

Sources and Factors Associated with Caffeine Consumption in the Year Previous and its Modification during the First Half of Pregnancy

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ABSTRACT

Objective: To identify caffeine sources and the relationship between socioeconomic, anthropometric, obstetric and lifestyle factors and caffeine consumption during the year before pregnancy, plus its modification during the first half of pregnancy.

Methods: A cross-sectional study carried out among 1,175 pregnant women. Information was obtained by personal interview. Polytomous regression model was used to identify factors associated with high consumption of caffeine (≥ 200 mg of caffeine a day).

Results: During the first half of pregnancy 95.3% of pregnant women consumed caffeine, with an average intake of 72.6 mg/day (DE 92.7), whereas pre-pregnancy averaged 150.1 mg/day (DE 141.1). The 9.9% having high consumption, which after adjusting for other variables, showed associations with primary education, smoking and drinking alcohol during pregnancy, and more number of previous spontaneous abortions and children alive. An increase in the consumption of decaffeinated coffee (16.5%) and diet caffeinated cola drinks (3.8%) was observed with respect to the previous year and, as was a reduced intake of coffee (36.2%) and cola drinks (30.2%).

Conclusion: Caffeine consumption during pregnancy is widespread; and high consumption is associated with women using tobacco and alcohol, a lower educational level, and higher parity as well as more previous spontaneous abortions.

Keywords:

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INTRODUCTION

Although there are few studies with conclusive results, lifestyle before and during pregnancy and female socio-demographic factors may affect the newborn development.

During gestation, harmful habits, such as tobacco, alcohol or caffeine, have been associated with adverse outcomes in pregnancy. Therefore it is extremely important to inform obstetric patients about the previous mentioned behavior.

Several observational studies have shown that women tend to adopt healthy behaviors during pregnancy (1), even during preconception stage (2, 3). It has been noticed a decrease in consumption of alcohol, caffeine, tobacco or other harmful substances to the fetus. However, the consumption persists in a significant number of pregnant women, being caffeine the most consumed substance (4). It has been rated that 95% of women take coffee, cola or caffeinated drugs during pregnancy (5).

Although the results are inconsistent, several studies have related caffeine intake with adverse perinatal effects. Some authors conclude the caffeine intake is harmful because it could produce intrauterine growth restriction and fetal death (6), while others affirm there are no such effects (7,8), or they even conclude there are beneficial effects like reducing diabetes gestational risk (9,10).

The aim of this study was to identify the main sources of caffeine during the first half of the pregnancy and the consumption change over the previous year. We hoped to identify key factors associated with caffeine consumption, since there are no recent studies that describe caffeine consumption in pregnant women in our population.

SUBJECTS AND METHODS

We conducted a cross-sectional study in the catchment area of Virgen de las Nieves University Hospital (Granada, Spain). It provides medical coverage to the northern part of the province of Granada, with a population of 400,000 inhabitants, and approximately 4,000 births per year.

The reference population consists of healthy pregnant women living in this area and attending their 20th gestational week visit. According to the Integrated Healthcare Process "Pregnancy, Childbirth and Postpartum" of the Ministry of Health of the Government of Andalusia, all pregnant women should have an ultrasound examination at the hospital around the 20th week. Ethical approval was given to this study by the Ethics Committee of the University of Granada and the Ethics Committee of Virgen de las Nieves Hospital. Before participating, all women signed a written consent form.

The eligibility criteria were: singleton pregnancy, Spanish nationality, being over 18 years old, absence of complicated pregnancies that required rest, and absence of metabolic, chronic or acute diseases that might limit one's daily activities. From the original set of potential women, one of every five women was systematically recruited, selecting one out of five according to the visit order of those coming to the hospital for their ultrasound visit. During the recruitment period, a total of 1,222 women were thus selected from the reference population. Finally, 1,175 of them fulfilled the selection criteria and wished to take part in the study.

All these pregnant women were contacted by two previously trained interviewers, right before the ultrasound examination. After agreeing to participate, each woman was interviewed face to face, and a structured questionnaire was used to collect the data. Pilot samples of 50 women (not included in the present study) were previously interviewed during a 2-month period of time so as to train the interviewers and check the consistency of the gathered information.

