alcohol, and 0.3 % cannabis. Mean *T*-scores (*SD*) for personality dimensions were 51.1 (9.6) for *extraversion*, 48 (8.9) for *psychoticism*, and 43.6 (8.5) for *neuroticism*. Extroversion (*p* = .029) and *psychoticism* (*p* = .009) were identified as risk factors after adjustment by age, level of education, employment status during pregnancy, low social support, and previous psychiatric history. For each increment of 10 units in their scores,

Resumen

Este estudio evalúa los patrones de consumo de substancias durante el embarazo y las dimensiones de personalidad asociadas, en una muestra multicéntrica de 1804 mujeres de población general. En el 2-3 día posparto, completaron una entrevista auto-administrada sobre el consumo de alcohol, tabaco, cafeína, cannabis, cocaína, opiáceos, drogas de diseño, además de variables socio-demográficas, obstétricas/reproductivas, historia psiquiátrica previa, apoyo social durante el embarazo y el cuestionario de personalidad de Eysenck (EPQ-RS). Se generaron modelos de regresión logística múltiple. La prevalencia del consumo fue del 50% (N=909): 40% cafeína, 21% tabaco, 3,5% alcohol, y 0,3 cannabis. Las puntuaciones *T* medias (*DE*) de personalidad fueron: *extraversión* 51,1 (9,6), *psicoticismo* 48 (8,9) y *neuroticismo* 43,6 (8,5). Las dimensiones de *extraversión* (*p*=0,029) y *psicoticismo* (*p*=0,009), fueron identificadas como factores de riesgo tras ajustar por edad, nivel educación, estatus laboral durante el embarazo, bajo apoyo social, e historia psiquiátrica previa. Para cada incremento de 10 unidades en sus

the odds of substance use increased by 12% and 16% respectively. Low education, being on leave during pregnancy, and previous psychiatric history were independent factors ($p < .05$) associated with substance use during pregnancy. Primiparity was a protective factor ($p = .001$). The final models showed a good fit ($p = .26$). The screening of substance use during pregnancy should include personality dimensions apart from psychosocial variables and history of psychiatric disorders. It is important to identify the associated risk factors for substance use during pregnancy to prevent and improve foetal/neonatal and maternal health during perinatal period.

Keywords: Alcohol; Caffeine; Cannabis; Tobacco; Substance use; Pregnancy; Personality.

puntuaciones, el *odds* de consumo de substancias durante el embarazo se incrementó un 12% y un 16% respectivamente. Menor educación, estar de baja, y antecedentes psiquiátricos fueron también factores independientes ($p<0,05$) asociados al consumo. Ser primípara fue factor protector ($p=0,001$). El modelo final mostró un ajuste satisfactorio ($p=0,26$). El cribaje de las mujeres con riesgo de consumo de substancias durante el embarazo debería incluir la personalidad además de variables psicosociales y antecedentes psiquiátricos. Identificar los factores de riesgo asociados es importante para prevenir y mejorar la salud materna y fetal/neonatal durante el embarazo y posparto.

Palabras clave: Alcohol; Cafeína; Cannabis; Tabaco; Consumo de substancias; Embarazo; Personalidad.

Psychoactive substance use is widespread among the general population. The most widely used legal and illegal substances globally are caffeine, tobacco, alcohol and cannabis (Kuczkowski, 2009; WHO, 2010). The last two decades have seen a marked increase in the prevalence of recreational substance use among young people, including women of childbearing age (15-44 years) (Chen & Jacobson, 2012; EMCDD, 2016; SAMHSA, 2013). The use of substances and their effects on the organism differ between women and men (Ait-Daoud et al., 2019; Díaz-Mesa et al., 2016; Patró-Hernandez et al., 2019), with women more vulnerable to substance use during reproductive age (Louw, 2018).

Pregnancy is a unique period for women, in which the use of substances can affect their health as well as interfere at different levels (teratogenic and epigenetic) in the development of the foetus, depending on dose, time and substance consumed (Álvarez-Segura et al., 2014; Cook et al., 2017; Volkow, Compton & Wago, 2017).

