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Fetal growth and development disorders in smoking pregnant women

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BACKGROUND: Due to the increased frequency of smoking in pregnant women, an interest in the study of the mechanisms of the fetoplacental unit in women with tobacco addiction has also been increased all over the world. The effect of low degrees of tobacco addiction of a pregnant woman on the fetus has not been studied in the available literature.

AIM: The aim of this study was to identify the growth and developmental abnormalities of the fetus at 30-34 weeks of gestation in smoking pregnant women at the third-trimester ultrasound screening.

MATERIALS AND METHODS: Pregnant women, who were observed in the Northern Medical Clinical Center named after N.A. Semashko, Arkhangelsk, Russia were examined during the ultrasound screening. A continuous examination of pregnant women with three ultrasound screenings was carried out, with the third screening performed in 1048 individuals.

RESULTS: The survey cohort included 120 pregnant women using the inclusion criteria. Two groups were formed depending on the presence or absence of smoking during pregnancy. The first group contained non-smoking pregnant women (n = 40); the second group comprised smokers during pregnancy (n = 80). Comparison of fetal development parameters in the group of pregnant smokers was carried out in two subgroups: the second "a" subgroup only consisted of smokers in the first trimester (embryonic period) and the second "b" subgroup contained smokers throughout pregnancy. All pregnant women who took part in the study signed a Patient Informed Consent form. The study design was observational, cross-sectional (one-step). The main manifestations of fetal growth and development disorders at 30-34 weeks of gestation in pregnant smokers were low estimated fetal weight, low tubular bone length and low head circumference by the gestational age. Low (below the 10th percentile) estimated fetal weight by the gestational age was recorded only in the group of pregnant women who smoke (p = 0.001) and in 90.0% of cases even with a weak degree of tobacco addiction. It was accompanied by low bone sizes and was detected in 10.0% of cases among women who stopped smoking in the first trimester and in 15.0% of cases among those who continued to smoke throughout pregnancy. This result confirmed early symmetrical intrauterine growth restriction of the fetus. Pregnant smokers at 30-34 weeks of gestation had significantly more often low (below the 5th percentile) fetometric parameters characterizing bone growth: femur length (p = 0.01), shinbone length (p = 0.035), shoulder bone length (p = 0.004), biparietal head size (p = 0.006), and head circumference (p = 0.002). Low values of the fetal head circumference were found in 50.0% of cases among pregnant smokers. In the absence of signs of fetal bone growth restriction and the estimated fetal weight in P10-95 values in the group of smoking pregnant women, significantly more often (p = 0.027) than in non-smokers, low (below the 5th percentile) head circumference for gestational age was recorded in 29.8% of cases. In addition, in this group of fetuses of pregnant smokers, elevated ratios of abdominal circumference to head circumference were found, which indicated fetal head growth restriction. The fetometry data obtained were confirmed by anthropometric measurements in the newborns during term delivery, the length of full-term newborns in pregnant smokers being significantly lower (p = 0.040).

CONCLUSIONS: Fetuses of pregnant smokers were more likely to have low fetometric parameters by gestational age. Low estimated weights of the fetuses were found in 90.0% of cases with a weak degree of tobacco addiction.

Keywords: pregnancy; fetus; fetometry; fetal growth restriction; intrauterine growth retardation; slowed fetal growth; tobacco smoking.

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Нарушение роста и развития плода у беременных при табакокурении

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Обоснование. В связи с увеличением частоты курения у беременных во всем мире возрос интерес к исследованию механизмов функционирования фетоплацентарного комплекса при табачной зависимости. Влияние слабой степени табачной зависимости беременной на плод в доступной литературе практически не исследовано.

Цель — выявить нарушения роста и развития плода у курящих беременных в сроке 30–34 недели гестации при третьем ультразвуковом скрининге.

Материалы и методы. Обследованы беременные, наблюдавшиеся в ФГБУЗ СМКЦ им. Н.А. Семашко ФМБА России: проведены три ультразвуковых скрининга. Третий скрининг выполнен у 1048 беременных.

