

Maternal coffee intake and the risk of threatened abortion

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Research article

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Abstract

Background Maternal caffeine intake has an effect on fetal growth through cross the placenta freely. The objective of this study is to examine the association of pre-pregnancy coffee consumption pattern with the risk of threatened abortion. **Methods** A cross-sectional analysis was conducted for a total of 4,111 pregnant women who completed baseline examination for the Korean Pregnancy Outcome Study between 2013 and 2017. Coffee consumption pattern before pregnancy was measured by a questionnaire. The frequency of coffee consumption was divided into seldom (<1 cup/week), light (<1 cup/day), moderate (1 cup/day), and heavy coffee drinkers (≥ 2 cups/day). Threatened abortion was defined as the occurrence of vaginal bleeding in the first 20 weeks of pregnancy. Multiple logistic regression models were applied to examine the association between pre-pregnancy coffee consumption and the risk of threatened abortion, after adjusting for age, body mass index, systolic blood pressure, smoking, drinking, physical activity before and after pregnancy, stress level, history of depression, and reproductive information. **Results** Women with heavy coffee drinking were at increased odds for having threatened abortion in unadjusted model (odds ratio [OR], 1.271; 95% confidence interval [CI], 1.008 to 1.602). Compared to women with seldom coffee drinkers, the fully adjusted ORs for the risk of threatened abortion were significant in moderate (OR, 1.420; 95% CI, 1.001 to 2.014) and heavy coffee drinkers (OR, 1.750; 95% CI, 1.156 to 2.651). **Conclusions** Heavy coffee drinking was independently associated with a higher risk of threatened abortion among Korean pregnant women.

Background

Coffee is one of the most popular consumed beverages throughout the world [1-3]. According to Korean National Health and Nutrition Examination Survey, the prevalence of daily coffee drinking (1 or more cups/day) greatly increased from 54.6% in 2001 to 65.3% in 2010 – 2011 in Korean adults[4]. The average coffee consumption among Korean adults is high as 11.3 times per week recently, which is more than five-times greater compared to other Asia-Pacific region[3]. Coffee is composed of many physiologically active substances especially, caffeine is an important component of coffee[5, 6]. Other caffeinated beverages or foods do not significantly contribute to daily caffeine intake in Korean[7].

Therefore, it is important to examine the effect of coffee consumption on health.

Caffeine is the most generally consumed xenobiotic in pregnant women, with the potential to adverse effects in the development of the fetoplacental. Maternal caffeine intake during pregnancy has an effect on fetal growth through cross the placenta freely and decrease blood flow to the placenta, although the specific effects on a fetus are inconsistent[8, 9]. However, it is still unclear whether coffee consumption is an independent risk factor for threatened abortion, which is the most common complication with an incidence of 15-20% of ongoing pregnancies [10, 11]. Threatened abortion may suggest an underlying placental dysfunction, which could induce pregnancy complications in later pregnancy[12, 13].

There is continuous concern that coffee intake would increase particularly in pregnant women, which would result in adverse health effects. Therefore, the aim of this study is to evaluate the coffee consumption pattern before pregnancy and its association with the risk of threatened abortion among

Korean pregnant women.

Methods

Study participants

Data for the present study were derived from Korean Pregnancy Outcome Study (KPOS), a prospective cohort study. Between March 2013 and January 2017, all pregnant women who visited Cheil General Hospital and CHA Hospital for antenatal care during the first trimester were asked to participate in the KPOS study. Women were excluded from enrolment if they were not Korean or were pregnant with triplets or higher-order multiple gestations. A total of 4,195 pregnant women were included in the baseline analysis after excluding 10 foreigners, 218 individuals who declined to participate in the study, and 114 individuals who were missing key variables. Gestational age was determined by the last menstrual period in naturally conceived women and was confirmed on first trimester ultrasound. After the first antenatal visit, eligible participants were requested to complete several sets of questionnaires or examinations at each visit: Visit 1 in the 1st trimester (around 12 weeks of gestation); Visit 2 in the 2nd trimester (around 24 weeks of gestation); Visit 3 in the 3rd trimester (around 36 weeks of gestation); Visit 4 at delivery; Visit 5 at 4-6 weeks after birth.

After excluding 84 individuals with missing dietary questionnaire from baseline participants, a cross-sectional analysis was conducted for 4,111 women aged 18-46 years old. Trained research nurses explained the study in detail and obtained written informed consents and completed questionnaires. All participants provided written informed consent, and the study protocol was approved by the Institutional Review Board (IRB) of Cheil General Hospital (IRB number: CGH-IRB-2013-10) and CHA Hospital (IRB number: 2013-14-KNC13-018), separately. It was emphasized to all participants that they were free to withdraw from any part of the study at any point in time.

