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ORIGINAL ARTICLE

THE COMBINED EFFECTS OF ALCOHOL AND TOBACCO USE DURING PREGNANCY ON BIRTH OUTCOMES

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ABSTRACT

Background: Exposure to alcohol and tobacco during pregnancy may lead to developmental disorders in the foetus and can also adversely impact pregnancy outcomes and the newborn's health status.

Objective: Assessment of alcohol consumption and tobacco use during pregnancy as well as their impact on pregnancy outcomes and birth parameters of the newborn in a selected group of mothers with children aged ≤ 2 years.

Material and methods: The study was conducted in 104 mothers with children aged ≤ 2 years living in the Mazowiecki Voivodeship. A questionnaire was used for assessing selected lifestyle parameters tobacco and alcohol use, dietary supplements use, physical activity during pregnancy, socio-demographic characteristics as well as children's birth parameters (birth weight, length, head circumference, chest circumference). Data were analyzed statistically using logistic regression analysis, *Spearman's* rang correlation, the *Mann-Whitney* U, *Kruskal-Wallis*, *Student*-t, *Tukey* and *Chi*^{2} tests (p≤0.05; STATISTICA 13.1 PL).

Results: 22% of the participants solely smoked cigarettes, 13% solely drank alcohol while 7% smoked cigarettes and drank alcohol. Both cigarette smoking and alcohol use increased the risk of preterm birth (OR 9.6, 95% CI 2.9 – 31.4, p=0.00015; OR 5.3 95% CI 1.3 – 22.3, p=0.0199, respectively) as along with a low birth weight (OR 6.9, 95% CI 1.9 – 25.2, p=0.0028; OR 7.6, 95% CI 1.7 – 34.3, p=0.007). Cigarette smoking and alcohol use by the pregnant women also adversely impacted on children's health status (8.7 ± 1.4 vs. 9.7 ± 0.8, p=0.001 and 8.5 ± 1.9 vs. 9.6 ± 0.8, p=0.027, respectively). Simultaneous use of alcohol and cigarettes exacerbated the adverse impact of such substances on birth parameters and health status (birth weight, body length, Apgar score) as well as on pregnancy duration.

Conclusions: The introduction of educational programs for high risk groups as well as prenatal obligatory consultations for mothers about the negative effects of substance use on fetus and the development of the child are warranted.

Conclusions: Introducing educational programs are thus warranted for high risk groups as well as prenatal obligatory consultations for mothers about the adverse effects of such substance use on foetal and child development.

Key words: *pregnancy, alcohol use, smoking, birth parameters, pregnancy outcomes*

STRESZCZENIE

Wprowadzenie: Ekspozycja na używki (alkohol, papierosy, kofeinę) w okresie ciąży może prowadzić do zaburzeń rozwoju płodowego, jak również może negatywnie wpływać na przebieg ciąży i stan urodzeniowy dziecka.

Cel pracy: Ocena powszechności picia (spożywania) alkoholu i palenia tytoniu w ciąży oraz ich wpływu na przebieg ciąży i parametry urodzeniowe noworodka w wybranej grupie matek dzieci do 2 roku życia.

Materiał i metody: Badanie przeprowadzono wśród 104 matek dzieci poniżej 2 roku życia zamieszkujących województwo mazowieckie. Do oceny wybranych parametrów stylu życia (palenie papierosów, spożywanie alkoholu, kawy oraz herbaty, aktywność fizyczna), charakterystyki socjo-demograficznej oraz parametrów urodzeniowych dziecka (wykorzystano kwestionariusz ankiety. Wyniki zinterpretowano za pomocą analizy regresji logistycznej, korelacji rang *Spearmana*, oraz testów U *Manna-Whitneya*, *Kruskala-Wallisa*, t-*Studenta*, *Tukeya* i *Chi*^{2} (p≤0.05; STATISTICA 13.1 PL).