Результаты. При использовании критериев включения сформирована когорта из 120 человек. В зависимости от наличия или отсутствия курения во время беременности сформированы две группы. В первую группу включены некурящие беременные (40 человек), во вторую — курящие на протяжении беременности (80 человек). Сравнение показателей развития плода в группе курящих беременных проведено в двух подгруппах: 2а — курящие только в I триместре (эмбриональный период) и 2б — курящие всю беременность. Все беременные, участвовавшие в исследовании, подписали информированное согласие пациента. Тип исследования — обсервационное, поперечное (одномоментное). Нарушения роста и развития плода в сроке 30–34 недели гестации у курящих беременных в основном проявлялись низкой предполагаемой массой плода, низкими значениями длины трубчатых костей и низкими значениями окружности головы к сроку гестации. Низкая предполагаемая масса плода (ниже 10-го перцентиля) к сроку гестации зарегистрирована только в группе курящих беременных (p = 0,001) и в 90,0 % случаев даже при слабой степени табачной зависимости. Она сопровождалась низкими значениями размеров костей и зафиксирована у 10,0 % в группе женщин, отказавшихся от курения в I триместре, и у 15,0 % в группе, продолжавших курить на протяжении всей беременности, что подтверждает раннее формирование симметричной задержки развития плода. У плодов курящих беременных в сроке 30–34 недели гестации достоверно чаще выявляли низкие (менее 5-го перцентиля) значения фетометрических показателей, характеризующих рост костей: длины бедренных костей (p = 0,01), длины костей голени (p = 0,035), длины костей плеча (p = 0,004), бипариетального размера головы (p = 0,006), окружности головы (p = 0,002). Низкие значения окружности головы плода встречались в 50,0 % случаев у курящих беременных. При отсутствии признаков задержки роста костей плода и предполагаемой массе плода в пределах 10–95-го перцентиля в группе курящих беременных достоверно чаще (p = 0,027), чем у некурящих, регистрировали низкие показатели окружности головы к гестационному возрасту (менее 5-го перцентиля) — в 29,8 % случаев, и именно в этой группе курящих беременных высокие значения отношения окружности живота к окружности головы свидетельствовали об отставании роста головы у плода. Данные фетометрии подтверждаются антропометрическими показателями новорожденных при срочных родах, длина доношенных новорожденных у курящих беременных достоверно меньше (p = 0,040).

Заключение. У плодов курящих беременных достоверно чаще отмечены низкие к сроку гестации значения фетометрических показателей. Низкие показатели предполагаемой массы плода выявлены в 90,0 % случаев при слабой степени табачной зависимости.

Ключевые слова: беременность; плод; фетометрические показатели; задержка развития плода; задержка внутриутробного развития плода; замедленный рост плода; табакокурение.

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BACKGROUND

Studies have revealed that the most studied fetal complication of smoking during pregnancy is the low birth weight in newborns [1–5]. If impaired physical development is present, slow growth and malnutrition of the fetus (P05) are diagnosed in accordance with the International Classification of Diseases, 10th Edition (ICD-10).

P05.0 Small fetus for gestational age. This usually refers to a condition when the body weight is less and the body height is greater than the 10th percentile for gestational age. Low birth weight is used for the calculated term.

P05.1 Small fetus for gestational age. This usually refers to a condition when the body weight and height are less than the 10th percentile for the gestational age. Small fetus is used for the calculated term.

P05.9 Unspecified fetal growth retardation and delayed growth (height) of the fetus not otherwise specified.

According to Suhag and Berghella (2013), fetal growth retardation (FGR) is established when the estimated fetal weight, calculated by biometric measurements, is less than the 10th percentile for gestational age, that is, the starting point in assessing fetal development is the estimated weight [6]. In the clinical guidelines for obstetrics and gynecology [7], the term "FGR syndrome" is adopted if the estimated weight is less than the 10th percentile for the gestational age. This group is heterogeneous. According to the clinical practice guideline on "fetal growth restriction" (2014), fetuses with developmental delay and an estimated fetal weight less than the 10th percentile are divided into two subgroups, namely, low weight for gestational age (LWGA) and intrauterine growth retardation (IUGR). LWGA is characterized with a normal amount of amniotic fluid and normal indicators of dopplerometry in the umbilical cord arteries, while IUGR is characterized with oligohydramnios and/or pathological indicators of dopplerometry in the umbilical artery or when the estimated fetal weight is less than the 5th percentile [8]. This terminology is supported by several researchers [6, 9, 10]. According to Suhag and Berghella (2013), the LWGA population is present in 40% of cases with constitutionally small fetuses, in 20% with genetic diseases or toxic effects (including maternal smoking), and in 40% of cases with disorders of the placentofetal blood flow or oligohydramnios, which enable diagnosis of IUGR in this group of fetuses with an estimated weight within the 5th–10th percentile [6].

