Research Report

Alcohol and Nicotine Consumption during Pregnancy

Prevalence and Predictors among Women in Bremen, Germany

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Abstract: *Aims:* The consumption of alcohol and nicotine during pregnancy relate to a multitude of personal and socioeconomic factors. Since even the consumption in non-clinical populations pose a health risk to children, epidemiologic data related to factors potentially contributing to an increase in consumption during pregnancy were investigated. *Methodology:* Cross-sectional analyses were based on interview data from 260 pregnant women taking part in a longitudinal intervention project (Bremer Initiative to Foster Early Child Development). Women had a below-average family income, a migration background, or faced other social and cultural challenges. Descriptive statistics were calculated to determine consumption prevalence. Logistic regression models were conducted to estimate associations of alcohol or nicotine consumption with personal and socioeconomic factors. *Results:* Of the total sample (mean age: 31.1 years), 45 % consumed alcohol and/or nicotine during pregnancy. 92.3 % quit drinking and 62.8 % stopped smoking following confirmation of pregnancy. Better social support and higher age increased the likelihood of alcohol consumption, while this was decreased by an Islamic cultural background. Smoking was predicted by a lower level of education. Unplanned pregnancies predicted the consumption of both, alcohol and nicotine. *Conclusions:* A multitude of factors influence alcohol and nicotine consumption in non-clinical populations. Preventive strategies should include pre-pregnancy stages and health information needs to mirror factors contributing to consumption.

Keywords: alcohol exposure, nicotine exposure, prevalence, predictors, pregnancy

Alkohol- und Nikotinkonsum während der Schwangerschaft: Prävalenzen und Prädiktoren von Frauen aus Bremen, Deutschland

Zusammenfassung: *Zielsetzung:* Alkohol -und Nikotinkonsum bei Schwangeren hängt mit vielfältigen persönlichen und sozioökonomischen Faktoren zusammen. Da auch der gesellschaftlich akzeptierte Konsum in der nichtklinischen Bevölkerung ein Gesundheitsrisiko für das ungeborene Kind darstellen kann, wurden epidemiologische Daten und verschiedene Faktoren untersucht, die die Wahrscheinlichkeit eines Konsums während einer Schwangerschaft erhöhen könnten. *Methodik:* Es wurden Querschnittsanalysen basierend auf Interviewdaten von 260 schwangeren Frauen, die an einem längsschnittlichen Interventionsprojekt (Bremer Initiative to Foster Early Child Development, BRISE) teilnahmen, durchgeführt. Die Frauen hatten ein unterdurchschnittliches Familieneinkommen, einen Migrationshintergrund oder standen vor anderen sozialen und kulturellen Herausforderungen. Zur Bestimmung der Konsumprävalenz wurden deskriptive Statistiken berechnet und zur Ermittlung von Assoziationen zwischen Alkohol- oder Nikotinkonsum und persönlichen und sozioökonomischen Faktoren wurden logistische Regressionen durchgeführt. *Ergebnisse:* Von der Gesamtstichprobe (Durchschnittsalter 31.1 Jahre), konsumierten 45 % Alkohol und/oder Nikotin während der Schwangerschaft. Bessere soziale Unterstützung und ein höheres Alter erhöhten die Wahrscheinlichkeit des Alkoholkonsums, während ein islamischer Kulturhintergrund diese verringerte. Das Rauchen wurde durch ein niedrigeres Bildungsniveau vorhergesagt. Ungeplante Schwangerschaften prognostizierten sowohl Alkohol- als auch Nikotinkonsum. 92.3 % haben das Trinken und 62.8 % das Rauchen nach Schwangerschaftsbestätigung eingestellt. *Schlussfolgerungen:* Vielfältige Faktoren beeinflussen den Alkohol- und Nikotinkonsum in nichtklinischen Populationen. Präventionsstrategien sollten Phasen vor der Schwangerschaft einbeziehen und zusätzlich zu Gesundheitsinformationen soziale Faktoren, die den Konsum begünstigen, berücksichtigen.

Schlüsselwörter: Alkoholexposition, Nikotinexposition, Prävalenzen, Prädiktoren, Schwangerschaft

Introduction

The consumption of alcohol and nicotine during pregnancy poses one of the highest health risks for the unborn child. Risks for the developing organism may arise at every stage of the pregnancy, including fertilization, embryogenesis and the fetal period (Chahal et al., 2017; Nulman et al., 2018; Subramoney et al., 2018; Ulrich & Petermann,

2016). Yet, both substances are among those toxic substances most frequently consumed by women of childbearing age across the world (Forray, 2016). The consumption has not only negative effects for the children who are affected, but also for the consumer. According to the World Health Organization, alcohol and nicotine consumption is a causal factor in a multitude of diseases and injuries, and results in approximately 75000 deaths in Germany each year (Deutsche Hauptstelle für Suchtfragen, 2022). Any dose of alcohol or nicotine consumption confers a health risk (Le Daré et al., 2019).