Wyniki: W badanej grupie 22% kobiet w trakcie ciąży paliło papierosy, 13% spożywało alkohol, natomiast jednoczesne stosowanie obu używek deklarowało około 7% badanych. Palenie tytoniu, jak również spożywanie alkoholu zwiększało ryzyko wystąpienia porodu przedwczesnego (odpowiednio: OR 9.6, 95%CI 2.9 – 31.4, p=0.00015; OR 5.3 95% CI 1.3 – 22.3, p=0.0199) oraz niskiej masy urodzeniowej (OR 6.9, 95%CI 1.9 – 25.2, p=0.0028; OR 7.6, 95% CI 1.7 – 34.3, p=0.007), jak również predysponowało do gorszego stanu urodzeniowego dziecka (odpowiednio 8.7 ± 1.4 vs. 9.7 ± 0.8, p=0.001 oraz 8.5 ± 1.9 vs. 9.6 ± 0.8, p=0.027). Jednoczesne spożywanie alkoholu i palenie tytoniu zwiększało negatywne oddziaływanie stosowanych używek zarówno na parametry urodzeniowe, jak i stan zdrowia dziecka (masa urodzeniowa, długość ciała, punkty w skali *Apgar*) oraz czas trwania ciąży.

Wnioski: Konieczne jest wdrożenie programów edukacyjnych skierowanych do grup ryzyka, jak również wprowadzenie obowiązkowej rozmowy z matkami (przyszłymi rodzicami) na temat szkodliwego działania używek na płód i rozwój dziecka.

Słowa kluczowe: *ciąża, spożycie alkoholu, palenie tytoniu, parametry urodzeniowe, przebieg ciąży*

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INTRODUCTION

Recent studies have shown the importance of lifestyle on pregnancy outcome, child's health both during childhood and adulthood as well as on maternal health [28, 31]. This is all related to the concept of intrauterine programming, which states that exposure to certain environmental factors during pregnancy induces adaptation changes in the fetus, which may lead to its developmental disorders and an increase in the risk for the occurrence of non-communicable chronic diseases at later life [8, 29, 31]. Exposure to stimulants or substance use such as drinking alcohol as well as cigarette smoking, both actively and passively, are among environmental factors that induce adaptation changes to human body [29, 36]. Alcohol crosses placental barrier and is metabolized 2-fold slower by the fetus as compared to the mother and its stronger teratogenic effect occurs between the 1st and 8th week of gestation. However, it should be mentioned that alcohol has negative effects throughout the period of pregnancy and depends on the ingested dose and frequency of intoxication. Alcohol increases the risk of abortion, occurrence of fetal alcohol syndrome (FAS), alcohol-related birth defects (ARBD) as well as alcohol-related neurodevelopmental disorders [6, 33]. On the other hand, tobacco use, both active and passive, increase the level of carbon monoxide and nicotine in the blood of the mother and fetus. Nicotine decreases blood flow with the maternal-placental circulation, which increases the risk of IUGR and premature separation of the placenta. There is a clear correlation between the number of smoked cigarettes or exposure to cigarette smoke and the occurrence of low birth weight (<2500 g). Women who smoke cigarettes during pregnancy are more likely to experience ectopic pregnancy, preterm placental abruption, and particularly, cesarean birth and preterm birth, which alone causes more infant deaths than any other known cause. The most severe consequences of smoking tobacco during pregnancy are intrauterine fetus death as well as increase risk SIDS during the first months of life [1, 33, 36]. Compounds present in cigarette smoke inhaled by the mother get into fetal circulation and lead to many disorders, including tachycardia, tachyarrhythmia and a decline in immunity. Children, who have been exposed to negative effects of smoking during fetal life are at higher risk for the development of cardiovascular disorders, asthma and allergies. In addition, substance use by mothers during pregnancy has been demonstrated to increase the risk of psychiatric disorders, attention deficit hyperactivity disorder (ADHD) and poor school performance in their children [33].

Studies have indicated that a large proportion of women smoke tobacco and drink alcohol in their reproductive years [25, 30, 37], which can negatively affect the development of the fetus [6, 36]. Furthermore, despite the abundance of information about the adverse effects of drinking alcohol and smoking cigarettes on pregnancy outcome, a lot of women still use these substances when pregnant [19, 23, 36, 37, 38]. For this reason, the purpose of the present study was to assess the rates of this substance use during pregnancy as well as its impact on pregnancy outcome and birth parameters of the newborn in a selected group of mothers of children aged ≤2 years.

MATERIAL AND METHODS

The study was conducted among 104 mothers of children aged ≤2 years, patients of pediatric counseling centers from Warsaw and the surrounding area (Figure 1).