The prevalence of use among pregnant women seems to be significantly lower than in non-pregnant women of the same age (Lamy & Thibaut, 2010; Lange, Probst, Rehm & Popova, 2018; Popova, Lange, Probst & Rehm, 2017). In general, this is estimated by extrapolation from epidemiological studies in the general population (Lange et al., 2018; Powers, McDermott, Loxton & Chojenta, 2013). A systematic review and meta-analysis (Lange et al., 2018) indicates that globally (131 countries), 53% of women who smoke continue to do so during pregnancy. Europe in particular has the highest prevalence of smoking during pregnancy, 8.1%, but the lowest proportion of women, 30%, of daily smokers. In Spain, this extrapolation points to a prevalence of smoking of over 20% during pregnancy. Alcohol use is around 10%, varying by country (Popova et al., 2017). A prevalence of 25% is estimated for Europe, with 10-15% for Spain (Popova et al., 2017). Regarding illicit drugs, the two most prevalent substances used during pregnancy are cannabis and cocaine (Cook et al., 2017). A prevalence ranging from 2% to 10% has been calculated for cannabis use, higher at the beginning of pregnancy and

lower in the last trimester (Alshaarawy & Anthony, 2019), and 0.5-3% for cocaine (Bhuvaneswar, Chang, Epstein et al., 2008). Finally, caffeine, found in a variety of beverages, including coffee, tea and cola, as well as chocolate, is another of the substances widely consumed in many countries for its psychostimulatory effects, although it is rarely studied in pregnant women (Kuczkowski, 2009).

Most studies on substance use during pregnancy have focused on investigating its effects on the foetus and newborn, mentioned above, and on associated risk factors, such as a low level of education, multiparity, being single, and anxious and depressive symptomatology (Alvarez-Segura et al., 2014; Cook et al., 2017; Havens, Simmons, Shannon & Hansen, 2009; Skagerström, Chang & Nilsen, 2011). However, few studies have focused on personality as a risk factor for substance use in pregnancy.

Personality traits are important in explaining individual differences in behaviour, cognition, and emotion; they are partially heritable (Vukasovic & Bratko, 2015) and known to be linked to health (Strickhouser et al., 2017). Research in the general population indicates that high scores in the personality traits of *extraversion* and *neuroticism* are associated with the use of addictive substances (Connor-Smith & Flachsbart, 2010; Munafo, Zetteler & Clark, 2007). In a study of the registry of Australian twins and siblings, results showed that a profile of high *neuroticism*, low *friendliness* and *responsibility* is associated with substance use disorders, smoking, alcohol, and cannabis, regardless of sex (Dash, Slutske, Martin, Statham, Agrawal & Lynskey, 2019). On the other hand, it has been observed that personality is an important factor in maternal behaviour and that low *neuroticism* and high *friendliness*, *extraversion* and *responsibility* are associated with adaptive maternal behaviour (McCabe, 2014).

It seems that women who smoke during pregnancy are most frequently those with a profile characterized by high *neuroticism* and *novelty seeking*, and low *extraversion* (Lupattelli, Ronningen, Krogsrud, Noredeng & Ystrom, 2018; Massey et al., 2016; Maxson, Edwards, Ingram & Miranda, 2012), although one study links it to low *neuroticism*

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(Ystrom, Vollrath & Nordeng, 2012). While those with low *harm avoidance* and high *self-direction* are more capable of quitting smoking (Massey et al., 2016), those who continue to drink alcohol during pregnancy score high on *extraversion* (Lupatelli et al., 2018) and *openness to experience* (Beijers, Burger et al., 2014) and low on *responsibility* (Beijers et al., 2014; Ystrom et al., 2012).

Identifying personality traits and other risk factors associated with substance use during pregnancy would seem important for preventing their use and improving maternal and foetal, neonatal and infant health during pregnancy and postpartum.

The aim of this study was to assess the association of Eysenk's (1985) personality dimensions with substance use during pregnancy in a general population sample of women who did not need psychiatric or psychological care during pregnancy, while accounting for the presence of other risk factors, socio-demographic, obstetric, personal and family psychiatric history and degree of social support.

Material and Methods

Participants

For a period of one year, women attending the obstetrics and gynaecology services of seven general university hospitals in Spain and giving birth to a live child were included. The study is part of a larger project (DEPREPOST) involving a prospective study conducted from immediate postpartum to 32 weeks postpartum (Sanjuan et al., 2008). All participants were Spanish, over 18 years old, Caucasian; none had received psychiatric/psychological treatment during pregnancy, and all were able to understand and answer the clinical questionnaires. Informed consent was requested from all participating women. The study was approved by the ethics committees of each institution.