Some information about social-demographic, obstetric and lifestyle variables (tobacco, diet, alcohol and physical activity during the first half of the pregnancy and the previous year of

the latter) was collected. The diet information was gathered using a Food Frequency Questionnaire previously translated, adapted and validated in a sample of Spanish women, and used in other studies among the Spanish population (11). Not only were participants asked about the frequency and the intake amount during the previous year and the first half of the pregnancy, they were also asked to report the intake frequency in terms of daily, weekly or monthly.

Caffeine sources included in the questionnaire were: cola, diet caffeinated cola, coffee, decaffeinated coffee, chocolate, and chocolate biscuits. The amount of caffeine (mg/day) consumed by the pregnant women was calculated based on the table of contents of caffeine in foods by Harland (12).

Current smokers were defined as those who smoked at least one cigarette per day, and ex-smokers were those who had quit the habit before or at the start of pregnancy. Regarding academic level, women were registered as: primary, secondary and university. Social status was classified from lowest (V) to highest (I) in view of occupation. Body mass index (BMI) was calculated as weight (in kg) just before the pregnancy divided by height (in m) squared. Pregnant women were then classified in view of caffeine intake, as <200 mg/day or ≥ 200 mg/day, the latter being the maximum amount recommended by expert groups during gestation (13).

A descriptive analysis of the sample was performed. The distributions were calculated in order to derive qualitative variables, absolute and relative frequencies. The arithmetic mean, standard deviation (SD) and range were calculated in order to obtain quantitative variables.

To compare the average caffeine consumption in the case of categorical variables, the ANOVA test was used. When significant differences among groups were identified, the Bonferroni correction was applied to identify differences among categories. The significance was set at $p < 0.05$. The crude and adjusted odds ratios and confidence intervals (95% CI) were calculated using a polytomous regression model to identify factors associated with consumption equal to or greater than 200 mg/day. Epidemiological and statistical criteria such as model selection

variables were used. Analyses were performed using the statistical package SPSS.15 (IBM, Armonk, NY, USA).

RESULTS

During the first half of gestation, 1,120 of the 1,175 pregnant women consumed caffeine (95.3%). Mean consumption was 72.6 mg/day (SD 92.7; range 0.1-650 mg/day), the average intake before pregnancy being 150.1 mg/day (SD 141.1; range 0.1-872 mg/day). Zero caffeine consumption before pregnancy was found in 21 pregnant women (1.8%), as compared to 55 (4.7%) during the first half of gestation; however, 49 of these 55 women had consumption over the recommended limit (200 mg/day) before gestation.

During the first half of gestation, a total of 116 pregnant women (9.9%) consumed an amount equal to or greater than 200 mg/day, compared to 370 women (31.2%) previous to pregnancy. We found that 762 (64.9%) participants decreased caffeine consumption during the first half of pregnancy, 315 (26.8%) did not change, and 98 (8.3%) increased their intake during this period with respect to the year before gestation.

Table 1 shows the different sources of caffeine as well as the frequency of use before and during the first half of pregnancy. Table 2 reflects modification in the consumption of the different sources of caffeine during the first half of the gestation as compared to the previous year.

The mean data on caffeine consumption, plus percentiles 25, 50 and 75 previous to gestation and during the first half of the gestation in relation to the studied variables, are shown in Table 3.

In turn, the descriptive characteristics of pregnant women consuming during the first half of pregnancy amounts of caffeine <200 mg/day or ≥ 200 mg/day are exposed in Table 4. After

analyzing consumption by age group, higher caffeine consumption (≥ 200 mg/day) was associated with maternal age over 40, though not to a statistically significant degree. Higher caffeine consumption was also found for pregnant women with lower level studies ($p < 0.05$). Similarly, a higher frequency of high consumption was observed as social status decreased ($p < 0.01$). Results indicated a higher frequency of high caffeine intake in active smokers when compared to ex-smokers and non-smokers ($p < 0.001$). The intake was also higher in women who consumed alcohol during the first half of gestation ($p < 0.05$). Among the obstetrical variables, a higher percentage of high caffeine consumption was observed for those pregnant women with a higher number of previous spontaneous abortions ($p < 0.001$) and women with higher parity ($p < 0.001$).