While the focus of previous research was primarily on the consumption of large quantities of alcohol and nicotine (Popova et al., 2017), the evidence relating to effects caused by low or moderate amounts remains rare. Studies demonstrating substance-induced physical, neuropsychological, and behavioural abnormalities in children have raised awareness for the dangers of legal drug use during pregnancies. Since consumption among non-clinical groups of pregnant women has not been studied to a similar extent, and harmful effects to the child's health and cognitive abilities are less well researched for lower doses, a certain degree of consumption may be common and even socially accepted. For example, the German Health Update Study from 2012 indicated that from a non-clinical population almost a third (103 of 374 pregnant women) stated to have drunk alcohol during their pregnancy. Usually, the consumption does not start during pregnany but can be ascribed to general consumption prevalence of society and thus, of women in their fertile age (Lange et al., 2015).

Despite different findings, systematic reviews cannot rule out negative effects of low-to-moderate prenatal alcohol or nicotine consumption on child development (Henderson et al., 2007). A more recent meta-analysis and systematic review related low-to-moderate consumption of alcohol during pregnancies to preterm births, reduced birth size for gestational age and decreased sensory sensibility (Mamluk et al., 2017; Römer et al., 2020). Low-to-moderate nicotine consumption was found to lead to impairments in orienting-, communication- and motor skills (Römer et al., 2020).

Thus, it remains important to reach (pregnant) women with different demographics and inform them about possible negative consequences of legal drug use for their unborn child and about potential support to change consumption behaviour. To improve strategies targeting women prone to consumption of legal drugs during their pregnancies, more information about the prevalence of consumption in different social groups and about social factors related to legal drug use during pregnancies is needed (Römer et al., 2020). We have recently stressed that knowledge about influential factors leading to abstinence or continuation of drinking and smoking during a pregnancy may relate to a combination of reasons. The lack of social support during pregnancy seems to increase the probability of alcohol and nicotine consumption (Powers et al., 2013). Furthermore, experiences of violence and other burdens may affect consumption behaviours prior and during pregnancy (Hauge et al., 2012; Powers et al., 2013; Skagerström et al., 2011). A higher educational level (> high school degree), increased age (≥ 25 years) and an unplanned pregnancy are associated with prenatal alcohol consumption (Melchior et al., 2015; Murphy et al., 2013), while a lower educational level, lower maternal age as well as an unplanned pregnancy are associated with low to moderate nicotine consumption (Baron et al., 2013; El-Khoury et al., 2016; Melchior et al., 2015). Data from a 12 federate states of Germany indicated that 33.7% of all pregnancies were unplanned (Helfferich et al., 2016). Furthermore, women's cultural background can play a role, which may be related to the extent to which the consumption of alcohol and nicotine is the social norm (Melchior et al., 2015).

The number of studies investigating low-to-moderate use of legal drugs in non-clinical populations is low (Römer et al., 2020). Comprehensive data on consumption prevalence of women in their fertile age seems also lacking, although this knowledge may be important for understanding and preventing consumption during pregnancies (Forray, 2016). This problem is increased, since different social groups are often not equally well represented in survey data. For instance, it is known that people with a lower level of education, a lower income, a higher number of social challenges and a migration background are less likely to take part in scientific research (Zeisler et al., 2019). Research has also shown that these women have often a greater need for and, at the same time, are more difficult to reach with information and support regarding their health and psychological well-being (Samkange-Zeeb et al., 2022; Zeisler et al., 2019).

Further, the majority of current data on prevalence in non-clinical groups does not include the time period between conception and confirmation of pregnancy (Muggli et al., 2017). However, a large part refers to the first trimester, during which life-defining developmental steps in cells and essential organs, like the heart and the brain, are taking place (Nulman et al., 2018).

The current study provided data on how socioeconomic factors relate to alcohol and nicotine consumption during pregnancy in a non-clinical population living in an urban area of Germany. Included districts are characterized by a below average family income and a high percentage of families with a migration background. More specifically, we sought to examine to what extent age, education level, pregnancy planning, social support, burdens and cultural background predicted alcohol- or nicotine consumption.