Assessment

On the second or third day postpartum, all participants completed a semi-structured interview to elicit data on socio-demographic aspects (age, education level, employment during pregnancy, economic situation), reproduction and obstetrics (pregnancy planning, parity, type of childbirth, pathology during pregnancy), relationship with partner and mother (no partner/mother, close and loving relationship, occasional disagreements, or poor relationship), family and personal psychiatric history (women who presented mental conditions requiring pharmacological or psychological treatment during pregnancy) and substance use during pregnancy.

The term substance use included both the use of legal (caffeine, tobacco and alcohol) and illegal substances (cannabis, cocaine, stimulants, hallucinogens, ketamine, ecstasy and opioids). Women were classified as either users or non-users (those reporting not using any legal or illegal

substances during pregnancy of the newborn index child). Substance-using women also described the usual frequency of each substance use during pregnancy as: "never," "less than once a month," "monthly," "weekly," and "daily." For the analysis, the first two categories ("never", "less than once a month") were considered "never" and women were assigned to the non-user group. Finally, the women were asked to describe the dose consumed during the last month of pregnancy. For caffeine, one cup of coffee/day (equivalent to two tea or three cola drinks) was taken as a measure of use, for alcohol the number of standard drinks/day was recorded, for tobacco the number of cigarettes/day, and for cannabis the number of joints/day.

Finally, the Eysenck Personality Questionnaire in its short, revised version, EPQ-RS (Eysenck, 1985), was administered to all women to assess personality. The EPQ-RS consists of 48 items selected from the 100 items in the original version assessing three dimensions of personality: *extraversion* (E), *neuroticism* (N), and *psychoticism* (P). *Extraversion* or social dimension includes the factors sociability, liveliness, activity, assertiveness, sensation seeking, carefreeness, spontaneity, and adventurousness; *neuroticism* or emotional dimension: anxiety, depression, feelings of guilt, low self-esteem, fear, irrationality, shyness, sadness, and emotionality; and *psychoticism* or impulsive dimension: aggressiveness, coldness, impulsiveness, self-centredness, lack of empathy, antisocial tendencies, creativity, and rigidity. The present study uses T scores, according to the standardized version for the Spanish population of women (Eysenck & Eysenck, 2001).

Statistical analysis

SPSS (v19.0) and R (v3.4.3) were used for statistical analysis. The chi-square test was used to compare using and non-using mothers with respect to the distribution of categorical variables. The comparison involving continuous variables was made using Student's *t*-test. A *p* value of 0.05 was defined as statistically significant. Effect size was quantified using Cohen's *d* in the case of numerical variables and Cohen's *w* in the case of categorical variables (Mangiafico, 2016). To determine the factors associated with substance use during pregnancy, a multivariate logistic regression model was applied. Variable selection followed the Hosmer and Lemeshow proposal (Hosmer & Lemeshow, 2000), which includes, as a first step, variables with a *p*-value below 0.2 in the univariate analysis as well as those variables considered relevant in the literature. Possible interactions between variables was also explored. The Hosmer and Lemeshow test was used to measure the logistic regression model's goodness of fit. The results are shown as odds ratios (ORs) with a 95% confidence interval (95% CI). In the case of the EPQ dimensions included in the model, the ORs associated with a difference of 10 points in the score were estimated.

Results

Table 1 shows the data for the socio-demographic, reproductive and obstetric variables, relationship with partner and mother, and the presence of personal and family psychiatric history of the 1804 women who met the inclusion criteria. Mean *T* scores (*SD*) of the personality dimensions were 51.1 (9.59) for *extraversion*, 43.6 (8.49) for *neuroticism* and 48 (8.93) for *psychoticism*.