Measurements

A face-to-face interview was conducted to evaluate participants' socio-demographic profiles, medical and family history, reproductive information, health-related behaviors, and psychological health. Participants completed the clinical and laboratory measurements in pregnancy, which included anthropometric measurements, blood pressure measurements, and blood and urine laboratory tests.

Socio-demographic status included age, educational level, household income, employment status, marital status, cohabiting family composition, and spouse information. The family history information included hypertension, diabetes, GDM, preeclampsia, depression, and other mental illness. Cigarette smoking, alcohol intake, and supplement intake were evaluated at each visit. Physical activity was assessed at each visit using the short form of the International Physical Activity Questionnaire (IPAQ).

Dietary intake patterns were evaluated with a food frequency questionnaire (FFQ). The level of coffee consumption pattern before the conception was estimated with the question "How often did you drink a coffee before the pregnancy?" on the FFQ. Coffee consumption was categorized into 5 groups (seldom, 2-3 cups/week, 4-6 cups/week, 1 cup/day, and 2 or more cups/day). In this analysis, participants were divided into four groups based on their reported amount of coffee consumption: ≥ 2 cups/day, "heavy coffee drinkers"; 1 cup/day, "moderate coffee drinkers"; < 1 cup/day, "light coffee drinkers"; and < 1 cup/week, "seldom coffee drinkers". The type of coffee was divided into black coffee, black coffee with sugar, black coffee with creamer, and instant coffee mix (instant coffee with creamer and sugar).

We obtained information on antenatal pregnancy complications and delivery details during pregnancy and postpartum. First trimester complications including emesis and threatened abortion were assessed at visit 1. In this study, threatened abortion was defined as the occurrence of vaginal bleeding in the first 20 weeks of pregnancy, determined via ultrasonographic examinations by physician [14, 15]. The delivery outcomes included gestational age at delivery, type of labour (induced or spontaneous), type of delivery, indication for Cesarean delivery, and delivery complications.

Blood pressures were measured at every visit using the automatic oscillometric technique, but a diagnosis of hypertensive disorders of pregnancy was confirmed by manual measurements using blood pressure cuffs and auscultation. Blood samples and placenta were stored in -70 °C freezers at a controlled temperature and humidity. All biological samples were marked with barcodes and stored in the National Biobank of Korea. We uploaded the data from all questionnaires and examinations to a web-based clinical data management system (iCReaT) managed by the Korea National Institute of Health.

Statistical analysis

We classified participants on the basis of the frequency of coffee consumption. For some analyses, the lower categories of exposure variables were combined into a single stratum because of the small numbers. We summarized the general characteristic of study participants with means with standard deviation for continuous variables and observed numbers with percentages for categorical variables. To assess the statistical differences, one-way analysis for variance and chi-square test were used for continuous and categorical variables, respectively. Multivariate logistic regression analysis was used to estimate odds ratios (OR) with 95% confidence intervals (CI) for the association of coffee consumption with threatened abortion. Age, body mass index, systolic blood pressure, cigarette smoking, alcohol consumption, parity, physical activity before pregnancy, current physical activity, stress, history of depression, and the number of livebirth, stillbirth, miscarriage, and abortion were considered as covariates in the adjusted model. In additional sensitivity analyses, we conducted an additional multiple logistic regression analysis to estimate the association of the type of coffee and threatened abortion. All statistical analyses were performed using SAS software (version 9.4, SAS; NC, USA) and statistical significance was defined as a two-sided p-value of less than 0.05.

Results

The baseline characteristics of study participants are presented according to the frequency of coffee consumption pattern before pregnancy in Table 1. Of the 4,111 participants, there were 732 heavy coffee drinkers (≥ 2 cups/day, 17.8%), 1,405 moderate coffee drinkers (1 cup/day, 34.2%), 699 light coffee drinkers (< 1 cup/day, 17.0%), and 1,275 seldom coffee drinkers (31.0%). The mean age of total pregnant women was 33.2 years old. Participants with heavy coffee drinking were more likely to have an older age, higher educational ascertainment, economic status, and body mass index, and higher frequencies of history of depression, former smoker, and former drinker. The overall prevalence of threatened abortion in this pregnant women was 18.1%. As shown in Figure 1, heavy coffee drinkers showed the highest prevalence of threatened abortion, especially they need a drug or inpatient treatment.