According to previous research, we hypothesized that women who smoke cigarettes are often younger and less educated, while women who drink alcohol are often older and better educated (El-Khoury et al., 2016; Melchior et al., 2015). In countries with a predominant Muslim culture, the consumption of alcohol and nicotine is socially less accepted. Hence, having a cultural background related to these countries may be an important factor that prevents from the consumption during pregnancy. We further hypothesized that alcohol and nicotine consumption is generally increased when women face an unplanned pregnancy (Baron et al., 2013; Muggli et al., 2016), lack of social support or considerable burdens (Hauge et al., 2012; Powers et al., 2013; Skagerström et al., 2011). To address current gaps in the literature we aimed to investigate prevalence data in pregnant women for pre- and post-pregnancy confirmation (i.e., before and after women learned about their pregnancy). Knowledge about consumption prevalence during all stages of a pregnancy and about factors influencing consumption behaviour, especially in low-to-moderate amounts, may guide future research to develop adequate prevention strategies. Those should be adaptable, sensitive and inclusive with regard to the specific pregnancy state and living circumstances of pregnant women in order to ensure prevention benefits for women from hard-to-reach populations.

Methodology

Study Design

The current study is part of the Bremer Initiative to Foster Early Child Development (BRISE, German: Bremer Initiative zur Stärkung frühkindlicher Entwicklung [Schütte et al., 2020]). BRISE is a longitudinal intervention project investigating early development of children growing up in families with social and cultural challenges. The project has started in 2017 and is currently funded until 2025. Families remain part of the initiative between pregnancy and the children's first year of primary school. During this time, several measurement time points are being scheduled depending on the child's age. BRISE aims to identify strategies supporting healthy pregnancies and educational equality.

Recruitment Process and Data Collection

Women or families living in pre-selected urban areas of Bremen, Germany were recruited by scientific staff of the University of Bremen as well as by gatekeepers in the social and health care system. Recruiting strategies included advertising the program across the whole city. This comprised the distribution of flyers and posters in the targeted living areas, direct contact with potential participants, the representation of the project at family-focused events and cooperation with professional gate-keepers, who are working with pregnant women and young families, e.g., women's healthcare workers and family-related institutions. Furthermore, new parents in the participating areas received a letter that introduced BRISE. All participants gave their written consent in advance of their participation in BRISE. Data for this study was collected via home-based interviews by researchers holding a Master's degree in Psychology or a related discipline at minimum. The researchers also underwent specific trainings in research methods, design and ethics, as well as in safety education (i.e., regarding emergency response and estimating children's best interest). The interviews included questions referring to the consumption behaviour of alcohol and nicotine during pregnancy, age, education, whether the pregnancy was planned, social environment, life burdens and migration background.

Participants

A detailed description of sample characteristics is presented in Table 1 (see results). The current data set is based on the first measurement point of the longitudinal study, which was conducted during the third trimester of pregnancy (T0) or, if that was not possible, within the first 18 weeks postpartum (T0 post). Thus, each woman provided one dataset.

Participating women are part of the first and second wave of BRISE, incorporating mothers of 300 children. The first two BRISE waves included 150 children each. Allocation to a wave followed the date of the 1st participation in an interview. This normally coincided with measurement point T0 and T0post, but for 32 women was a later measurement time point scheduled within the first months after childbirth. All T0 and T0post data included in the first two BRISE waves was gathered before the 1st lockdown following the outbreak of the COVID19 pandemic.

Seven mothers gave birth to twins, providing one dataset, and one mother participated with siblings. For consistency, only data of the first pregnancy was included in the current analysis. Considering that 32 women did not take part in either T0 or T0post, a sample of n=260 women answered the questions relevant for their alcohol and nicotine consumption behaviour during pregnancy and were included in the data analyses. All women were, with regard to alcohol and/or nicotine usage during their pregnancy, categorized as either "consumers" or "no consumers".

In our sample women consumed at maximum one to 15 cigarettes per day and one to seven drinks per week. According to definitions of consumption patterns across current studies (described below), consumption behaviours could be described as low-to-moderate (Missing information for n=1).