Nine hundred and nine women (50.4%) reported using a substance during pregnancy, the majority being legal: 40% caffeine, 20.8% tobacco, and 3.5% alcohol. Use of illicit substances was much lower (1.5%), with cannabis being the most frequent (0.3%). The frequency of caffeine consumption during pregnancy was daily in 577 (32%)

women, weekly in 128 (7.1%), and monthly in 21 (1.2%). Daily smoking was reported by 348 (19.3%) women, weekly by 15 (0.8%), and monthly by 13 (0.7%). The frequency with which alcohol was drunk during pregnancy was daily by one woman (0.1%), weekly by 23 (1.3%), and monthly by 39 (2.2%). Cannabis was used daily by 4 (0.2%) women, weekly by 1 (0.1%), and monthly by 1 (0.1%). The mean dose (SD) of caffeine in the last month was 18.1 (24.5) cups of coffee, with a range of (1-150); for smoking this was 197 (171) cigarettes (1-1120); for alcohol 29.7 (113) standard drinks (1-800); and for cannabis 42.2 (33.9) joints (1-90).

The result of the univariate analysis is shown in Table 1. Women who reported using substances during pregnancy had a lower level of education compared to non-users

Table 1. *Sample characteristics*

		Total sample N=1804		Users N=909 (50.4%)		Non-users N=895 (49.6%)		x²/t	g.d.l.	p value	d-Cohen/ w-Cohen
		N (%) / x̄ (SD)		N (%) / x̄ (SD)		N (%) / x̄ (SD)					
Age	Range:18-46	31.80	4.65	31.80	4.53	31.70	4.78	0.321	1802	0.749	0.02
Level of education	Primary	560	31.1	310	31.4	250	28.1	12.588	2	0.002	0.08
	Secondary	743	41.3	378	41.6	365	41.0				
	University	495	27.5	220	24.2	275	30.9				
Marital status	Married/stable relationship	1732	96.5	880	96.9	852	96.1	2.317	3	0.509	0.04
Employment during pregnancy	Employed	1217	67.8	596	65.6	621	70.0	8.414	3	0.038	0.07
	Unemployed	222	12.4	108	11.9	114	12.9				
	Student/homemaker	165	9.2	93	10.2	72	8.1				
	On sick leave	192	10.7	112	12.3	80	9.0				
Financial situation	Regular income	1115	62.8	569	63.1	546	62.5	4.246	3	0.236	0.04
	Occasional difficulties	505	28.5	256	28.4	249	28.5				
	Some problems	137	7.7	64	7.1	73	8.4				
	Serious problems	18	1.0	13	1.4	5	0.6				
Planned pregnancy	Planned and happy	1208	74.6	613	72.8	595	76.5	2.884	2	0.237	0.04
	Unplanned and happy	353	21.8	196	23.3	157	20.2				
	Accident	59	3.6	33	3.9	26	3.3				
Parity	Primiparity	827	47.0	383	43.1	444	51.1	11.001	1	0.001	0.08
Pathology during pregnancy	Yes	292	16.2	184	20.2	108	12.1	21.617	1	‹0.001	0.11
Relationship with partner	No partner	15	0.9	8	1.0	7	0.9	10.307	4	0.036	0.08
	Close and loving	1008	62.3	494	58.7	514	66.2				
	Occasional disagreements	546	33.8	314	37.3	232	29.9				
	Poor relationship	16	1.0	8	1.0	8	1.0				
	Tense	32	2.0	17	2.0	15	1.9				
Relationship with mother	No mother	84	5.2	52	6.2	32	4.1	7.256	4	0.123	0.07
	Close and loving	982	60.7	504	59.9	478	61.6				
	Occasional disagreements	491	30.3	260	30.9	231	29.8				
	Poor relationship	51	3.2	20	2.4	31	4.0				
	Tense	10	0.6	6	0.7	4	0.5				
Family psychiatric history	Yes	575	34.7	326	36.1	249	32.9	1.778	1	0.182	0.03
Personal psychiatric history	Yes	299	16.6	170	18.7	129	14.4	5.692	1	0.017	0.06
EPQ-RS Extraversion (E)		51.1	9.59	51.5	9.22	50.7	9.93	1.793	1.802	0.073	0.08
EPQ-RS Neuroticism (N)		43.6	8.49	44.0	8.44	43.2	8.53	1.804	1.802	0.071	0.09
EPQ-RS Psychoticism (P)		48	8.93	48.7	9.15	47.2	8.64	3.644	1.802	‹0.001	0.17

Note. SD: Standard deviation; EPQ-RS: Eysenck Personality Questionnaire Short Scale.