Table 2 showed the result of the multiple logistic regression analysis of the association between coffee consumption and the risk of threatened abortion. The highest amount of coffee consumption group was significantly associated with high risk of threatened abortion in the unadjusted model. After additional adjustment for age, body mass index, systolic blood pressure, cigarette smoking, alcohol consumption, physical activity before pregnancy, current physical activity, stress, history of depression, and the number of parity, livebirth, stillbirth, miscarriage, and abortion, the associations remained significant. Compared to women with seldom coffee drinkers, the adjusted OR for threatened abortion was 1.101, 1.420, and 1.750 for a pre-pregnancy intake on light coffee drinkers, moderate coffee drinkers, and heavy coffee drinkers, respectively. In additional sensitivity analysis in Supplementary Table 1 and 2, there were no significant associations between the type of coffee with additives and the risk of threatened abortion.

Discussion

We investigated the coffee consumption pattern before pregnancy and its association with the risk of threatened abortion in Korean pregnant women. Herein, habitual coffee consumption 1 or more cup of coffee per day before pregnancy was significantly associated

with an increased risk of threatened abortion during early pregnancy even after adjustment for cigarette smoking and alcohol consumption; however, the type of coffee did not significantly affect the risk of threatened abortion.

Pregnancies with the risk of threatened abortion in the first trimester occur about 15-20% of all pregnancies, however, there is still insufficient information about its risk factor and the way of prevention[16, 17]. In the present of 4,111 pregnant women, although the average maternal age of participants was relatively high, the overall prevalence of threatened abortion was 18.1%, similar to previous results. Since threatened abortion has been shown to be associated with an increased risk of poor pregnancy outcomes, approximately 50% of pregnant women who experienced threatened abortion eventually suffer miscarriages, it is required to be diagnosed and managed prevent maternal of fetal mortalities and morbidities[12, 18, 19].

Even though the market for caffeinated beverages has increased in the past decades, the most frequently consumed caffeine beverage is coffee[1, 7]. A standard cup of coffee generally expected to provide 100 mg of caffeine, however, it varies according to portion size, brewing method, and brand[1-3, 6, 7, 20]. Caffeine content in other beverages as follows: 64.0 mg in cup of tea, 46.0 mg in 12 oz of coke, 16.0 mg in cup of hot chocolate, and 46.0 mg in cup of caffeinated soda, but this caffeinated beverages do not significantly impact on daily caffeine consumption among Korean[7, 21]. Nisenblat et al reported that caffeine intake is not associated with an increased the risk of threatened abortion, with possible exception of intake of very high levels of caffeine intake [20]. However, caffeine and its metabolites easily cross the placenta and may exist in considerable quantities in the amniotic fluid and fetal blood[8, 22]. Moreover, the fetus metabolizes caffeine very slowly and even extremely small amount of maternal caffeine intake can be expected to lead to long-term fetal caffeine exposure[20, 22]. Regarding potential biological activities in experimental and human studies, caffeine exposure induces angiotensin by stimulating reactive oxygen species, which ultimately inhibit angiogenesis and negatively impact on the developing embryo[23]. In addition, caffeine consumption could increase generate of

circulating catecholamines, which could cause uteroplacental vasoconstriction leading to fetal hypoxia [20, 24, 25].

Although the threshold for caffeine's adverse effect on pregnant women was not well established, high levels of caffeine intake could have adverse effects on miscarriage, fetal growth restriction, and long-term behavioral effects in offspring[9, 11, 14, 20, 21, 26, 27].

Recently, some epidemiologic studies have found a significant association between 300 mg or more of caffeine intake per day and the risk of spontaneous abortion[21, 28, 29].

Consistent with previous studies, we have found that pregnant women with heavy coffee drinking were significantly at increased risk for having threatened abortion. In Chinese prospective study, caffeine intake before pregnancy did not increase the risk of spontaneous abortion, but caffeine intake more than 300 mg/day during the first trimester appeared to be significantly increased the risk[21]. The UK case-control study showed that caffeine consumption more than 300 mg/day during pregnancy about doubles the risk of miscarriage and its effect is driven by coffee consumption[28]. Similarly, adjusted risk among Danish women who consumed caffeine more than 375 mg/day was 2.21[29].