Inclusion and Exclusion Criteria

Women or families joined the study between the third trimester of pregnancy and the 18th week postpartum. A screening interview insured that the registration address of the sampled families belonged to pre-determined liv-

Table 1. Sample characteristics

Characteristic	Sample of n=260 women (answered on consumption related questions)	Sample of n=91 women (alcohol consumers during pregnancy)	Sample of n=43 women (nicotine consumers during pregnancy)
Maternal Age			
< 25	17.3 % (n=45)	12.1 % (n=11)	25.6 % (n=11)
25–29	21.9 % (n=57)	18.7 % (n=17)	16.3 % (n=7)
30–34	33.9 % (n=88)	33 % (n=30)	30.2 % (n=13)
≥ 35	26.9 % (n=70)	36.2 % (n=33)	27.9 % (n=12)
Educational level (ISCED11)			
Lower	67.7 % (n=176)	55.0 % (n=50)	88.5 % (n=38)
Higher	32.3 % (n=84)	45.0 % (n=41)	11.5 % (n=5)
Pregnancy planning			
Pregnancy was planned	59.5 % (n=155)	50.5 % (n=46)	37.2 % (n=16)
Pregnancy was not planned	40.5 % (n=105)	49.5 % (n=45)	62.8 % (n=27)
Social support			
Low	7.9 % (n=20)	3.4 % (n=3)	9.5 % (n=4)
Moderate	12.5 % (n=33)	11.2 % (n=10)	21.4 % (n=9)
High	79.6 % (n=207)	85.4 % (n=78)	69.0 % (n=30)
Burdens			
Low	80.1 % (n=208)	74.7 % (n=68)	70.7 % (n=30)
Moderate	16.3 % (n=43)	22.0 % (n=20)	22.0 % (n=9)
High	3.6 % (n=9)	3.3 % (n=3)	7.3 % (n=3)
Migration background			
General migration background	53.5 % (n=139)	37.4 % (n=34)	44.2 % (n=19)
Islamic cultural background	16.9 % (n=44)	1.1 % (n=1)	9.3 % (n=4)
Measurement time point			
T0 (during the third trimester)	44.6 % (n=116)	48.4 % (n=44)	53.5 % (n=23)
T0 post (postpartum)	55.4 % (n=144)	51.6 % (n=47)	46.5 % (n=20)
Partnership			
Yes	90.2 % (n=230)	90.1 % (n=82)	75.6 % (n=31)
No	9.8 % (n=25)	9.9 % (n=9)	24.4 % (n=10)

Notes. ISCED11 = International Standard Classification of Education. Results for social support and burdens are presented in sum-scores. Social support: A sum-score from 14 to 32 is classified as a low social support, a sum-score from 33 to 51 is classified as a moderate social support and a sum-score from 52 to 70 is classified as a high social support. Burdens: A sum-score from zero to ten is classified as low burdens, a sum-score from 11 to 21 is classified as moderate burdens and a sum-score from 22 to 33 is classified as high burdens.

ing quarters of Bremen, Germany. Pre-determination of living quarters was implemented prior to the start of the study in order to achieve comparability of the average socio-economic background in the neighbourhood of participating families and to ensure access to cooperating family support programmes. Upbringing of the women's infants had to further meet at least one criterion of predetermined social challenges, e.g., family migration background and/or parental low income (Schütte et al., 2020). Families with insufficient German or English language skills to answer the questionnaires and those who did not meet the inclusion criteria were excluded from the study. Families who had to be excluded were referred to other programmes and networks that were also able to offer adequate support.

Measures

Participants in the third trimester of their pregnancy or in their early postpartum period were questioned on various topics. For the current study, the answers that were subsequently used for analysis were in response to questions on alcohol and nicotine consumption patterns, age, education, pregnancy planning, social environment, life burdens and cultural background. The consumption of alcohol and nicotine was determined as follows: First, we asked participants if they have ever consumed alcohol or nicotine in their life. If the answer was "yes", we then asked if they had consumed alcohol or nicotine during their pregnancy. The questionnaire further indicated if they had stopped consumption while being pregnant, providing information whether they had stopped once they had confirmation of pregnancy or months or even years prior to getting pregnant. Women who continued drinking after confirmation of pregnancy were asked about their consumption behaviour to determine whether they did consume more than four to six alcoholic drinks per occasion, more than seven drinks per week or binged alcohol on more than one occasion during their pregnancy. According to the literature, discontinuing drinking after confirmation of the pregnancy or drinking below the aforementioned frequencies and amounts, was regarded as low-to-moderate drinking (Flak et al., 2014; Popova et al., 2017; Römer et al., 2020). We also determined the amount of nicotine consumption. According to previous research, here less than 20 cigarettes a day indicated low-to-moderate consumption behaviour (Clifford et al. 2012; Römer et al., 2020). The definitions for low-to-moderate consumption during pregnancy were established to separate these consumption amounts from those of high amounts and thus, to detect possible predictive factors for a non-clinical sample and often socially accepted consumption behaviours. Current literature still lacks consistent definitions of consumption behaviours (Römer et al., 2020); while they are not specifically related to consumption during pregnancy, they refer more often to the consumption in the general population.