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($p = 0.002$), a higher percentage of unemployment during pregnancy ($p = 0.038$), were more frequently multiparous ($p < 0.001$), had medical problems during pregnancy ($p = 0.000$), had a poor relationship with their partner ($p = 0.05$), and a greater frequency of personal psychiatric history ($p < 0.017$). Regarding personality traits, substance users scored higher in *extraversion, neuroticism* and *psychoticism* ($p = 0.001$) than non-users during pregnancy, although the first two dimensions did not reach statistical significance. It should be noted that in all cases the effect size was small. No other statistically significant differences were observed between both groups of women.

Table 2 shows the final logistic regression model of the predictive factors of substance use during pregnancy. A lower level of education ($p = 0.046$), being on sick leave during pregnancy ($p = 0.008$), and the presence of a psychiatric history prior to pregnancy ($p = 0.025$) were independent factors associated with substance use. Being primiparous was a protective factor ($p = 0.001$). The *extraversion* ($p = 0.029$) and *psychoticism* ($p = 0.009$) personality dimensions were identified as risk factors for substance use during pregnancy. For each 10-unit increase in the EPQ-RS score on the *extraversion* and *psychoticism* dimensions, the odds of substance use during pregnancy increased by 12% and 16%, respectively, after adjusting for age, education level, employment situation, parity, pathology during pregnancy, relationship with partner/mother, and psychiatric history. The final model showed a satisfactory fit ($p = 0.26$).

Discussion

This study explores the personality dimensions of Eysenck (1985) and the use of legal and illegal substances during pregnancy in a sample of 1804 Spanish women from the general population giving birth in their general public health service hospital. More than half of the sample studied had used some substance during pregnancy, with caffeine being the most frequent, followed by tobacco and alcohol. Illicit substances were very rarely used during pregnancy, cannabis being the most common. The study results confirm that there is a moderate association between *extraversion* and *psychoticism* and substance use during pregnancy. Other independent factors related to use were low educational level, being on sick leave during pregnancy, multiparity, and the presence of a personal psychiatric history prior to pregnancy.

Prevalence of legal and illegal substance use during pregnancy

Regarding the use of legal substances during pregnancy, the prevalence data for caffeine consumption in the literature are very limited despite it being the world's most widely used psychoactive substance (Kuczkowski, 2009). In our sample, 40% of pregnant women drank on average 1-2 cups of coffee per day, approaching the caffeine levels (> 200mg/day) described as being associated with negative effects on pregnancy and the perinatal period (Chen, Bell, Browne, Druschel, & Romitti, 2014; Modzelewska et al., 2019); it is thus recommended that caffeine intake be minimized during pregnancy (Jahanfar & Jaafar, 2013).

In relation to smoking during pregnancy, the general population data for Spain (Puig et al., 2012) are similar to those of our study and confirmed by a recent systematic review (Lange et al., 2018). Smoking prevention focusing on women and their family environment should start before pregnancy and continue throughout it (WHO, 2013).

It cannot be ruled out that the relatively low prevalence of alcohol use observed in the present study is partly due to the fact that women were hiding it. Estimates of smoking during pregnancy are more accurate than those of alcohol or other substances (Chamberlain et al., 2013). Alcohol

Table 2. *Logistic regression model to predict substance use in pregnancy*

Variables		B (SE)	Wald	p	OR (CI95%)
Constant		-1.656 (0.424)	-3.903	‹0.001	
Level of education (reference: university)					
	Secondary	0.165 (0.124)	1.329	0.184	1.18 (0.92-1.50)
	Primary	0.275 (0.138)	1.991	0.046	1.32 (1.00-1.73)
Mother's employment situation during pregnancy					
	Employed	0.249 (0.158)	1.571	0.116	1.28 (0.94-1.75)
	Student/homemaker	0.366 (0.220)	1.665	0.096	1.44 (0.94-2.22)
	On sick leave	0.555 (0.211)	2.633	0.008	1.74 (1.15-2.63)
Personal psychiatric history		0.307 (0.137)	2.247	0.025	1.36 (1.04-1.78)
Primiparity		-0.337 (0.101)	-3.324	0.001	0.71 (0.59-0.87)
EPQ-RS					
	Extraversion	0.012 (0.005)	2.184	0.029	1.12 (1.01-1.25)*
	Psychoticism	0.015 (0.006)	2.616	0.009	1.16 (1.04-1.30)*