One meta-analysis has evaluated the risk of pregnancy loss increased by 3% for every increase in consumption of two cups of coffee per day[26]. For this reason, most women try to reduce their caffeine intake considerably during pregnancy, especially from the time when they prepare for pregnancy to first trimester[9, 27]. The current guidelines of World Health Organization recommend a caffeine intake below 300 mg/day, while the American College of Obstetricians and Gynecologists recommending a maximum caffeine intake of 200 mg/day[30, 31]. Different recommendations in guidelines can lead to confusion in preparing for pregnancy or in pregnant women. In addition, it is difficult to know the exact caffeine content because the amount varies depending on the size of coffee.

There are several limitations to this study that should be noted. The main limitation of the present study relates to inaccurate assessment of coffee consumption pattern because a 'cup' of coffee varies according to portion size, brewing method, and brand type. Despite the huge popularity of decaffeinated coffee in the market, we cannot measure its amount. In

future studies, objective measurements including combine biomarkers of caffeine exposure in blood, urine, and saliva with 24-hour dietary recall measurement should be needed to assess quantity of precise coffee consumption. Second, typical recall bias due to retrospective assessment of caffeine consumption should be considered. However, we may reduce the impact of recall bias since we measured assessment of coffee consumption before the onset of threatened abortion. Third, coffee consumption pattern before the pregnancy at only one single time point may not reflect chronic exposure over the years because women who prepare conceive tend to keep their eating habits healthy before become pregnant. Finally, although we controlled for several potential confounders in our analysis, residual confounding by diet or other lifestyle factors effects may have been present.

As the younger women continue to experience a western coffee culture and demand high quality coffee beans, this trend is expected to continue. The properties of coffee are regard as a double-edged sword and the balance between beneficial and harmful impacts on health. In this study, a high consumption of coffee to pregnancy seems to be associated with an increased risk of threatened abortion, whereas the type of coffee does not influence the risk. Among women who experienced threatened abortion during follow-up, a larger fraction was habitual coffee drinkers before the pregnancy compared with women who were seldom coffee drinkers.

Conclusions

As coffee consumption is a potentially modifiable risk factor, caffeine intake before conception and during pregnancy should be reduced. Our study may provide useful information to address the need for nutrition interventions for healthy coffee drinking in the pregnant women in Korea. Further prospective research is needed to confirm our findings and establish the causal associations of coffee's potential negative effects on pregnancy complications.

Abbreviations

Korean Pregnancy Outcome Study (KPOS)

Institutional Review Board (IRB)

International Physical Activity Questionnaire (IPAQ)

food frequency questionnaire (FFQ)

odds ratios (OR)

confidence intervals (CI)

Declarations

Ethics approval and consent to participate

All procedures were approved by the Institutional Review Board (IRB) of Cheil General Hospital (IRB number: CGH-IRB-2013-10) and CHA Hospital (IRB number: 2013-14-KNC13-018), separately. All participants provided written informed consent prior to participation and it was emphasized to all participants that they were free to withdraw from any part of the study at any point in time.

Consent for publication

Not applicable.

Availability of data and material

The KPOS is being conducted mainly at the Cheil General Hospital & Women's Healthcare Center and CHA Gangnam Medical Center, where the staff are responsible for the collection, management, and distribution of the data. All data are stored electronically in anonymous format and are currently only available to the KPOS researchers; however, data analysis collaborations may be possible through specific research proposals. Future

information can be requested by e-mailing the principal investigator (hmryu2012@naver.com).

Competing interests

The authors declare that they have no conflict of interest.

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Authors' contributions

H-YP designed the study and reviewed the manuscript critically. HC analyzed and interpreted the data, and contributed to draft the manuscript. SK managed the data and provided clinical output. All authors read and approved the final version manuscript for submission.

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References

1. Mitchell DC, Knight CA, Hockenberry J, Teplansky R, Hartman TJF, Toxicology C: **Beverage caffeine intakes in the US**. 2014, **63**:136-142.
2. Verster JC, Koenig JJC, nutrition: **Caffeine intake and its sources: A review of national representative studies**. 2018, **58**(8):1250-1259.
3. Service USDoAFA: **South Korea: Coffee Market Brief Update**. 2016.