Table 5 shows the crude and adjusted odds ratio for each of the associated variables to caffeine consumption. Once adjusted, the variables associated with higher caffeine intake during the first half of the pregnancy were: tobacco, alcohol consumption during this stage, higher parity, as well as a higher number of previous spontaneous abortions, and a lower educational level. There was no statistically significant association between caffeine consumption and age or BMI, and there was no association with lower class level, as found in the crude analysis.

DISCUSSION

Caffeine consumption during pregnancy is widely studied due to the controversial results reported to date (6-9). However, few studies have investigated the social-demographic factors associated with the consumption of caffeine during gestation (2,3,5).

This study analyzes the main caffeine sources among Spanish women during the first half of gestation, modification in the intake of this substance as compared to the previous year, and

social-demographic differences, anthropometric and obstetric factors, lifestyle, and their relationship with caffeine intake during the first half of gestation within our population.

A decrease in caffeine consumption was observed during the first half of gestation. This could be explained as a behavioral change aimed at enhancing personal care during this stage, or because symptoms such as nausea or aversion to the coffee smell or taste can be quite common during pregnancy. Notwithstanding, a substantial percentage of women does not vary consumption, or even increases caffeine intake. The average consumption during the year previous to pregnancy in our study population was 150.1 mg/day, higher than the 129.9 mg/day found by Chen et al. (14).

During the first half of the gestation widespread caffeine consumption was observed (95.3%). Indeed, 9.9% of pregnant women had a high intake, at or above 200 mg/day, the limit set by American College of Obstetricians and Gynecologists, as possibly associated with adverse outcomes, such as abortion or preterm delivery (13). Although there is no consensual cut-off point for “safe” consumption during gestation, some authors (5) establish it as 300 mg/day, finding that 8.3% of pregnant women exceed this amount.

Our results are in line with those by Pacheco et al. (5), conducted in a population of 250 pregnant women in Rio de Janeiro, where 96% consumed caffeine during their gestation, and Chen et al. (14) reported that 97% consumed caffeine. In contrast, a study carried out in Denmark (15), found a much lower prevalence (57%). Likewise, Grosso et al. (16) found that 57% of pregnant women consumed caffeine during the first trimester in their study carried out in Massachusetts. Crozier et al. (17) observed a decrease in the ratio of pregnant women who consume more than 300 mg/day of caffeine, from 39% before gestation to 16% during the first trimester.

The average consumption during the first half of pregnancy in this study (72.6 mg/day) was considerably lower than the 98 mg/day found by Grosso et al. (16); and Frary et al. (18)

estimated an average consumption of 125 mg/day for pregnant women in the United Kingdom, 15% having intake in excess of 200 mg/day. These discrepancies could be attributed to cultural trends and food differences, although genetics may also play a role (15).

In analyzing the caffeine sources, cola consumption does not appear to vary in most pregnant women, though the intake of diet cola light is greater, as found in other studies (17). Pacheco et al. (5) also described a higher caffeine intake from colas (75.4% of pregnant women consuming it), as did Chen et al. (14) (cola consumption by 66% in pregnant women compared to 45% consuming coffee). These authors also found that a large proportion of pregnant women continued to drink tea and cola during this period, although coffee was still the main source of caffeine. This is probably due to a lack of awareness regarding the caffeine content of cola drinks. We detected a decrease in coffee intake (36.2%) and a slight increase in the consumption of decaffeinated coffee (16.5%). Few differences were found between caffeine intake from sources such as chocolate or biscuits during this period.

Regarding the variables associated with the consumption of caffeine studied, there is a tendency to increase caffeine intake in pregnant women older than 40 or younger than 25 years. This finding supports the results of previous studies (14,15,20,21) that observe a higher consumption in pregnant women over 40, as well as studies reporting an increased use in pregnant women under 24 years (8,14). When analyzing the level of education, a higher frequency of high consumption is seen for lower educational levels, also confirming previous results (8,14,15,17,19). A higher frequency of high intake is furthermore noted in lower class pregnant women, although this association was lost in the adjusted analysis, probably because there were just a few cases categorized as lowest social class.

As for the consumption of other harmful substances, caffeine intake is associated with an increased consumption of alcohol and tobacco in pregnant women. These results agree with previous studies conducted in Denmark (15), Poland (21), Brazil (22), and the US (15,16); the

latter study showed increased caffeine consumption when the number of cigarettes smoked was higher.