Note. SE: Standard error; OR: Odds ratio; CI: 95% confidence interval; EPQ-RS: Eysenck Personality Questionnaire Short Scale.
* Odds ratios associated with a difference of 10 points in the EPQ-RS dimension scores. Hosmer-Lemeshow goodness of fit: p=0.26.

is known to have teratogenic, and probably epigenetic effects, and its prenatal and gestational use can cause maternal and foetal morbidity (Cook et al., 2017). An important aspect of drinking during pregnancy is that of unplanned pregnancies (WHO, 2014), which is the case in a quarter of the women in our sample. Given the difficulty of delimiting the dose-effect relationship, the recommendation is to abstain from drinking alcohol, preferably from the preconception stage when pregnancy is planned (Hoyne et al., 2016; WHO, 2014).

Regarding cannabis use, studies in pregnant women (Ebrahim & Gfroerer, 2003; Kassada, Marcon, Pagliarani & Rossi, 2013) estimate that between 1.5 and 2.8% use cannabis, similar to our results. It is possible that psychological and social factors influence women to stop using some substances more than others, and that the perception of harming the foetus is different with illegal substances than with legal substances (Mark & Terplan, 2017). At the present time, it is important to be aware of the role of cannabis use legalization in many countries and its use and prevention during pregnancy (Scheyer et al., 2019).

Personality dimensions and other factors associated with substance use in pregnancy

The results of the study indicate that personality variables should be taken into account in assessing risks of substance use in pregnant women. *Extraversion*, a dimension reflecting sociability, energy, assertiveness, sensation seeking and carefreeness, also predicts the risk of use in our sample after adjusting for other risk factors. It has been observed that extraverted women have a greater tendency to continue drinking alcohol during pregnancy (Ystrom et al., 2012). The likely explanation for these results would be that these women take substances to enjoy social situations, in line with research showing that extraverted people drink to increase positive rather than to avoid negative feelings (Kuntsche et al., 2008; Munafo et al., 2007). This need for stimulation can, on the other hand, help to underestimate the health risk that their use involves and favour that women continue using during pregnancy. Studies of smoking during pregnancy (Maxson et al., 2012) indicate that smokers show low levels of *extraversion* compared to non-smokers. A recent multinational study in 18 European countries using an anonymous online questionnaire has explored the impact of women's personality characteristics on drinking and smoking habits before and during pregnancy (Lupatelli et al., 2018). Women with a high level of *extraversion* had a 10-17% greater tendency to drink medium/high levels of alcohol, while high *neuroticism* was associated with a 16% higher risk of continuing to smoke during pregnancy (Connor-Smith & Flachsbart, 2007). The results showed trait-specific associations in certain European regions.

The sample studied did not yield an association between *neuroticism* and substance use during pregnancy. In

theory, *neuroticism* is related to a coping style focused more on emotion and less on the risk of harm (e.g., use of substances to cope with emotions) and empirically correlates (with a medium effect size) with substance use as a way of handling stress (Connor-Smith & Flachsbart, 2007). Previous research has presented smoking as a way of dealing with emotions and problems, and the risk of continuing to smoke during pregnancy is high (Lopez, Konrath & Seng, 2011). Although there are data indicating that there are no gender differences in managing to quit smoking (Marqueta, Nerín, Gargallo & Beamonte, 2017), pregnancy can be an important motivator for women to do so. A recent study in pregnant women has found that smokers low on the *harm-avoidance* dimension and with high *self-direction* were shown to be better able to abstain from use during pregnancy (Massey et al., 2016).

Finally, the association between *psychoticism* and substance use during pregnancy can be attributed to the fact that this dimension is related to impulsivity and the assessment of poor reasoning and priority (Eysenck, 1985; Kuntsche et al., 2008). Impulsivity has been considered a vulnerability factor for substance use (Vassileva & Conrod, 2019), and some theories of addiction even conceptualize it as an impulse control syndrome (Conrod & Nicolau, 2016). In fact, the triad of *sensation seeking*, anxiety, and impulsivity have repeatedly been associated with substance use (Crews & Boettiger, 2009; Ersche, Turton, Pradhan, Bullmore & Robbins, 2010). The data support the hypothesis that pregnant women with high *psychoticism/impulsivity* are at greater risk of continuing to use psychoactive substances during pregnancy.