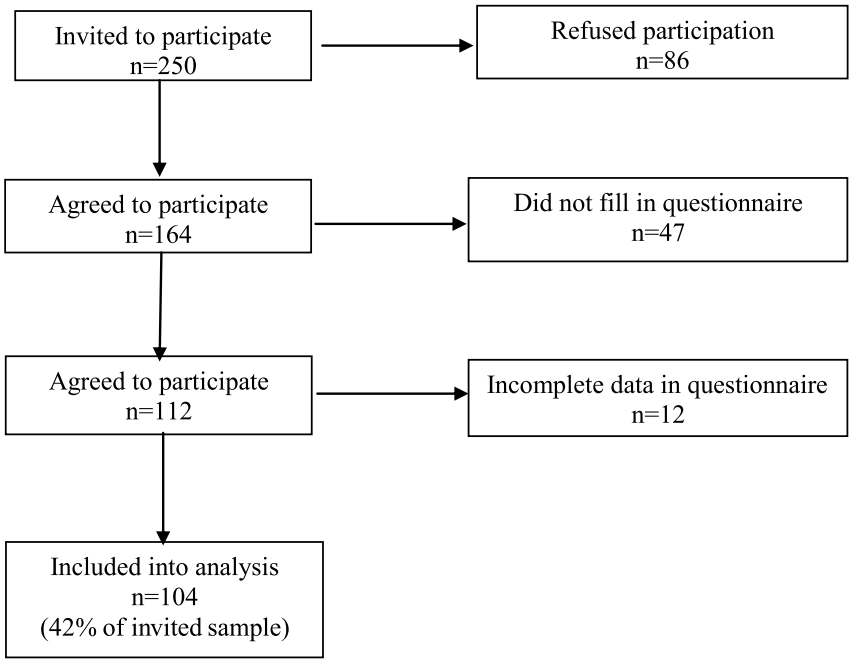

Figure 1. Flow chart of sample collection

Table 1. Maternal characteristics and alcohol and tobacco use during pregnancy

Variables	Total n=104 (100)	Alcohol and tobacco use during pregnancy n (%) Abstinents n=75 (72)	Alcohol n=6 (6)	Tobacco n=16 (15)	Alcohol and tobacco n=7 (7)	p-value
Maternal age, y	28.46 ± 5.62 16 ÷ 42	29.7 ± 5.1[a] 19 ÷ 42	27.0 ± 5.2[a] 20 ÷ 34	26.1 ± 5.5[a] 19 ÷ 39	21.9 ± 6.0[b] 16 ÷ 31	0.0002*
Maternal education						
primary or vocational	26 (25)	8 (11)	1 (17)	11 (69)	6 (86)	
secondary	27 (26)	21 (28)	1 (17)	4 (25)	1 (14)	
university	51 (49)	46 (61)	4 (17)	1 (6)	-	<0.0001*
Occupation situation						
working	14 (13)	11 (15)	-	2 (13)	1 (14)	
employed and/or studying						
sick leave	3 (3)	5 (7)	-	-	-	
unemployed and/or no	58 (56)	47 (63)	4 (67)	7 (44)	-	
studying	27 (26)	12 (16)	2 (33)	7 (44)	6 (86)	0.0074**
Maternal place of residence						
rural area	10 (10)	10 (13)	-	-	-	
city <100.000 inhabitants	14 (13)	12 (16)	-	1 (6)	1 (14)	
city >100.000 inhabitants	80 (77)	53 (71)	6 (100)	15 (94)	6 (86)	0.31**
Economic situation						
poor	27 (26)	10 (13)	1 (17)	9 (56)	7 (100)	
average	43 (41)	34 (45)	2 (33)	7 (44)	-	
good	34 (33)	31 (41)	3 (50)	-	-	<0.0001**
Pre-pregnancy BMI category						
underweight	5 (5)	2 (5)	-	1 (6)	-	
normal	85 (82)	59 (79)	6 (100)	14 (88)	6 (86)	
overweight and obesity	14 (13)	12 (16)	-	1 (6)	12 (16)	0.81**
Weight gain during pregnancy, kg	13.07 ± 5.62 - 4 ÷ 27	13.4 ± 4.4[a] - 4 ÷ 27	14.8 ± 3.4[a] 10 ÷ 20	12.0 ± 3.2[ab] 9 ÷ 22	10.1 ± 3.4[b] 6 ÷ 16	0.0275***
Weight gain during pregnancy, kg/week	0.34 ± 0.11 - 0.14 ÷ 0.71	0.34 ± 0.12 - 0.14 ÷ 0.71	0.39 ± 0.08 0.27 ÷ 0.50	0.32 ± 0.07 0.23 ÷ 0.54	0.30 ± 0.14 0.17 ÷ 0.14	0.159***
Dietary supplements use						
no	46 (44)	27 (36)	3 (50)	9 (56)	7 (100)	
yes	58 (56)	48 (64)	3 (50)	7 (44)	-	0.0077**
Physical activity						
no	69 (66)	49 (65)	4 (67)	11 (69)	5 (71)	
yes	35 (34)	26 (35)	2 (33)	5 (31)	2 (29)	0.98**

*t-*Student* and NIR *Tukey* test; **Chi^2 test; ***ANOVA *Kruskal-Wallis* test, a, b – the values in lines with the same letters do not differ significantly (ANOVA, post-hoc *Tukey's* test, p<0.05).