On the other hand, an association between high intake of caffeine and BMI is not observed, while Santos et al. (21) report a higher consumption in pregnant women with lower BMI.

Regarding obstetric variables, previous studies showed a higher caffeine intake in women having more previous pregnancies and deliveries (8, 15, 22). These facts are also consistent with this study, where a higher consumption of caffeine is significantly associated with a higher number of previous abortions and parity pregnancies. This finding could be interpreted as an increased risk of miscarriage in women who consume high amounts of this substance, as suggested by previous studies (22-25), yet further, broader studies should be conducted to confirm this association.

To our knowledge, this is the first study performed in Spain assessing the factors associated with increased consumption of caffeine in pregnant women during the first half of the pregnancy, establishing a limit of 200 mg/day to define high intake (13). This sample of pregnant women is representative of all healthy women in reference to the geographic area. Therefore, these results can be extrapolated to similar populations. The study was conducted only in Spanish pregnant women due to the different sociocultural characteristics. The average caffeine intake was calculated from meals and drinks included in a questionnaire (11), previously validated in Spanish population, being excluded herbal supplements, tea, energy drinks and drugs because its consumption in the pregnant population is very low.

For the time being, it can be concluded that caffeine intake is widespread in the pregnant women of our population, although with a high frequency of consumption and an average intake lower than in other populations. High intake (≥ 200 mg/day) was greater in pregnant women with lower educational level, a greater number of spontaneous abortions and parity, and in

women consuming tobacco and alcohol. Accordingly, these women should be well informed and receive more support during gestation to reduce caffeine consumption.

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Caffeine Consumption in Pregnancy

Table 1: Sources of caffeine and frequency of use during the year prior to pregnancy and first half of gestation

	Cola n (%)		Cola light n (%)		Coffee n (%)		Decaffeinated coffee n (%)		Chocolate n (%)		Cookies n (%)	
	BEFORE	PREG	BEFORE	PREG	BEFORE	PREG	BEFORE	PREG	BEFORE	PREG	BEFORE	PREG
Never	414 (35.2)	519 (44.2)	852 (72.5)	918 (78.1)	521 (44.3)	790 (67.2)	875 (74.5)	741 (63.1)	479 (40.7)	544 (46.3)	718 (61.1)	775 (66.0)
1-3/month	83 (7.1)	111 (9.4)	36 (3.1)	43 (3.7)	17 (1.5)	17 (1.4)	27 (2.3)	42 (3.6)	287 (24.4)	279 (23.7)	195 (16.6)	160 (13.6)
1-6/week	361 (30.7)	332 (28.3)	176 (15.0)	155 (13.2)	64 (5.4)	67 (5.7)	106 (9.0)	124 (10.5)	324 (27.6)	276 (23.5)	248 (21.1)	227 (19.3)
1-6/day	307 (26.1)	207 (17.6)	106 (9.0)	57 (4.8)	572 (48.7)	300 (25.5)	165 (14.0)	266 (22.6)	83 (7.1)	74 (6.3)	14 (1.2)	13 (1.1)
>6/day	8 (0.7)	4 (0.3)	4 (0.3)	1 (0.1)	0 (-)	0 (-)	0 (-)	0 (-)	1(0.1)	1(0.1)	0 (-)	0 (-)
Missing	2 (0.2)	2 (0.2)	1(0.1)	1 (0.1)	1 (0.1)	1 (0.1)	2 (0.2)	2 (0.2)	1(0.1)	1(0.1)	0 (-)	0 (-)
Total	1175		1175		1175		1175		1175		1175	

n (%)= number (percentage); PREG= Caffeine consumption during the first half of pregnancy; BEFORE= Caffeine consumption in the previous year

Table 2: Changes in consumption of the different sources of caffeine during first half of pregnancy compared to year prior to pregnancy

	Increased n (%)	Not change n (%)	Decreased n (%)	Missing data n (%)	Total
Cola drinks	76 (6.5)	742 (63.1)	355 (30.2)	2 (0.2)	1175
Cola light	45 (3.8)	977 (83.1)	152 (13.0)	1 (0.1)	1175
Coffee	14 (1.2)	735 (62.5)	425 (36.2)	1 (0.1)	1175
Decaffeinated coffe	194 (16.5)	907 (77.2)	72 (6.1)	2 (0.2)	1175
Chocolate	123 (10.5)	857 (72.9)	194 (16.5)	1 (0.1)	1175
Cookies	58 (5.0)	998 (84.9)	119 (10.1)	0 (-)	1175