Fetuses with FGR are divided into two groups:

1) With symmetric developmental delay, proportional delay in fetometric parameters of the fetus, and abdominal circumference (AC) and head circumference (HC) parameters less than the 5th percentile. This develops at the end of the first trimester and early period of the second trimester of pregnancy.
2) With an asymmetric developmental delay, disproportionate disorders of fetometric indicators, and a deficit in the growth of AC with normal indicators of HC. This develops in third trimester [7, 11–13].

Lee et al. (2003) propose to divide fetuses with LWGA into three groups: 1) small for gestational age by weight (mass), 2) small for gestational age by height, and 3) small for gestational age by height and weight [4]. In the ICD-10 P05.9 section "Slow growth and lack of nutrition of the fetus," change in only one anthropometric indicator, the height of the newborn, is envisaged. Thus, we consider it necessary to distinguish fetuses with delayed bone growth who mothers were smoking during pregnancy.

This study aimed to identify abnormalities in the growth and development of the fetus of pregnant women, who were smoking during pregnancy, at 30–34 weeks of gestation through three ultrasound screening sessions.

MATERIALS AND METHODS

Study design

Pregnant women, who consulted in the N.A. Semashko Northern Medical Clinical Center of the Federal Medical and Biological Agency of Russia, were examined during ultrasound screening. Screening of pregnant women was performed in accordance with the Order of the Ministry of Health of the Russian Federation No. 457 dated December 28, 2000, with additions from the Order of the Ministry of Health of the Russian Federation No. 808n dated October 2, 2009. A continuous examination of pregnant women was performed with three ultrasound screenings. Three screenings were performed in 1048 pregnant women.

Following the implementation of the inclusion and exclusion criteria, an examination cohort of 120 patients was formed. The nonsmoking group (group 1) 40 nonsmoking pregnant women, and the smoking group (group 2) included 80 pregnant women with tobacco addiction according to the Fagerström test "smoking pregnant women." Since the "window of vulnerability" for exposure to tobacco smoke occurs during the pre- and peri-implantation period [14], the indicators of fetal development in the smoking group were compared in two subgroups, namely, subgroup 2a of women smoking only in the first trimester (embryonic period) and subgroup 2b of women smoking throughout pregnancy. All pregnant women signed an informed consent. The study followed a cross-sectional design.

Compliance criteria

The inclusion criteria were a singleton pregnancy, cephalic presentation of the fetus, presence or absence of smoking during pregnancy, and voluntary consent of the pregnant women for examination.

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The exclusion criteria were alcohol abuse, intake of psychoactive substances, severe extragenital pathology, in vitro fertilization, and refusal to participate in the study.

Description of the medical intervention

In all pregnant women of the examined groups, the gestational age was calculated from day 1 of the last menstruation and correlated with the gestational age established at the first ultrasound screening. The screening protocol for ultrasound study followed the Order of the Ministry of Health of the Russian Federation No. 457, dated December 28, 2000 [15]. Values of the measured parameters were correlated with the biometric diagrams and tables of Merz [11] in accordance with the gestational age, indicating values in the 5th–95th percentile interval as normal, below the 5th percentile as low, and above the 95th percentile as high. In neonatology, birth weight less than the 10th percentile for gestational age was considered low, and estimated fetal weight less than the 10th percentile was regarded as low [11].

Main study outcome

The anthropometric data of newborns of the examined groups were assessed.

Statistical analysis

Statistical data analysis was performed using the SPSS 22.0 statistical software package for Windows. Quantitative characters are presented as the median (*Me*) and the first and third quartiles (Q_1; Q_3). Quantitative differences between the groups were assessed using the nonparametric Mann–Whitney test; Pearson's χ^2 test was used to detect a relationship between two nominal variables. The level of critical significance was $p \le 0.05$.