Inclusion criteria were children age ≤24 months old and consent to participate in the study. All participants were inhabitants of Mazowiecki Voivodship and were within the age range of 16 to 42 years (28.5 ± 5.6). Most of the subjects were characterized by normal BMI before gestation (82%; 22.2 ± 3.1; 15.6 ÷ 33.5) and were mainly dwellers of big towns (77%) with population of above 100 000. About half of the subjects (49%) attended higher institutions, 41% were characterized by an average income and most of them (63%) had only one child. A detailed study sample characteristics was shown in Table 1.

Retrospective assessment of selected elements of lifestyle of the participants and birth parameters of the newborn were carried out with the use of questionnaire during a visit to pediatricians. The

questionnaire consisted of questions pertaining to age, education, financial situation, dwelling place, profession, selected elements of lifestyle, including tobacco and alcohol use, coffee, tea and supplements consumption, and physical activity during pregnancy as well as anthropometric parameters before and after giving birth to the newborn. Furthermore, data related to birth parameters (body weight, length, head circumference, chest circumference, and points for evaluation of baby's condition according to *Apgar* scale) were accessed from the children's health book and certificate. *Ponderal* Index was calculated using birth body measurements ([birth weight (g)/birth length (cm^3)] x 100) and then tercile was determined as low (<10 percentile), average (10-90 percentile) and high (>90 percentile) [15]. Also, the questionnaire consisted of questions about infant anthropometric development in the first year of life.

Statistical analysis was performed using the software STATISTICA ver. 13.1. The normal distribution for quantitative variables was determined by *Shapiro-Wilk* test, but for the evaluation of statistical significance t-test, U *Mann-Withney* test as well as *Kruskal-Wallis* test were applied depending on the type of data. For certain set of data, post hoc analysis with the use of *Tukey* test had to be applied. *Chi*^{2} test was used for qualitative variables. *Spearman* rang correlation was also performed. Logistic regression analysis was conducted for dichotomic variables (occurrence of preterm birth as well as low birth weight), where substance use was treated as independent variables and the results were presented as odd ratios (OR) with 95% confidence interval (95%CI). A statistical significance of $p \leq 0.05$ was set for all statistical analyses.

Table 2. Tobacco use during pregnancy and infant birth parameters

Variables	Tobacco use during pregnancy $\bar{x}$ + SD min ÷ max			p-value
	Total n=104 (100)	No n=81 (78%)	Yes n=23 (22%)	
Gestational age, weeks	38.4 ± 2.5 27 ÷ 42	38.8 ± 2.2 28 ÷ 42	36.8 ± 2.8 27 ÷ 41	0.0001*
Preterm birth, n (%)	16 (15)	6 (7)	10 (43)	<0.0001**
Risk of premature birth, OR (95% CI)	-	-	9.6 (2.9 – 31.4)	0.0002
Birth weight, g	3238.9 ± 591.1 800 ÷ 4960	3346.5 ± 536.8 1180 ÷ 4960	2860.2 ± 628.9 800 ÷ 3900	0.000*
Low birth weight (<2500g), n (%)	9 (9)	4 (5)	5 (22)	0.01143**
Risk of low birth weight, OR (95% CI)	-	-	5.3 (1.3 – 22.3)	0.02
Birth length, cm	54.3 ± 3.7 35 ÷ 62	54.9 ± 3.3 36 ÷ 62	52.2 ± 4.5 35 ÷ 57	0.001*
Ponderal Index	2.0 ± 0.2 1.5 ÷ 3.0	2.0 ± 0.2 1.6 ÷ 2.8	2.0 ± 0.2 1.5 ÷ 2.5	0.31***
Ponderal Index category low average high	 14 (13) 74 (71) 16 (15)	 11 (14) 57 (70) 13 (16)	 3 (13) 17 (74) 3 (13)	0.93**
Head circumference at birth, cm	34.4 ± 2.0 25 ÷ 37	34.5 ± 1.8 25 ÷ 37	33.9 ± 2.5 26 ÷ 37	0.44*
Chest circumference at birth, cm	33.6 ± 2.1 24 ÷ 37	33.8 ± 2.0 25 ÷ 37	33.0 ± 2.4 24 ÷ 36	0.082*
Apgar score	9.5 ± 1.0 5 ÷ 10	9.7 ± 0.8 6 ÷ 10	8.7 ± 1.4 5 ÷ 10	0.001*
Birth disorders, n (%)	36 (35)	21 (26)	8 (35)	0.00047**
Passive tobacco smoke exposure, n (%)	31 (30)	13 (16)	18 (78)	<0.0001**
Passive tobacco smoke exposure, h	1.2 ± 2.2 0 ÷ 10	0.4 ± 1.2 0 ÷ 5	3.9 ± 1.2 0 ÷ 10	<0.0001**
Number of smoked cigarette per day	-	-	6.1 ± 4.0 1 ÷ 15	-