(%)= number of pregnant (percentage)

Table 3: Mean caffeine intake and percentiles 25, 50 and 75, in the year prior to pregnancy and during the first half of gestation according to the studied variables

	Before pregnancy			During pregnancy	
	n	Mean (SD)	p50 (p25; p75)	Mean (SD)	p50 (p25; p75)
Age, y					
< 25	178	141.9 (141.7)	115.6 (26.8; 229.3)	78.7 (96.7)	46.0 (8.9; 118.0)
25-29	345	153.9 (148.3)	116.4 (29.8; 268.7)	72.8 (90.4)	29.5 (7.4; 115.0)
30-34	436	147.3 (139.5)	115.5 (28.1; 269.7)	68.1 (93.6)	23.3 (6.6; 113.6)
35-39	199	153.9 (131.9)	117.4 (34.3; 270.1)	74.6 (91.3)	27.2 (6.8; 113.6)
≥40	17	182.3 (135.8)	132.7 (113.6; 268.9)	68.1 (93.5)	48.4 (24.5; 126.7)
Academic level					
University	358	135.1 (121.2)	114.1 (28.6; 244.4)	61.9 (7.4)	24.7 (7.1; 111.4)
Secondary	339	138.3 (137.8)	110.8 (22.5; 268.7)	62.1 (84.1)	22.4 (6.6; 109.4)
Primary	478	169.6 (154.6)	123.9 (46.0; 271.3)	88.0 (106.1)	47.4 (7.9; 122.1)
Social status					
Level I-II	189	135.8 (126.5)	114.1 (25.9; 237.1)	59.6 (68.8)	24.5 (6.8; 112.9)
Level III-IV	931	151.8 (140.9)	116.4 (29.8; 268.9)	74.3 (94.2)	29.8 (7.1; 115.0)
Level V	51	175.9 (189.6)	118.0 (37.6; 294.7)	91.2 (132.7)	29.3 (6.6; 119.2)
Smoking habits					
None smoking	504	110.6 (109.9)	95.8 (21.9; 140.2)	54.9 (78.7)	20.1 (5.3; 107.0)
Ex-smoking	242	142.4 (117.9)	115.5 (37.2; 267.5)	68.2 (81.6)	27.4 (6.8; 113.8)
Smoking	429	200.8 (167.7)	155.4 (48.8; 290.2)	95.8 (107.9)	49.8 (14.1; 127.2)
Alcohol consumption					
No	1106	143.0 (143.5)	115.0 (23.7; 234.3)	70.2 (91.4)	27.1 (6.8; 114.1)
Yes	69	159.0 (137.6)	126.7 (42.6; 274.1)	110.5 (105.1)	108.4 (19.9; 148.8)
BMI					
<25	789	147.9 (138.7)	115.7 (26.8; 267.5)	71.0 (93.8)	26.2 (6.8; 114.1)
25-29.9	268	156.6 (150.2)	116.5 (39.2; 270.7)	81.0 (97.1)	46.0 (7.5; 119.9)
≥30	118	149.8 (136.4)	116.4 (37.7; 268.9)	63.9 (72.1)	35.9 (7.1; 113.6)
Previous abortions					
0	933	144.5 (146.4)	115.1 (27.2; 267.5)	68.8 (88.6)	27.3 (6.9; 113.8)
1	199	166.0 (146.3)	126.7 (36.5; 274.1)	82.7 (101.2)	36.1 (7.5; 119.4)
≥2	43	196.7 (190.1)	119.0 (48.7; 314.1)	107.0 (126.4)	48.7 (6.8; 225.0)
Parity					
0	631	144.3 (132.6)	116.4 (36.5; 241.8)	60.4 (78.4)	24.8 (6.6; 110.8)
1	416	147.7 (142.4)	115.0 (23.1; 268.7)	80.7 (95.9)	36.3 (7.4; 119.7)
≥2	128	186.1 (170.4)	123.9 (46.6; 287.5)	106.1 (129.7)	55.6 (9.5; 127.1)

n = number of pregnant; SD= standard deviation

Table 4: Demographic and pregnancy characteristics of mothers by categories according to caffeine intake during first half of gestation