RESULTS

A computer program was used to calculate the estimated fetal weight using the formula: Log10W = –1.7492 + 0.166 × × biparietal diameter + 0.046 · AC – 2.646 (AC · biparietal

Table 1. Fetometric parameters of the fetus in the nonsmoking and smoking groups of pregnant women

Indicators	Pregnant women, *n* (%)		*p*-level
	Group 1, *n* = 40	Group 2, *n* = 80	
Biparietal diameter			0.006
– normal	33 (82.5)	46 (57.5)	
– low	7 (17.5)	34 (42.5)	
– above normal	0 (0.0)	0 (0.0)	
Frontal–occipital circumference			0.265
– normal	36 (90.0)	70 (87.5)	
– low	2 (5.0)	9 (11.2)	
– above normal	2 (5.0)	1 (1.3)	
Head circumference			0.002
– normal	32 (80.0)	40 (50.0)	
– low	8 (20.0)	40 (50.0)	
– above normal	0 (0.0)	0 (0.0)	
Abdominal circumference			0.063
– normal	32 (80.0)	71 (88.8)	
– low	1 (2.5)	5 (6.2)	
– above normal	7 (17.5)	4 (5.0)	
Femoral bone			0.010
– normal	39 (97.5)	64 (80.0)	
– low	1 (2.5)	16 (20.0)	
– above normal	0 (0.0)	0 (0.0)	
Shin bones			0.035
– normal	39 (97.5)	71 (88.8)	
– low	0 (0.0)	9 (11.2)	
– above normal	1 (2.5)	0 (0.0)	
Shoulder			0.004
– normal	40 (100.0)	67 (83.8)	
– low	0 (0.0)	13 (16.2)	
– above normal	0 (0.0)	0 (0.0)	
Forearm			0.300
– normal	40 (100.0)	76 (95.0)	
– low	0 (0.0)	4 (5.0)	
– above normal	0 (00.0)	0 (0.0)	

Note: p was calculated using the Pearson Chi-square test.

Table 2. Estimated fetal weight in the nonsmoking and smoking groups of pregnant women

Fetal weight	Pregnant women, *n* (%)		*p*-level
	Group 1, *n* = 40	Group 2, *n* = 80	
Normal	36 (90.0)	70 (87.5)	0.001
Low	0 (0.0)	10 (12.5)	
Above normal	4 (10.0)	0 (0.0)	

Note: *p* was calculated using the Pearson Chi-square test.

Table 3. Estimated fetal weight in groups of women who stopped smoking in trimester I and those smoking throughout the pregnancy

Fetal weight	Pregnant women, *n* (%)		*p*-level
	Subgroup 2a, *n* = 40	Subgroup 2b, *n* = 40	
Norm	36 (90.0)	34 (85.0)	0.499
Low	4 (10.0)	6 (15.0)	

Note: *p* was calculated using the Pearson Chi-square test.

Table 4. Fetometric parameters in fetuses with no signs of bone growth retardation in the nonsmoking and smoking groups of pregnant women

Indicator	No signs of bone growth retardation according to ultrasound examination data, *n* (%)		
	Nonsmoking, *n* = 35	Smoking, *n* = 47	*p*-level
Biparietal diameter			0.180
– norm	32 (91.4)	38 (80.9)	
– low	3 (8.6)	9 (19.1)	
Frontal–occipital circumference			0.483
– norm	33 (94.3)	45 (95.8)	
– low	0 (0.0	1 (2.1)	
– above normal	2 (5.7)	1 (2.1)	
Head circumference			0.027
– norm	32 (91.4)	33 (70.2)	
– low	3 (8.6)	14 (29.8)	
Abdominal circumference			0.191
– norm	28 (80.0)	43 (91.5)	
– low	0 (0.0)	0 (0.0)	
– above normal	7 (20.0)	4 (8.5)	

Note: *p* was calculated using the Pearson Chi-square test.

diameter)/1000 (cm, kg) [16], and fetometric parameters of the fetus were analyzed (Table 1).

A significant difference in the smoking and nonsmoking groups of pregnant women was revealed in fetuses in terms of biparietal head size, HC, femoral bone length, leg bone length, and shoulder bone length. Fetometry disorders may be associated with FGR. Since the third screening is performed at 30–34 weeks of gestation, the estimated fetal weight in the smoking and nonsmoking groups of pregnant women was determined in accordance with the gestational age (Table 2).

