

The effect of smoking and caffeine on the fetus and placenta in pregnancy

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Summary

The aim of this study was to determine the effects of tobacco use and consumption of caffeine in pregnancy on the fetus and placenta by measuring the body weights, head circumferences, and lengths of newborns, and also weights and diameters of placentas.

In this prospective study, two main groups were chosen for the study:

Group I: A total of 63 pregnant non-smokers; were separated into two subgroups according to their daily caffeine intake; less than 300 mg (Ia) (n = 44), and more than 300 mg (Ib) (n = 19).

Group II: 60 pregnant smokers were also separated into two subgroups; daily caffeine intake less than 300 mg (IIa) (n = 43), and more than 300 mg (IIb) (n = 17).

The newborns and placentas of both groups were examined. The body weights, lengths, and head circumferences of newborns and also weights and diameters of placentas were measured.

The pregnant non-smokers consuming caffeine more than 300 mg/day had statistically significant lower weights of newborns and placentas ($p < 0.05$). However, there was no significant difference between groups according to the lengths, head circumferences of newborns and diameters of placentas. There were significantly lower body weights of newborns and placentas in pregnant smokers ($p < 0.05$). There was no difference according to the diameters of placentas, and lengths and head circumferences of newborns in either group.

In conclusion, it is suggested that smoking in pregnancy should be prevented both for the health of newborns and mothers, and also caffeine including beverages like tea and coffee should be limited in pregnancy.

Key words: Caffeine, Fetus, Placenta, Pregnancy, Smoking.

Introduction

Today, tobacco users among pregnant women are growing in number due to the increase in tobacco consumption of the female population. Tobacco use in pregnancy restricts intrauterine growth of the fetus, especially by affecting the placenta, and thus resulting in low birthweight newborns. It is well established that carbon monoxide and nicotine in tobacco smoke causes some tissue level changes secondary to hypoxia and nutritional disorders by decreasing vasodilator amines, leading to organic dysfunctions and stillbirth [1-5]. Caffeine is prevalently found in frequently consumed foods and beverages like coffee, tea, coke and chocolate in daily life. Because of its structural similarity to the purine molecules in DNA, caffeine has a potential inhibitory effect on cell division and metabolism [6, 7]. It has been revealed that caffeine can easily pass through the placenta. Also it has been reported in many studies that excess consumption of beverages like tea, coffee and coke in pregnancy may result in low birthweight newborns [8-11].

The aim of this study was to determine the effects of caffeine consumption and tobacco use on the fetus and placenta. Additionally, their effects on placental diameters were also included in our study which has not been reported in the literature before.

Materials and methods

Women with 37 to 41 week-old pregnancies who had spontaneous vaginal deliveries were included in this prospective study. The newborns and placentas were examined for several parameters.

Pregnant patients who had medical or surgical problems (hemorrhage, hypertension, diabetes mellitus, infection, etc.) had been excluded. Tobacco use in pregnancy was expressed as "cigarette per day". A total of 60 pregnant women who consumed less than ten cigarettes per day were included in the study. In our study we considered tea and coffee as sources for caffeine, which are frequently consumed daily beverages. The amount of caffeine in foods and beverages is not known because of the variabilities in daily consumption.

Therefore we chose an average of 300 mg as a reference value. Daily caffeine intake (mg/day) was obtained from average daily consumption of tea and coffee as cup(s). We used the formula of Bunker and McWilliams obtained from the "Handbook of Non-Prescription Drugs" [12]. The amount of caffeine per cup of coffee and tea was calculated as 107 mg and 34 mg, respectively.

Two main groups were chosen in the study:

Group I: A total of 63 non smokers pregnant were separated into two subgroups according to their daily caffeine intake; less than 300 mg (Ia) (n = 44), and more than 300 mg (Ib) (n = 19).

Group II: 60 pregnant smokers were also separated into two subgroups; a daily caffeine intake less than 300 mg (IIa) (n = 43), and more than 300 mg (IIb) (n = 17).

All newborns and placentas of these patients were examined. The body weights, lengths, and head circumferences of the

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newborns and also weights and diameters of placentas were measured.

Newborns were weighed naked just after delivery with classic scales. The weights were noted as grams. The head circumferences were measured with a standard paper disposable tape from the occipital prominence projecting over the eyebrows. Obtained values were noted as centimeters. The lengths were measured with a standard paper disposable tape in the supine position. Values were noted as centimeters. Placentas were all intact after delivery and weighed by classic scales. Obtained values were noted as grams. The weights of the cords were not taken into consideration. The placental diameters were measured in two different axes by a standard paper disposable tape and an average was obtained. Values were noted as centimeters.

Statistics

All obtained values were recorded with a computer and statistical analysis was done by a package program (SPSS). The significance among groups was investigated by the chi-square test. A p value less than 0.05 was considered significant.

Results

Newborns and placentas of pregnant nonsmokers (group I), according to their daily caffeine intake of less than 300 mg (Ia), and more than 300 mg (Ib) were studied. The newborn weights, lengths, head circumferences, placental weights, and diameters were analyzed (Table 1).

Table 1. — Comparison of parameters of placentas and newborns according to caffeine consumption in pregnant nonsmokers.