* - U *Manna-Withney* test; ** *Chi*^{2} test; ***t-*Student* test

Table 3. Alcohol use during pregnancy and infant birth parameters

Variables	Alcohol use during pregnancy $\bar{x}$ + SD min ÷ max		p-value
	No (n=91) 87	Yes (n=13) 13	
Gestational age [weeks]	38.7 ± 2.2 28 ÷ 42	36.4 ± 3.5 27 ÷ 40	0.010*
Preterm birth, n (%)	10 (11)	6 (46)	0.001**
Risk of premature birth, OR (95% CI)	-	6.9 (1.9 – 25.2)	0.0028
Birth weight [g]	3304.8 ± 528.5 1180 ÷ 4960	2778.1 ± 801.0 800 ÷ 3890	0.010*
Birth length [cm]	54.6 ± 3.2 36 ÷ 62	51.7 ± 5.9 35 ÷ 58	0.036*
Low birth weight (<2500g), n (%)	5 (5)	4 (31)	0.0024**
Risk of low birth weight, OR (95% CI)	-	7.6 (1.7 – 34.3)	0.007
Ponderal Index	2.0 ± 0.2 1.5 ÷ 2.8	2.0 ± 0.2 1.6 ÷ 2.3	0.4***
Ponderal Index category low average high	 12 (13) 64 (70) 15 (16)	 2 10 (77) 1 (8)	0.71**
Head circumference at birth [cm]	34.5 ± 1.7 25 ÷ 37	33.3 ± 3.0 26 ÷ 37	0.24*
Chest circumference at birth [cm]	33.8 ± 1.9 25 ÷ 37	32.7 ± 3.4 24 ÷ 36.5	0.34*
Apgar score	9.6 ± 0.8 7 ÷ 10	8.5 ± 1.9 5 ÷ 10	0.027*
Birth disorders, n (%)	29 (32)	7 (54)	0.1192**

* U *Manna-Withney* test; ** *Chi*^{2} test; *** t-*Student* test

RESULTS

This paper presents the impact of drinking alcohol and smoking during pregnancy on the birth parameters of the studied group of children.

Among all the participants, 15% were found to have given birth to premature babies and the average gestation period was 38.4 ± 2.5 (27÷42) weeks (Table 1). The mean birth weight of the newborns was 3238.9 ± 591.1, but a big inter-individual difference was observed being in the range of 800 g to 4960 g. 9% of the newborns were characterized by low birth weight (<2500 g) while 3% of them were found to be macrosomic (>4500 g). The mean value of points within the *Apgar* scale was high, being 9.5 ± 1.0 with high inter-individual variation from 5 to 10 points. ≤7 points in the *Apgar* scale was found in 5.3% of the newborns. Furthermore, the occurrence of different birth disorders, including hyperbilirubinemia, circulatory and respiratory failure, heart defects, apnea, Down syndrome, retinopathy, HCV infection, weak muscular tone, skin pallor as well as the presence of the 6th finger on the hand were noticed in 34.6% of the newborns. No statistical significance was observed between the evaluated birth parameters and socio-demographic features as well as the mother's BMI.

It was found that most of the participants (72%) abstained from drinking alcohol during pregnancy, but 6% stated they consumed alcohol. 15% of the subjects declared smoking tobacco during, while 7% of them both consumed alcohol and smoked cigarettes during pregnancy. Substance use was more frequent among younger women, women with lower level of education, unemployed as well as women with lower socio-economic status. Additionally, women, who smoked tobacco and drank alcohol during pregnancy were characterized by lower weigh gain and very seldom used dietary supplements (Table 1).