4. Je Y, Jeong S, Park TJAPjocn: **Coffee consumption patterns in Korean adults: the Korean National Health and Nutrition Examination Survey (2001-2011)**. 2014.
5. Ludwig IA, Clifford MN, Lean ME, Ashihara H, Crozier AJF, function: **Coffee: biochemistry and potential impact on health**. 2014, **5(8):1695-1717**.
6. Heckman MA, Weil J, De Mejia EGJJofs: **Caffeine (1, 3, 7-trimethylxanthine) in foods: a comprehensive review on consumption, functionality, safety, and regulatory matters**. 2010, **75(3):R77-R87**.
7. Lim HS, Hwang JY, Choi JC, Kim MJFA, A CP: **Assessment of caffeine intake in the Korean population**. 2015, **32(11):1786-1798**.
8. Sajadi-Ernazarova KR, Hamilton RJ: **Caffeine, Withdrawal**. In: *StatPearls [Internet]*. edn.: StatPearls Publishing; 2017.
9. BMJ CSGJT: **Maternal caffeine intake during pregnancy and risk of fetal growth restriction: a large prospective observational study**. 2008, **337**.
10. Jouppila PJJocu: **Clinical consequences after ultrasonic diagnosis of intrauterine hernatoma in threatened abortion**. 1985, **13(2):107-111**.
11. Weng X, Odouli R, Li D-KJAjoo, gynecology: **Maternal caffeine consumption during pregnancy and the risk of miscarriage: a prospective cohort study**. 2008, **198(3):279**. e271-279. e278.
12. Saraswat L, Bhattacharya S, Maheshwari A, Bhattacharya SJBAIJJoO, Gynaecology: **Maternal and perinatal outcome in women with threatened miscarriage in the first trimester: a systematic review**. 2010, **117(3):245-257**.
13. Wijesiriwardana A, Bhattacharya S, Shetty A, Smith N, Bhattacharya SJO, Gynecology: **Obstetric outcome in women with threatened miscarriage in the first trimester**. 2006, **107(3):557-562**.
14. Johns J, Muttukrishna S, Lygnos M, Groome N, Jauniaux EJRbo: **Maternal serum hormone concentrations for prediction of adverse outcome in threatened miscarriage**. 2007, **15(4):413-421**.

15. Woodward PJ, Kennedy A, Sohaey R: **Diagnostic imaging: obstetrics**: Elsevier Health Sciences; 2016.
16. Kanmaz AG, İnan AH, Beyan E, Budak AJGP: **The effects of threatened abortions on pregnancy outcomes**. 2019.
17. Farrell T, Owen PJBAlJoO, Gynaecology: **The significance of extrachorionic membrane separation in threatened miscarriage**. 1996, **103**(9):926-928.
18. Dadkhah F, Kashanian M, Eliasi GJEhd: **A comparison between the pregnancy outcome in women both with or without threatened abortion**. 2010, **86**(3):193-196.
19. Van Oppenraaij R, Jauniaux E, Christiansen O, Horcajadas J, Farquharson R, Exalto NJHru: **Predicting adverse obstetric outcome after early pregnancy events and complications: a review**. 2009, **15**(4):409-421.
20. Nisenblat V, Norman RJ: **The effects of caffeine on reproductive outcomes in women**. 2016.
21. Wen W, Shu XO, Jacobs Jr DR, Brown JEJE: **The associations of maternal caffeine consumption and nausea with spontaneous abortion**. 2001, **12**(1):38-42.
22. Berger AJTJorm: **Effects of caffeine consumption on pregnancy outcome. A review**. 1988, **33**(12):945-956.
23. Ma Zl, Wang G, Lu Wh, Cheng X, Chuai M, Lee KKH, Yang XJJoAT: **Investigating the effect of excess caffeine exposure on placental angiogenesis using chicken'functional 'placental blood vessel network**. 2016, **36**(2):285-295.
24. Kirkinen P, Jouppila P, Koivula A, Vuori J, Puukka MJAjoo, gynecology: **The effect of caffeine on placental and fetal blood flow in human pregnancy**. 1983, **147**(8):939-942.
25. Tsubouchi H, Shimoya K, Hayashi S, Toda M, Morimoto K, Murata YJJoG, Obstetrics: **Effect of coffee intake on blood flow and maternal stress during the third trimester of pregnancy**. 2006, **92**(1):19-22.
26. Li J, Zhao H, Song JM, Zhang J, Tang YL, Xin CMJJoG, Obstetrics: **A meta-analysis of risk of pregnancy loss and caffeine and coffee consumption during pregnancy**. 2015, **130**(2):116-122.

27. Peck JD, Leviton A, Cowan LDJF, Toxicology C: **A review of the epidemiologic evidence concerning the reproductive health effects of caffeine consumption: a 2000–2009 update.** 2010, **48**(10):2549-2576.
28. Giannelli M, Doyle P, Roman E, Pelerin M, Hermon CJP, epidemiology p: **The effect of caffeine consumption and nausea on the risk of miscarriage.** 2003, **17**(4):316-323.
29. Rasch VJAoegS: **Cigarette, alcohol, and caffeine consumption: risk factors for spontaneous abortion.** 2003, **82**(2):182-188.
30. Obstetricians ACo, Obstetrics GJ, Gynecology: **Moderate caffeine consumption during pregnancy. ACOG Committee Opinion No. 462.** 2010, **116**(2):467-468.
31. Organization WH: **The world health report 2002: reducing risks, promoting healthy life:** World Health Organization; 2002.