For more information on integrated variables, like response categories and methodological preparation see electronic supplementary material (ESM) 1.

Statistical Analyses

In this cross-sectional analysis we first calculated descriptive statistics to analyze the prevalence of pregnant women's alcohol and nicotine consumption. We estimated the prevalence for alcohol, nicotine or the combined use of both substances pre- and post-pregnancy confirmation. Descriptive statistics concerning migration background and all variables that were entered into the subsequent statistical analyses are described below.

Second, we conducted a multivariable binary logistic regression to determine predicting factors of alcohol as well as nicotine consumption during pregnancy separately for each substance. We included alcohol or nicotine consumption as dependent variables. The independent variables that could function as predictors were age (in years), education, pregnancy planning, social support, life burdens challenges and an Islamic cultural background.

Adjusted Odds ratios are presented for each predictor as included in combination with the other predictors in the regression model. The respective reference categories for each predicting factor are established as followed: Age (highest age), education ("lower" education), pregnancy planning (pregnancy was "planned"), social support and burdens (highest sum scores), Islamic cultural background (no "Islamic cultural background"). The two regression models differed in their respective dependent variable. In one model the dependent variable was either alcohol consumption and no alcohol consumption during pregnancy. In the other model the dependent variable was either nicotine consumption and no nicotine consumption during pregnancy. The absence of multicollinearity of included independent variables was checked and confirmed in advance and a collinearity diagnosis was carried out subsequently. The tolerance value of >0.1 and the variance inflation factor of <10 pertained the appropriate range for each model. In addition, we controlled for possible confounder-, mediator- or moderator effects of birth order (1st child or not) and time point of the interviews (T0 or T0post, i.e. pre- or post-partum). Due to power estimations and regarded small sample sizes of sub-samples that consumed pre -or post-pregnancy confirmation, changing consumption behaviour following

confirmation of pregnancy, could not be considered for the logistic regressions. Statistical analyses were performed using IBM SPSS Statistics Version 26 and R Version 3.6.1. A reporting checklist, according to the STROBE statement is presented in attached reporting statement (von Elm et al., 2008).

Results

Prevalence of Alcohol and Nicotine Consumption during Pregnancy

Consumption prevalence for both substances is presented in Table 2. Of the entire sample, 25% stated to have never consumed alcohol or nicotine in their life, whereas 25% stopped consuming alcohol and 23.8% nicotine months or years before their pregnancy.

Furthermore, 45% of the participating women reported to have consumed either alcohol or nicotine during their pregnancy. Of those, 14.5% stated to have consumed both substances at some point during their pregnancy. To be more precise, the prevalence of alcohol consumption indicated that 35% of the overall sample drank alcohol at some point during their pregnancy. Of these, 92.3% quit drinking alcohol following pregnancy confirmation (i.e., within the first trimester). The prevalence of nicotine consumption indicated that during the course of their pregnancy, 16.5% of the women smoked. Of these women, 62.8% stopped smoking after confirmation of the pregnancy, while 37.2% continued smoking.

16.9% of the participating women had an Islamic cultural background and of those 65.9% stated that they never drank alcohol, 72.7% that they never smoked cigarettes in their life and 56.8% that they did neither. Thus, they comprise 38.5% of the women who stated that they never consumed alcohol or nicotine in their life.

Descriptive Statistics of Included Predictor-Variables

The mean age of the participating women was 31.1 years (Standard Deviation: 5.8). With a maximum of an upper secondary education, the education level of 67.3% of the women was classified as "lower" and that of the remaining 32.3% as "higher". In total, 59.5% of the participants indicated their pregnancies as planned. Women had on average a high level of social support (Mean=58.7, Standard Deviation: 12.7, Range: 14–70) and 90.2% stated to live in a partnership. The extent of extra burdens challenges during their pregnancy was low (Mean=5.6, Standard Deviation: 6.4, Range: 0–33). Of all woman, 53.5% either migrated or had at least one parent that had migrated to Germany. For 16.9% of the sample the migration background included a predominantly Muslim country.

Predictors Alcohol and Nicotine Consumption

The statistical analysis regarding predicting factors of alcohol and nicotine consumption is summarized in Table 3.