Table 4. Alcohol and tobacco use during pregnancy and infant birth parameters

Variables	Alcohol and tobacco use during pregnancy $\bar{x}$ + SD min ÷ max				p-value
	Abstinents n=75(72)	Alcohol n=6 (6)	Tobacco n=16 (15)	Alcohol and tobacco n=7 (7)	
Gestational age [weeks]	38.9 ± 2.2[a] 28 ÷ 42	38.2 ± 2.3[a] 34 ÷ 40	37.7 ± 1.8[a] 35 ÷ 41	34.9 ± 3.8[b] 27 ÷ 39	0.0005*
Preterm birth, n (%)	5 (7)	1 (17)	5 (31)	5 (71)	<0.0001**
Birth weight [g]	3359.5 ± 533.6[a] 1180 ÷ 4960	3183.3 ± 601.3[a] 2300 ÷ 3890	3048.1 ± 430.7[a] 2480 ÷ 3900	2430.7 ± 822.7[b] 800 ÷ 3300	0.0011*
Low birth weight (<2500g), n (%)	3 (4)	1 (17)	2 (13)	3 (43)	0.004**
Birth length [cm]	54.8 ± 3.3[a] 36 ÷ 62	55.0 ± 3.1[a] 50 ÷ 58	53.7 ± 2.4[a] 50 ÷ 57	48.9 ± 6.5[b] 35 ÷ 55	0.0021*
Ponderal Index	2.0 ± 0.2 1.6 ÷ 2.8	1.9 ± 0.2 1.6 ÷ 2.2	2.0 ± 0.3 1.5 ÷ 2.5	2.0 ± 0.2 1.66 ÷ 2.3	0.6*
Ponderal Index category					
low	10 (13)	1 (17)	2 (13)	1 (14)	
average	52 (69)	5 (83)	12 (75)	5 (71)	0.96**
high	13 (17)	-	2 (13)	1 (14)	
Head circumference at birth [cm]	34.5 ± 1.8 25 ÷ 367	34.2 ± 1.2 32 ÷ 35	34.5 ± 1.2 33 ÷ 36	32.6 ± 4.0 26 ÷ 37	0.6543*
Chest circumference at birth [cm]	33.8 ± 2.0 25 ÷ 37	33.6 ± 2.2 31 ÷ 36.5	33.4 ± 0,8 32 ÷ 35	31.9 ± 4.2 24 ÷ 36	0.3192*
Apgar score	9.7 ± 0.6[a] 7 ÷ 10	9.3 ± 1.6[a] 6 ÷ 10	9.1 ± 1.0[a] 7.0 ÷ 10	7.7 ± 1.0[b] 5 ÷ 10	0.0002*

* ANOVA *Kruskal-Wallis* test; ** *Chi*^{2} test, a, b – the values in lines with the same letters do not differ significantly (ANOVA, post-hoc *Tukey's* test, $p<0.05$).

Statistical analysis revealed that 30% of the respondents were at risk to the damaging effects of cigarette smoke, out of which 22% actively smoked cigarettes during pregnancy with the mean number of smoked cigarettes standing at 6.1 ± 4.0 (1÷15) daily. The number of smoked cigarettes correlated negatively with the child's birth weight ($r = -0.447$; $p\leq0.05$). Smoking tobacco was found to shorten gestation period, caused lower birth weight, body length on average by 15% and 4%, respectively as well as lower points in the *Apgar* scale. No statistical significance was found for the other evaluated parameters (Table 2). Cigarette smoking had also negative impact on the child's heath status; abnormalities were noticed among 65% of the newborns from smoking mothers vs. 25% of non-smoking mothers (p=0.0005), which included heart defects, skin pallor, hypotrophy, hypoxia and different types of infections. Smoking tobacco was found to increase the risk of premature birth OR 9.6 (95% CI 2.9 – 31.4; p=0.0002) as well as lower birth weight OR 5.3 (95% CI 1.3 – 22.3; p=0.02).

Alcohol ingestion during pregnancy was found in 13% of the participants with beer being the most frequently consumed alcoholic beverage (n=11). One respondent declared consuming wine once every 3 months, while another participants stated she ingested vodka once per week (Table 3). Gestation period in women, who drank alcohol during pregnancy, was shorter by 2.3 weeks and their children were characterized by lower birth weight and length by 19% and 6%, respectively as well as lower points in the *Apgar* scale. Alcohol intake also increased the risk of premature birth OR 6.9 (95% CI 1.9 – 25.2; p=0.0028) as well as low birth weight OR 7.6 (95% CI 1.7 – 34.3; p=0.007). Alcohol consumption during pregnancy did not significantly affect the occurrence of birth defects among the investigated newborns.