Tables

Table 1. Baseline characteristics of study participants by the frequency of coffee consumption before pregnancy (n=4,111)

Variables	Frequency of coffee consumption				<i>p</i>
	Heavy coffee drinkers (≥2 cups/day) (n=732)	Moderate coffee drinkers (1 cup/day) (n=1,405)	Light coffee drinkers (<1 cup/day) (n=699)	Seldom coffee drinkers (n=1,275)	
Maternal age, years	34.1 ± 3.8	33.3 ± 3.7	33.0 ± 3.9	32.8 ± 3.9	<0.001
<20	0 (0.0)	0 (0.0)	0 (0.0)	1 (0.1)	<0.001
20 - 24	1 (0.1)	8 (0.6)	12 (1.7)	18 (1.4)	
25 - 29	75 (10.2)	227 (16.2)	115 (16.5)	244 (19.1)	
30 - 34	339 (46.3)	652 (46.4)	335 (47.9)	602 (47.2)	
35 - 39	250 (34.2)	440 (31.3)	203 (29.0)	356 (27.9)	
≥40	67 (9.2)	78 (5.6)	34 (4.9)	54 (4.2)	
Marital status					
Married	706 (96.4)	1367 (97.3)	674 (96.4)	1237 (97.0)	0.808
Unmarried	25 (3.4)	35 (2.5)	24 (3.4)	37 (2.9)	
Divorced/ Widowed/ Separated	1 (0.1)	3 (0.2)	1 (0.1)	1 (0.1)	
Educational status					
≤High school	79 (10.8)	98 (7.0)	67 (9.6)	115 (9.0)	0.016
College or university	511 (69.8)	1075 (76.5)	517 (74.0)	955 (74.9)	
≥Graduate school	142 (19.4)	232 (16.5)	115 (16.5)	205 (16.1)	
Household Income, million Korean-won/month					<0.001
<2	15 (2.0)	21 (1.5)	24 (3.4)	33 (2.6)	<0.001
2 - 3	64 (8.7)	131 (9.3)	87 (12.4)	166 (13.0)	
3 - 4	131 (17.9)	224 (15.9)	140 (20.0)	241 (18.9)	
4 - 5	144 (19.7)	312 (22.2)	149 (21.3)	272 (21.3)	
≥5	378 (51.6)	717 (51.0)	299 (42.8)	563 (44.2)	
Number of fetus					
Singleton	719 (98.2)	1385 (98.6)	685 (98.0)	1255 (98.4)	0.703
Twin	13 (1.8)	19 (1.4)	14 (2.0)	20 (1.6)	
Parity	0.4 ± 0.6	0.5 ± 0.6	0.5 ± 0.6	0.4 ± 0.6	0.004
0	476 (65.0)	832 (59.2)	414 (59.2)	827 (64.9)	0.001
1	209 (28.6)	499 (35.5)	252 (36.1)	403 (31.6)	
≥2	47 (6.4)	74 (5.3)	33 (4.7)	45 (3.5)	
History of diseases					
Hypertension	7 (1.0)	5 (0.4)	5 (0.7)	10 (0.8)	0.168
Diabetes mellitus	6 (0.8)	5 (0.4)	6 (0.9)	9 (0.7)	0.186
Depression	9 (1.2)	10 (0.7)	5 (0.7)	7 (0.5)	0.046
Polycystic ovarian syndrome	10 (1.4)	28 (2.0)	12 (1.7)	22 (1.7)	0.106
Thyroid hormone dysfunction	42 (5.7)	77 (5.5)	52 (7.4)	83 (6.5)	0.009
Type of pregnancy					
Normal	708 (96.7)	1316 (93.7)	650 (93.0)	1184 (92.9)	0.003