Predictors Alcohol Consumption

The dependent variable differentiated the group of women who consumed or abstained from alcohol during their pregnancy. The overall model likelihood ratio was significant (χ^2=51.1, p=.000) with R-squares of .195 (Cox and Snell) and .266 (Nagelkerke).

The analysis revealed that a higher age (OR: 1.066 (95% CI:1.005–1.132), p=.033), an unplanned pregnancy (OR: .359 [95% CI:.187-.691], p=.002), an increased social support (OR: 1.037 [95% CI: 1.008–1.068], p=.012) and a non-Islamic cultural background (OR: .042 [95% CI: .005-.321], p=.002), were associated with the consumption of low-to-moderate amounts of alcohol of pregnant women.

Table 2. Prevalence of alcohol and nicotine consumption during pregnancy

	Alcohol consumption	Nicotine consumption
Proportion of those who stopped consuming before pregnancy	25% (n=65 of 260)	23.8% (n=62 of 260)
Proportion of those who consumed at some point during pregnancy	35% (n=91 of 260)	16.5% (n=43 of 260)
Proportion of those who quit following pregnancy confirmation.	32.3% (n=84 of 260)	10.3% (n=27 of 260)
Proportion of those who continued following pregnancy confirmation.	2.6% (n=7 of 260)	6.2% (n=16 of 260)
	Alcohol/Nicotine consumption	
Proportion of those who consumed alcohol or nicotine during pregnancy	45.0% (n=117 of 260)	
Proportion of those who consumed alcohol and nicotine during pregnancy	14.5% (n=17 of 260)	

Predictors of Nicotine Consumption

The overall model likelihood ratio was again significant (χ^2=32.0, p=.000) with R-squares of .128 (Cox and Snell) and .213 (Nagelkerke). A lower educational level (OR: .154, [95% CI: .050-.479], p=.001) and an unplanned pregnancy (OR: .298 [95% CI: .136-.654], p=.003) predicted the consumption of nicotine during pregnancy.

Discussion

This study aimed at gaining knowledge about the prevalence of alcohol and nicotine consumption in a hard-to-reach, non-clinical population of pregnant women, who are confronted with social and cultural challenges. We were interested in whether age, pregnancy planning, maternal education, cultural background, burdens or availability of social support were associated with women's consumption patterns during their pregnancy. This was analyzed by way of a regression analysis, where consumption was predicted by these different factors within a cross-sectional design.

Both substances are legal and socially accepted in Germany, where the study took place, mirroring the majority of regions across the world (Anderson et al., 2018). Acceptance of low-to-moderate consumption of alcohol and nicotine, which was characteristic for the current sample, often extends to women who want to get or are pregnant (Jensen et al., 1998). Research still lacks information on coherent results regarding effects that can be attributed to certain consumption quantities (Römer et al., 2019). Thus, it is officially recommended to avoid any consumption of alcohol and nicotine during pregnancy (Deutsche Gesellschaft für Ernährung, 2014; Guerby et al., 2020). Alternatives, such as electronic cigarettes, may also harm the unborn child (Römer et al., 2021). Since legal drug use seemingly affects nearly half of the participating women, it is important to gain a better understanding of factors that may increase or decrease the likelihood of legal drug consumption during pregnancy.

A quarter of the women in our sample (25%) stated to have never consumed alcohol or nicotine in their life. One reason of this seemingly high proportion may reflect that this study included many families with a migration background, with 16.9% of the participating women having a cultural background that shaped by the Islamic religion. Especially alcohol, but also nicotine and other drugs are generally forbidden in Islam, which leads to women avoiding these drugs during pregnancy as well (Bahar et al., 2005). Reasons for stating to have never used alcohol or nicotine or stopping at some point in their life included an interest in a healthy lifestyle. The orientation towards a healthy lifestyle may also be related to the high proportion of women (62.9%) who planned their pregnancy. However, it cannot be ruled out that in some cases there might have been a tendency of participants to answer questions in line with expected socially desirable re-

Table 3. Predicting factors for low to moderate alcohol and nicotine consumption during pregnancy

Predicting factor	OR (95% CI)	P value	Regression coefficient B
Alcohol			
Maternal Age	1.066 (1.005–1.132)	**.033***	.064
Educational level (ISCED)	1.655 (.876–3.125)	.120	.504
Pregnancy planning	.359 (.187-.691)	**.002****	-1.023
Social support	1.037 (1.008–1.068)	**.012***	.037
Burdens	1.020 (.971–1.072)	.434	.020
Islamic migration background	.042 (.005-.321)	**.002****	-3.177
Nicotine			
Maternal Age	1.030 (.965–1.009)	.375	.029
Educational level (ISCED)	.154 (.050-.479)	**.001****	-1.868
Pregnancy planning	.298 (.136-.654)	**.003****	-1.210
Social support	.996 (.966–1.026)	.786	-.004
Burdens	1.034 (.977–1.094)	.246	.003
Islamic migration background	.325 (.089–1.194)	.091	-1.123