Our results confirmed previous data in the literature, with substance use during pregnancy being independently associated with low educational level (Havens et al., 2009), being on sick leave (Truong, Lupattelli, Kristensen & Nordeng, 2017) and the presence of personal psychiatric history (Conway, Compton, Stinson & Grant, 2006; EMCDDA, 2012). Conversely, primiparity was a protective factor. Being pregnant for the first time can be strongly motivating for change or behaviour modification. Primiparous women are more successful in quitting alcohol and cigarettes during pregnancy (Powers et al., 2013; Schneider et al., 2010).

Limitations

This study has several potential limitations that must be considered when interpreting the results. Substance use data were collected using a semi-structured interview and may be subject to bias. It is worth noting the low level of self-reported illicit use. Lower prevalence of such use has been associated with various factors, such as fear of legal consequences, feelings of guilt, memory lapses and the interview method (Friguls et al., 2012; Shipton et al., 2009). In this regard, the assessment of use took place 2-3 days after delivery, when the mothers knew the health status of

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their newborns. Furthermore, the frequency of use was recorded for each month of pregnancy, while the amount of use referred to the final month of pregnancy. It can be argued that this figure may not be representative of the amount of substances consumed during the complete pregnancy. Many women who are regular users but stop do so in the first trimester, so it seems important to evaluate use at that time (Shipton et al., 2009; Figueras et al., 2008). Substance use data were collected retrospectively and the cross-sectional design does not allow the direction of the association to be established. Our study did not collect data on women non-smokers exposed to cigarette smoke during pregnancy (Aurrekoetxea et al., 2014).

Regarding personality, this would have been better explored before pregnancy within a more neutral framework than 2-3 days postpartum. It would be interesting to explore other dimensions of personality and coping styles.

The results of the study cannot be extrapolated to the total general population since we excluded pregnant women with current psychiatric disorder, which in itself is a risk factor associated with substance use during pregnancy (Figueras et al., 2008). Finally, we would like to point out that ours was an extensive sample of the non-clinical Spanish population to study personality factors and their association with substance use during pregnancy, taking into account other risk factors.

Conclusions

In a non-clinical sample, one in two women reported having used psychoactive substances during pregnancy, mostly caffeine, alcohol and tobacco. Substance use was associated with socio-demographic characteristics, a history of psychiatric history, health problems during pregnancy, and personality traits. The results indicate that the dimensions of *extraversion* and *psychoticism* (women with high sociability, energy, sensation seeking and assertiveness, greater impulsiveness and less reflection) have an impact on the use of cigarettes, alcohol and caffeine during pregnancy.

Early identification of risk factors should include the study of personality traits. Systematic screening for the use of legal and illegal toxins should be done prior to conception and repeated every trimester during pregnancy in those women with positive results (urinalysis/self-reports) or with risk factors. Both measures will help establish a prevention and intervention program to prevent the effects of substance use on the mother-child dyad.

Acknowledgments

Ethical considerations

The study was approved by the Research and Ethics Committees (CEICs) of the participating centres (Hospital Clínic and IMIM-Hospital del Mar, Barcelona; Hospital Pere Mata, URV, Reus; Hospital Consorci Sanitari, Terrasa; Corporació Sanitaria Parc Tauli, Sabadell; Hospital Son Dureta, Palma de Mallorca; Hospital Carlos Haya and Fundación IMABIS, Málaga; and Hospital Clínico, UV, Valencia). All procedures were carried out in accordance with the 1964 Declaration of Helsinki and subsequent modifications, as well as with the national and institutional research and ethical standards. Written informed consent was obtained from all participants.

Conflicts of interest

None of the authors declares any conflicts of interest.

Author contributions

MLI, RN, LG, MT and RMS, study design. MLI, RN and KL, data analysis. MLI, RN, EG and RMS wrote the first version of the manuscript. AG, RG, VV, FC, MR, IG, FM, EG, RMS and JS gathered data. MT, FF and LG played a relevant role in interpreting results. All authors participated in and approved the latest version of the manuscript.

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