Ovulation induction	1 (0.1)	20 (1.4)	7 (1.0)	8 (0.6)	
Artificial insemination	6 (0.8)	15 (1.1)	5 (0.7)	19 (1.5)	
In vitro fertilization	17 (2.3)	53 (3.8)	37 (5.3)	64 (5.0)	
Blood pressure					
Systolic blood pressure, mmHg	114.5 ± 13.2	114.2 ± 13.3	114.4 ± 13.6	112.9 ± 13.0	0.019
Diastolic blood pressure, mmHg	66.2 ± 10.0	66.2 ± 9.5	66.6 ± 10.0	66.1 ± 9.8	0.756
Body mass index, kg/m ²	22.2 ± 3.2	21.6 ± 2.9	21.9 ± 3.2	21.3 ± 3.1	<0.001
<18.5	59 (8.1)	129 (9.2)	62 (8.9)	174 (13.6)	<0.001
18.5 - 22.9	439 (60.0)	917 (65.3)	436 (62.4)	814 (63.8)	
23.0 - 24.9	114 (15.6)	182 (13.0)	101 (14.4)	151 (11.8)	
25.0 - 29.9	98 (13.4)	154 (11.0)	79 (11.3)	112 (8.8)	
≥30.0	22 (3.0)	23 (1.6)	21 (3.0)	24 (1.9)	
Cigarette smoking					
Never smoked	613 (83.7)	1261 (89.8)	630 (90.1)	1148 (90.0)	<0.001
Former smoker	117 (16.0)	142 (10.1)	67 (9.6)	127 (10.0)	
Quit before pregnancy	77 (65.8)	111 (78.2)	47 (70.1)	103 (81.1)	
Quit after pregnancy	40 (34.2)	31 (21.8)	20 (29.9)	24 (18.9)	
Current smoker	2 (0.3)	1 (0.1)	2 (0.3)	0 (0.0)	
Passive smoking	322 (44.0)	525 (37.4)	237 (33.9)	423 (33.2)	<0.001
Alcohol consumption					
Never drank	112 (15.3)	235 (16.7)	154 (22.0)	287 (22.5)	<0.001
Former drinker	619 (84.6)	1169 (83.3)	544 (77.8)	985 (77.3)	
Quit before pregnancy	290 (46.8)	665 (56.9)	344 (63.2)	688 (69.8)	
Quit after pregnancy	329 (53.2)	504 (43.1)	200 (36.8)	297 (30.2)	
Current drinker	1 (0.1)	0 (0.0)	1 (0.1)	3 (0.2)	
Type of Coffee					
Black coffee	460 (64.7)	922 (66.5)	422 (61.1)		<0.001
Black coffee with sugar	26 (3.7)	109 (7.9)	59 (8.5)		
Black coffee with non-dairy creamer	17 (2.4)	56 (4.0)	29 (4.2)		
Instant coffee with sugar and non-dairy creamer	208 (29.3)	299 (21.6)	181 (26.2)		

Data expressed as mean ± standard deviation or number (percentage)

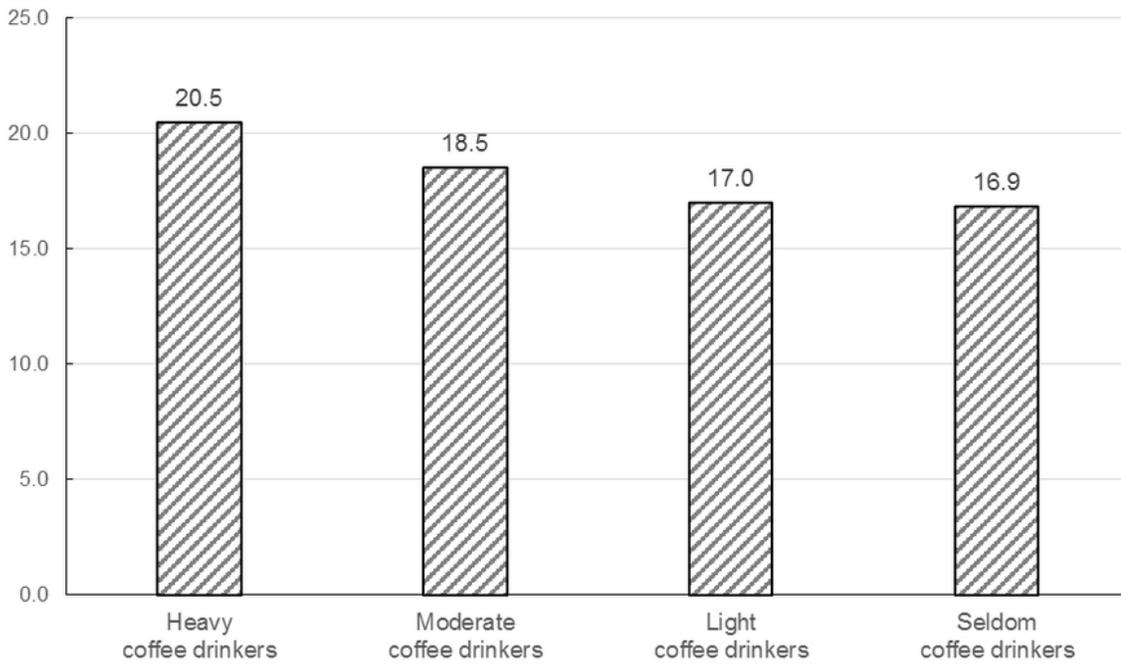
Table 2. Association between coffee consumption and the risk of threatened abortion