Notes. *p<.05; ** p<.01; *** p<.001. OR = Odds Ratio; CI = Confidence Interval. Bold numbers indicate significant predictors for alcohol and nicotine consumption.

sponses (Latkin et al., 2017; Skarbek-Kozietulska et al., 2012).

Previous studies focusing on the consumption of low-to-moderate amounts of alcohol during pregnancies demonstrate that prevalence of alcohol consumption during pregnancies may be influenced by a multitude of personal, socio-economic and cultural aspects of a population. Our results are partly in line with these findings. The current data indicated that women with a higher age, better social support, an unplanned pregnancy and without an Islamic cultural background are more likely to drink low to moderate amounts of alcohol during their pregnancy. Importantly, expecting or knowing to be pregnant seemed to have a profound effect on the avoidance of alcohol. Not only planning, and therefore expecting or hoping to becoming pregnant, were associated with the avoidance of alcohol consumption, but almost the entire group, who did consume alcohol, stopped drinking following pregnancy confirmation. We assume that most women consumed alcohol during the early phase of their pregnancy due to a lack of awareness of their pregnancy and due to the general social acceptance of alcohol consumption in Germany. The finding, that women often stopped consuming alcohol following pregnancy confirmation may indicate that they did not consume alcohol as a strategy to cope with difficult life challenges that may co-occur with a pregnancy. It rather seems that knowledge of potential harmful consequences of alcohol consumption guided the women's behaviour following or even before confirmation of pregnancy in most instances (McCormack et al., 2017).

In comparison to previous studies, it seems odd that the existence of burdens had no effect, and a supportive social environment even increased alcohol consumption. These findings underline the importance of distinguishing between drinking in non-clinical populations and clinically relevant consumption patterns, where this is often the case (Gosdin et al., 2022). It also needs to be considered that the women, who were included in this study, all face certain challenges (see inclusion criteria), meaning a certain amount of burdens may be reflected uniformly across the entire group as a continuous variable in life. Additional challenges that were reported seemed low and may have not been as influential as in both, women with alcohol-dependencies or with mostly an above-average socio-economic status (Gorard & See, 2009). Since drinking seems unrelated to reported burdens, social support may consequently also not be needed to overcome drinking. It may rather reflect social integration and, thus, the participation in social events facilitating drinking. This may be particularly true for the first trimester, when the pregnancy is unknown or recommended not to be announced. The influence of social influences on drinking is also demonstrated by women with an Islamic cultural background: in concordance with religious expectations, it is a significant predictor for not drinking alcohol during a pregnancy in our statistical model. Thus, our results support the notion that drinking while being pregnant may be related to a multitude of factors comprising social status, social influences and life planning. More research about effects on the child of low-to-moderate alcohol consumption during the early phases of a pregnancy appears to be an important step in future research, since consumption during this phase seems most common.

Reasons for smoking during pregnancy are as well described as those for alcohol consumption, but not entirely similar. Our results are, again, partly in line with those from previous studies. Pregnancy planning generally increased the likelihood of non-smoking during pregnancy, which paralleled the findings for alcohol consumption. Our statistical model also indicated that a lower educational level predicts the consumption of nicotine during pregnancy. The relation between lower education or lower socio-economic status and increased likelihood of smoking, which has been established not only for pregnant women, but also for other populations too (National Center for Chronic Disease Prevention and Health Promotion (US) Office on Smoking and Health, 2014). It is known that access to health information is more difficult for people with lower education (Samkange-Zeeb et al., 2022). Cigarette packages in Germany, however, clearly and visibly inform about smoking-related health risks. It may be assumed that for lower educated people immediate stress-reducing, mood-lifting and arousing effects of nicotine may be a stronger motivator for smoking than later occurring harmful effects on general health and risking physical addiction to nicotine for abstinence (Cummings et al., 2004). This may be because lower education, as one key variable of low socio-economic status, often co-varies with a higher risk of lower income, unemployment as well as social burdens and emotional stress affecting everyday life, and fewer possibilities of coping with these challenges (Hauge et al., 2012). Thus, the finding that lower education increased the likelihood for smoking during a pregnancy may be related to the pre-pregnancy living situation of the women participating in this study rather than specific burdens occurring during the pregnancy (Hauge et al., 2012; Powers et al., 2013).