In addition, it was found that simultaneous use of alcohol and tobacco during pregnancy had a synergistic negative effect on pregnancy duration as well as the child's birth parameters, such as body weight, body length as well as the number of points in the *Apgar* scale – differences were statistically significant (Table 4). Women, who used both alcohol and tobacco smoked on average more cigarettes daily than women, who used only tobacco (9.0 vs. 4.9; p=0.025). Furthermore, more birth abnormalities, including hear defects, hypoxia and infections were found in children from women within this group as compared to women, who did not use any of these substances (86% vs. 27%; p=0.002).

DISCUSSION

The result of the present study has demonstrated negative effects of alcohol ingestion and smoking tobacco during pregnancy on gestation period, birth weight as well as health status of the newborn. Furthermore, the adverse effects of the use of these substances were stronger when they were taken simultaneously. Despite the abundance of information about the negative effects of drinking alcohol and smoking cigarettes on pregnancy outcome, it was found that 22% of the respondents smoked tobacco and 7% of them used both alcohol and tobacco during pregnancy.

Studies conducted by *Caleyachetty* et al. [2] have shown the proportion of women, who actively smoke during pregnancy is small in low and middle income countries and stand at the level of just 2.5% (95%CI 0.00 – 6.40). The results of the present investigation showed a higher percentage of women (22%), who smoked during pregnancy, which is in concordance with the results of studies from different countries, where researchers demonstrated that 15-30% of women - 13% [20], 20% [7, 9], 22% [14], 25% [17, 36], 27% [23]. It is worth mentioning that women often do not disclose active smoking during pregnancy [17, 26]. Passive smoking, to which many pregnant women are exposed to, has also been shown to be hazardous [9, 14, 17, 26, 35].

Globally, it has been estimated that about 10% (95%CI 8.9 – 11.1) of women ingest alcohol during pregnancy. Countries with high percentage of women, who drink alcohol during pregnancy, have been found to be: Ireland (60%), Belarus (47%), Denmark (46%) and Russia (37%). The percentage of women, who ingest alcohol during pregnancy in Poland, has been estimated to be between 15 and 25% [27], which is higher than the number found in the present study (13%). Studies conducted in Poland by different authors have yielded variable results for women, who drink alcohol during pregnancy: 15% reported by *Wojtyła* et al. [37], 24% by *Żuralska* et al. [38], 44% by *Godala* et al. [9], and 60% by *Gacek* et al. [7]. It is worth underlying that these data are fragmentary and there is scarcity of representative research in this area. It is alarming to mention that only 43% of gynecologists and obstetricians recommend to their patients total abstinence during prenatal visits and consultations, and even 2% of these specialists recommended ingestion of small amounts of alcohol during pregnancy. 55% of physicians have been shown not to even mention about the harmful effects of alcohol consumption on the fetus and child [37].

Results from different studies have shown alcohol ingestion and smoking tobacco during pregnancy is practiced mainly by young women with the lowest level of education and worst socio-economic status, which were also confirmed in the present study. Young pregnant women are significantly more likely than older pregnant women to smoke cigarettes, use illicit drugs, and drink alcohol during pregnancy [7, 14, 19, 20, 32, 36, 37]. Women, who do not plan or think of pregnancy as well as women, who not experienced any positive reaction or support from family members were more often found to smoke tobacco or exposed to cigarette smoke. Generally, the absence of social support may be a particularly important determinant of which young women drink, smoke, or use drugs during pregnancy [19, 32]. Teenage girls belong to high risk group for substance use, which further increases the risk for the occurrence of pathologies of pregnancy [3, 25].

The negative effect of smoking tobacco on birth weight, including the risk for giving birth to a child with low birth weight has been demonstrated in this study and confirmed the results of previous investigations from different countries [4, 13, 16, 34, 35, 37]. The number smoked cigarettes seems to be the most important determinant in causing these birth defects.