	Total No.	No. (%)	Unadjusted OR (95% CI)	Adjusted OR (95% CI) ^a
Seldom coffee drinkers (<1 cup/week)	1275	215 (16.9)	1.000	1.000
Light coffee drinkers (<1 cup/day)	699	119 (17.0)	1.012 (0.791 - 1.293)	1.101 (0.710 - 1.708)
Moderate coffee drinkers (1 cup/day)	1405	260 (18.5)	1.121 (0.918 - 1.367)	1.420 (1.001 - 2.014)
Heavy coffee drinkers (≥2 cups/day)	732	150 (20.5)	1.271 (1.008 - 1.602)	1.750 (1.156 - 2.651)

^aAdjusted model: adjusted for age, body mass index, systolic blood pressure, cigarette smoking, alcohol consumption, parity, physical activity before pregnancy, current physical activity, stress, history of depression, and the number of livebirth, stillbirth, miscarriage, and abortion

Figures

A) The prevalence of threatened abortion by coffee consumption



B) The severity of threatened abortion by coffee consumption

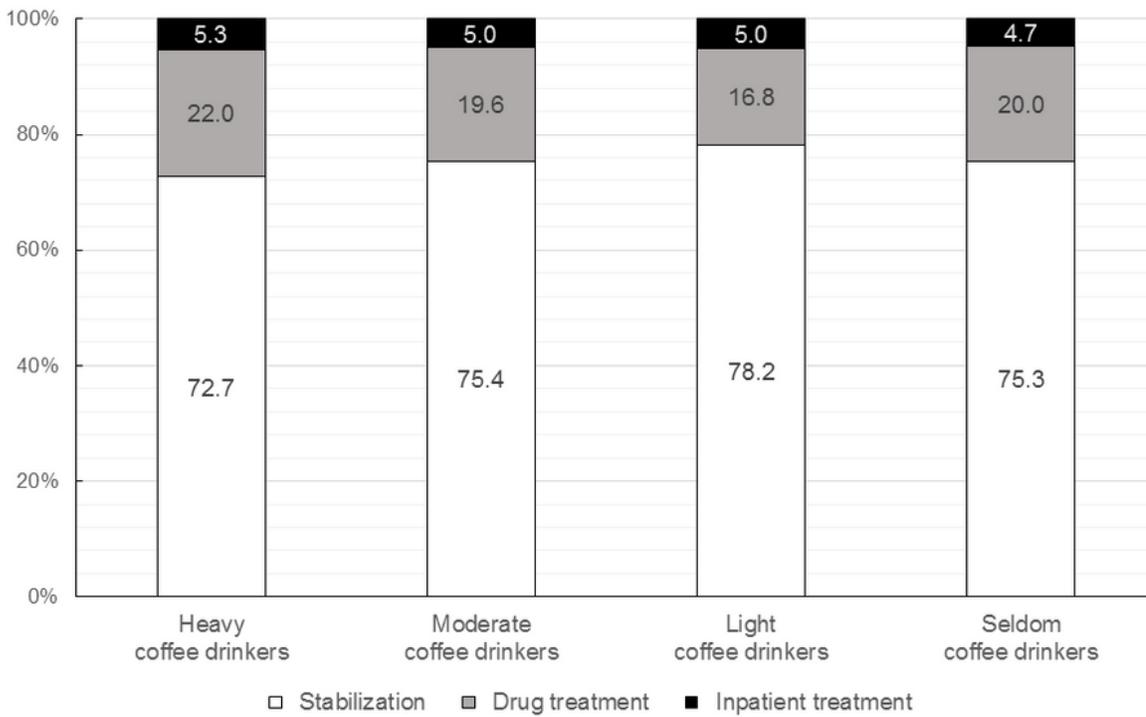


Figure 1

Prevalence and severity of threatened abortion by coffee consumption

Supplementary Files

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- [supplement1.docx](#)