Fewer women (16.5 %) stated to have consumed nicotine, but more than a third of these continued smoking after pregnancy confirmation. This may be because even low amounts of nicotine lead to physical addiction (Henningfield et al., 1997) and it is, therefore, harder to quit smoking than to stop drinking alcohol. In accordance, the proportion of women that stopped drinking after confirmation of the pregnancy was larger than the proportion of women who stopped smoking in the same time period. Future research regarding this finding is needed. Our study indicat-

ed that a combination of physical addiction, less access to health care information and a certain kind of living circumstances might cause women to continue smoking even after confirmation of pregnancy.

Despite interesting results, the study also faced certain limitations. The current analyses are limited due to data being based on interviews. If possible, interviews should be backed up by biological markers to reduce the effect of social desirability influencing responses (Chiandetti et al., 2017; Jaffee, 2018). Since hard-to-reach populations are often characterized by a lack of trust into medical research (Nicholson et al., 2015), they may rather oppose to biomarkers and future study designs need to address these concerns to gain more authentic prevalence data. Due to small sub-sample sizes regarding variables like an Islamic cultural background that entered the logistic regression model, calculations of current data should be repeated with representative sample sizes in order to reach a generalizable conclusion. Further, longitudinal studies are needed to better understand the influence of social and other factors on consumption behavior. Nevertheless, the current study enabled to evaluate the risk-assessment of women, regarding consumption of alcohol and nicotine during pregnancy. This relates primarily to the consumption before confirmation of pregnancy. It is essential to include this timespan when analyzing data on consumption prevalence. The early pregnancy is a sensible and fundamental timespan, that comprises complex developmental processes including fertilization, nidation, cell development, the formation of the first organ structures and cardiac activity (Nulman et al., 2018). Thus, not only the consumption of toxic substances after pregnancy confirmation but also and especially the early consumption until confirmation can result in harmful effects (McCormack et al., 2017; McCowan, 2009; Nulman et al., 2018; Sundermann et al., 2020). Regarding the estimation of consumption prevalence during early pregnancy, further analyses should also consider data of consumption prevalence of women in their fertile age to enable an adequate prevention.

Negative health outcomes caused by high level consumption amounts are already known (Nulman et al., 2018). Thus, consideration of low-to-moderate consumption would enable to gain a complex overview regarding health outcomes, prevalence and population-specific needs that facilitates the development of adequate preventive measures. To investigate consumption behaviours of women in childbearing age and during different stages of their pregnancy and resulting effects on their offspring, future research should include socioeconomic factors that are known to be associated with alcohol or nicotine consumption. It is, furthermore, important to include women with particular life-challenges like migration backgrounds or low income, since these populations are often underrepresented and their reasons for legal drug consumption might differ from populations with a higher socio-economic status.

The high percentage of women consuming legal drugs at the beginning of their pregnancy and especially the continuation of smoking after pregnancy confirmation poses possible health risks for unborn children in large proportions of non-clinical populations. This calls for more studies investigating these health risks to reduce current data controversies and establish better prevention strategies. Consistent representations of knowledge on effects of alcohol and nicotine consumption and its risks for the health of women and their children would be crucial.

Implications for the Practical Field

- Prevention strategies should reach women of all educational levels, and should precede as well as include the stage of confirmation of pregnancy.
- It seems important to inform adolescent women and their partners about the harming effects of legal drugs on an unborn child and potential difficulties to quit consumption.
- Prevention strategies should take housing situations that increase the motivation of drug taking seriously and, therefore, should not be restricted to health education, only. Support for women with difficulties to quit consumption is also needed.

Conclusions

Appropriate estimations of consumption prevalence regarding all stages of pregnancy and the inclusion of socioeconomic factors that are known to be associated with the consumption should be considered in future research. Not being aware of the pregnancy, while not planning to have a child, seemed to be important factors for both, drinking and smoking in non-clinical populations. Health education informing women about possible risks for an unborn child even for low-to-moderate and legal drug consumption should reach women in their adolescence, irrespective of pregnancy planning.

Electronic Supplementary Material

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ESM 1. Measurements

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The present study was approved by the ethics committee of German Psychological Society in 2013. The procedure and the objectives of the study were explained to the participants in advance and their consent was obtained through a written informed consent document before soliciting information. This manuscript does not include details, images, or videos of individual participants.

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