The present study revealed a negative correlation between the number of smoked cigarettes and the child's birth weight. Children of mothers, who smoked tobacco during pregnancy were found to be smaller in weight by about 170-377 g in comparison to children of non-smoking mothers [1]. Studies by *Jaddoe* et al. [13] also showed the negative impact of smoking during pregnancy on head and chest circumference of the newborns. Smoking tobacco increases the risk of bleeding and preterm birth, which is related to preterm placental abruption [4, 16, 18, 35]. Furthermore, smoking tobacco negatively affects the newborn health status expressed as points in the *Apgar* scale and increases the risk of hypoxia and infections in the newborn [36]. Smoking cigarette during pregnancy also increases the risk of the occurrence of birth defects, including heart defect, which was demonstrated in the present study as well as by other investigations [1, 10, 36].

Alcohol ingestion is one of the anti-health behaviors practiced by some women during pregnancy. The exact effects of alcohol on the fetus remain to be elucidated, which is related to lack of evidence of the existence of safe dose of alcohol that could be ingested during pregnancy. However, it clear that even the smallest amount of alcohol can be transferred from the mother to fetus via the placenta and therefore, the blood level of alcohol in the fetus is the same as in the mother. The consequences of alcohol ingestion include premature birth, IUGR and intrauterine fetus death [6, 22, 24]. However, a meta-analysis conducted by *Patra* et al. [24] as well as systematic review

performer by *Henderson* et al. [12] have indicated that sporadic alcohol consumption or the ingestion of 10 g ethanol/day does not increase the risk of giving birth to a baby with low birth weight. The present study demonstrated that ethanol intake in the amount of >18 g/day did increase the risk of the occurrence of low birth weight, which is supported by the results of studies by *Henderson* et al. [12] and *Patra* et al. [24]. Results from some investigations have shown that alcohol ingestion during pregnancy increases the risk of the development of birth defects [6, 33, 37], but this was not confirmed in the present study. One of the severe and well-known consequences of alcohol intake during pregnancy is the development of FAS, which frequency of occurrence in Poland has been estimated to be 900 children annually, but many other cases may remain undisclosed or undiagnosed [33, 38].

Children born to mothers, who both ingest alcohol and smoke tobacco are at a higher risk of preterm birth, developing or having worst birth parameters as well as poorer health status in comparison to children born to mothers, who only ingest alcohol or only smoked cigarettes [21]. This may be related to the similar biochemical action of alcohol and tobacco that leads to perturbations in nutritional status as well as health status of the mother, including low folate status, which contributes to elevation of blood level of homocysteine and subsequently to oxidative stress [21]. For this reason, it is worth considering the increase of the intake of dietary supplements, for example folic acid and antioxidants by pregnant women, who smoke tobacco and drink alcohol [5]. However, but the result of the present study indicate the contrary that pregnant women, who smoke and drink alcohol very seldom use dietary supplements.

The major strength of this study was the investigation of the effect of alcohol and tobacco use, as well as its combined effect on birth outcomes in children of mothers from Mazowiecki Voivodship. Our research can be the basis for designing further research on a larger and representative group of mothers and their children.

This study has a number of limitations. First, the study sample is small and the rate of refused participation is high (34%) with no data about the reasons for refusal or socio-demographic characteristic of these patients. Second, the data about alcohol and tobacco use during pregnancy were self-reported by participants, so we cannot exclude the possibility of false reports which may led to an underestimation of the real rate of alcohol and tobacco use during pregnancy. Third, all the data was collected retrospectively which may increase the risk of error. Fourth, because this study is cross-sectional, not prospective, we can investigate only associations, not the causations between alcohol and tobacco use and birth parameters. Further prospective studies in larger samples would be required.

CONCLUSIONS

1. Tobacco use during pregnancy was declared by 22.1% of respondents, whereas alcohol use was declared by 12.5% of participants.
2. In the group of alcohol users there were significantly higher rates of preterm birth ($p \leq 0.001$) and low birth weight ($p \leq 0.01$) observed, as well as lower birth length ($p \leq 0.05$) and *Apgar* score ($p \leq 0.05$).
3. Among tobacco users during pregnancy significantly higher rates of preterm birth ($p \leq 0.001$) and low birth weight ($p \leq 0.01$) were observed. Also, in this group birth length and *Apgar* score were significantly lower compared with non-smokers ($p \leq 0.001$ for both measurements).
4. In group of both tobacco and alcohol users the rates of preterm birth and low birth weight were significantly higher compared with only tobacco or alcohol users ($p \leq 0.001$ and $p \leq 0.01$, respectively), as well as birth length ($p \leq 0.01$) and *Apgar* score ($p \leq 0.001$).

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Conflict of interest

The authors declare no conflict of interest.

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