	Total pregnant	Intake < 200 mg/día	Intake ≥ 200 mg/día	p
	n (%)	n (%)	n (%)	
Age, y				
< 25	178 (15.1)	160 (89.9)	18 (10.1)	ns
25-29	345 (29.4)	307 (89.0)	38 (11.0)	
30-34	436 (37.1)	395 (90.6)	41 (9.4)	
35-39	199 (16.9)	183 (91.9)	16 (8.1)	
≥ 40	17 (1.5)	14 (82.3)	3 (17.7)	
Academic level				
University	358 (30.5)	337 (94.1)	21 (5.9)	<0.05
Secondary	347 (28.8)	311 (91.7)	28 (8.3)	
Primary	478 (40.7)	411 (86.0)	67 (14.0)	
Social status				
Level I-II	189 (16.2)	181 (95.8)	8 (4.2)	<0.01
Level III-IV	931 (79.5)	831 (89.3)	100(10.7)	
Level V	51 (4.3)	43 (84.3)	8 (15.7)	
Smoking habit				
Smoking	429 (36.5)	360 (83.9)	69 (16.1)	<0.0001
Ex smoking	242 (20.6)	223 (92.1)	19 (7.9)	
Non smoking	504 (42.9)	476 (94.4)	28 (5.6)	
Alcohol consumption				
No	1059 (90.1)	1002 (94.6)	57 (5.4)	<0.05
Yes	116 (9.9)	57 (89.7)	12 (10.3)	
BMI				
<25	789 (67.1)	713 (90.4)	76 (9.6)	ns
25-29,9	268 (22.8)	235 (87.7)	33 (12.3)	
≥ 30	118 (10.1)	111 (91.7)	7 (8.3)	
Previous spontaneous				
abortion	933 (79.4)	853 (91.4)	80 (8.6)	<.0001
0	199 (17.0)	174 (87.4)	25 (12.6)	
1	43 (3.6)	32 (74.4)	11 (25.6)	
≥ 2				
Parity				
0	631 (53.7)	590 (93.5)	41 (6.5)	<0.0001
1	416 (35.4)	361 (86.8)	55 (13.2)	
≥2	128 (10.9)	108 (84.4)	20 (15.6)	
Total	1175 (100)	1059 (90.1)	116 (9.9)	

n (%)= number of pregnant women (percentage)

Table 5: Association of selected characteristics with consumption ≥ 200 mg/day of caffeine during the first half of pregnancy

		Crude Odds ratio	95% CI	Adjusted Odds ratio	95% CI
Age, y	<25	1	Reference	1	Reference
	25-29	1.1	0.61-1.99	1.47	0.79-2.72
	30-34	0.92	0.51-1.65	1.53	0.82-2.84
	35-39	0.78	0.38-1.57	1.07	0.51-2.24
	≥ 40	1.90	0.50-7.27	3.60	0.87-14.98
Academic level	University	1	Reference	1	Reference
	Secondary	1.44	0.80-2.60	1.32	0.72-2.42
	Primary	2.62*	1.57-4.36	2.40*	1.40-4.13
Social status	Level I-II	1	Reference	1	Reference
	Level III-IV	1.51	0.93-2.43	1.12	0.62-1.99
	Level V	3.91*	1.18-12.99	3.10	0.81-11.93
Smoking habit	Non smoking	1	Reference	1	Reference
	Ex -smoking	1.45	0.79-2.65	1.44	0.78-2.65
	Smoking	3.26*	2.06-5.16	2.91*	1.82-4.65
Alcohol consumption	No	1	Reference	1	Reference
	Yes	2.03*	1.05-3.90	1.97*	0.99-.88
BMI	<25	1	Reference	1	Reference
	25-29.9	1.31	0.85-2.03	1.21	0.71-1.77
	≥ 30	0.59	0.26-1.31	0.47	0.21-1.08
Previous spontaneous abortion	0	1	Reference	1	Reference
	1	1.53	0.95-2.47	1.34	0.81-2.21
	≥ 2	3.66*	1.78-7.55	3.51*	1.63-7.54
Parity	0	1	Reference	1	Reference
	1	2.19*	1.43-3.35	2.26*	1.41-3.60
	≥ 2	2.66*	1.50-4.72	2.40*	1.27-4.55