	Weight of newborn (g)	Length of newborn (cm)	Head circumference (cm)	Weight of placenta (g)	Diameter of placenta (cm)
Caffeine consumption of less than 300 mg/day n = 44 (Ia)	3371 ± 502	49.9 ± 1.79	35.12 ± 1.29	532 ± 151	18.2 ± 2.39
Caffeine consumption of more than 300 mg/day n = 19 (Ib)	3243 ± 458	49.3 ± 2.53	35.96 ± 2.01	451 ± 192	17.34 ± 2.78
p value	p < 0.05	p > 0.05	p > 0.05	p < 0.05	p > 0.05

According to caffeine intake, there was no significant difference among newborn lengths, head circumferences and placental diameters between group Ia and Ib (p > 0.05). However differences were statistically significant among weights of newborns and placentas between groups (p < 0.05).

Newborns and placentas of pregnant smokers (group II), according to daily caffeine intake of less than 300 mg (IIa), and more than 300 mg (IIb) were also studied. The newborn weights, lengths, head circumferences, placental weights, and diameters were analyzed (Table 2).

Table 2. — Comparison of parameters of placentas and newborns according to caffeine consumption in pregnant smokers.

	Weight of newborn (g)	Length of newborn (cm)	Head circumference (cm)	Weight of placenta (g)	Diameter of placenta (cm)
Caffeine consumption of less than 300 mg/day n = 43 (IIa)	3257 ± 497	48.7 ± 20.1	34.95 ± 1.71	517 ± 159.13	17.85 ± 3.09
Caffeine consumption of more than 300 mg/day n = 17 (IIb)	3070 ± 477	47.1 ± 1.98	34.1 ± 1.03	420 ± 190.23	17.19 ± 2.81
p value	p < 0.05	p > 0.05	p > 0.05	p < 0.05	p > 0.05

According to these analyses, there was no significant difference among newborn lengths, head circumferences and placental diameters (p > 0.05). Statistical analyses revealed significant differences among weights of newborns and placentas (p < 0.05).

Discussion

It has been reported that active or passive smoking during pregnancy significantly increases perinatal morbidity and mortality; also during the postnatal period, the negative effects of smoking on physical and mental development of babies has been demonstrated [1-5]. The most important effect of smoking during pregnancy is fetal hypoxia [1-5, 13, 14]. Moreover, long-term maternal smoking causes some structural alterations in the placenta. Degenerative changes of placental vasculature is not only dependent on the number of smoked cigarettes per day but also on the duration of smoking in years [1-5, 13, 14]. There are contradictions between reports about effects of caffeine on fetuses. Weatherbee *et al.* found that caffeine causes vasoconstriction in uteroplacental circulation by increasing catecholamine release from the adrenal medulla [15]. Similarly, other studies have implied that unfavorable effects of caffeine on the fetus is directly proportional to the consumed amount [7-11]. On the contrary, Kurppa *et al.* emphasized that there is no relation between maternal caffeine consumption and congenital malformations, and that caffeine simply has no effect on the fetus [16].

Many studies have demonstrated that there is delayed caffeine elimination, especially during the second and third trimesters of pregnancy, and elimination returns to prior levels one week after delivery [8-11, 17, 18]. In the study of Beaulac-Baillargeon, a decrease was observed in weights of the newborns and placentas of pregnant nonsmokers that consumed more than 300 mg of caffeine per day [19]. In our study, we measured the weights of newborns and placentas of pregnant non-smokers that consumed more than 300 mg of caffeine per day decreased by an average of 128 g and 81 g, respectively, when compared to pregnant non-smokers that consumed less than 300

mg caffeine per day. Also decreases in placental weights, and weights, heights, head circumferences of newborns of pregnant smokers that consumed more than 300 mg of caffeine per day are reported in Beaulac-Baillargeon *et al.* study and others [19-22]. We found statistically significant decreases in the weights of placentas and newborns of pregnant smokers who consumed less or more than 300 mg of caffeine. However there were no significant changes in lengths and head circumferences of the newborns. We concluded that the weights of placentas and newborns are significantly affected by the associated influences of smoking and caffeine consumption. In a large prospective study newborns of pregnant non-smokers who consumed excess amounts of beverages like tea and coffee, had no significant differences in terms of weight, length, and head circumference when compared to newborns of pregnant non-smokers who consumed less of these beverages [23].

However when smoking is added to excess consumption of caffeine-rich beverages, significant decreases have been observed in these parameters [23]. In our study, weights of the newborns and placentas of pregnant non-smokers differed significantly according to caffeine consumption of more or less than 300 mg. However there was no decrease in lengths and head circumferences of the newborns. Linn *et al.* [24] reported that excess caffeine consumption in pregnancy had a decreasing effect only on the weight of the newborn but no change in length and head circumference.

We found a significant difference between weights of the newborns of pregnant non-smokers who consumed more or less than 300 mg of caffeine per day. If smoking is added to caffeine consumption, a decrease in weights of the newborns is more prominent. Meberg *et al.* noted that no difference was detected between placental diameters of pregnant smokers or non-smokers without questioning coffee consumption status [25]. There are no reports in the literature on the relation between caffeine consumption in pregnancy and placental diameter. Our study was different on this point because we compared placental diameters of non-pregnant smokers who consumed more or less than 300 mg of caffeine per day. No significant difference could be detected. Also there was no significant difference between groups in which smoking was added to coffee consumption.

In conclusion, we detected that caffeine consumption of more than 300 mg per day during pregnancy decreased both placental and newborn weights without any effects on lengths, head circumferences of newborns and placental diameters. Also when smoking was added to caffeine consumption, decreases in the weights of newborns and placentas were more pronounced. We suggest that tobacco use during pregnancy must be prevented both for the health of newborns and mothers, and that also consumption of beverages including caffeine like tea and coffee should be limited during pregnancy.

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