Fetal weight values over the 95th percentile for gestational age were recorded only in the nonsmoking group. The estimated fetal weight less than the 10th percentile for gestational age was recorded only in the smoking group (p = 0.001). In these 10 fetuses, based on the combination of low weight and low rates of fetal bone growth, a small fetal size for gestational age was established.

A comparative assessment of the weight of fetuses in groups of women who stopped smoking in the first trimester and those who were smoking throughout pregnancy was performed. Data are presented in Table 3.

Fetal weights below the 10th percentile for gestational age were registered with nearly the same frequency in the two subgroups. This confirms the early symmetrical development of fetal disorder [7, 11].

The main fetometric parameters were assessed in fetuses without growth retardation of the long bones of the fetus to clarify the role of the toxic effect of tobacco smoke products on individual fetometric parameters. The results are presented in Table 4.

Table 5. Anthropometric indicators of newborns in nonsmoking and smoking groups of women during term delivery

Признак	Women, *Me* (Q_1; Q_3)		*p*-level
	Group 1, *n* = 38	Group 2, *n* = 75	
Weight, g	3500 (3327.5; 3990)	3390 (3080; 3598)	0.087
Height, cm	53.0 (51.3; 54.0)	51.5 (50.0; 53.0)	0.040

Note: *p* was calculated using the Mann–Whitney test.

As shown in Table 4, in the absence of signs of fetal bone growth retardation in the smoking group of pregnant women, low HC values (<5th percentile) were registered in fetuses significantly more often, which is consistent with the data of Ekblad et al. (2013), who demonstrated a dynamic decrease in the fetal HC growth rate in women smoking during pregnancy [10].

The anthropometric indicators of newborns in case of term delivery in the study groups were assessed (Table 5).

As shown in Table 5, the median weight of full-term newborns of smoking mothers was 110 g lower than that of nonsmoking mothers, but the differences were insignificant. The height of full-term newborns of the smoking group was significantly less (p = 0.040), which corresponds to the literature data [12].

DISCUSSION

The results of this study revealed that disorders in the growth and development of the fetus at 30–34 weeks of gestation in the smoking group are mainly manifested by a low estimated fetal weight for gestational age, low values of the length of tubular bones for gestational age, and low HC values for gestational age. Many researchers agree that smoking during pregnancy increases significantly the resistance of placental blood flow, which leads to FGR [17, 18]. The assumption was that FGR is the result of the influence of nicotine that causes vasospasm. However, Sastry believes that FGR is facilitated by a decrease in transplacental transfer of amino acids, since nicotine blocks cholinergic receptors and disrupts the transport of amino acids to the fetus [19].

Low estimated fetal weight for gestational age was revealed in 10 pregnant smokers, namely, four women stopped smoking in the first trimester and six women were smoking throughout the pregnancy. Low tobacco dependence (according to the Fagerström test) was noted in nine pregnant women, and only one patient had a strong degree of tobacco dependence. All pregnant women indicated that they smoked ≤10 cigarettes per day. Jaddoe et al. showed that when comparing groups of pregnant women who stopped smoking in the first trimester and those who continued to smoke 10 cigarettes per day, no significant difference was found in the risk of low birth weight in the children, which was consistent with our data [20].

In three pregnant smokers, the estimated fetal weight was below the 5th percentile, which is the criterion for IUGR. In seven pregnant smokers, the estimated fetal weight was within the 5th–10th percentile interval, which was the basis for their inclusion in the FGR group. Three of these seven fetuses had impaired placentofetal blood flow, which allows them to be diagnosed with IUGR. In four patients, no disorders and signs of oligohydramnios were detected by Doppler examination, but since pregnant women were a high-risk (smoking) population, tobacco smoke products may have toxic effect on the fetus such as LWGA [10, 21, 22]. In this group, fetal congenital malformations were also found (agenesia of the left kidney). Thus, in the FGR group of fetuses, IUGR was diagnosed in six cases; therefore, case follow-up is required to predict the time of delivery, and LWGA was detected in four cases caused by the toxic effects of tobacco smoke products. Thus, it is necessary to study the curves of fetal weight and growth over time [11, 23, 24].

In an experimental study, Esposito et al. (2008) exposed pregnant mice to cigarette smoke during three different developmental periods, namely, pre-/peri-implantation period, post-implantation period, and entire gestation period. Intrauterine exposure to cigarette smoke during the pre-/peri-implantation period of mouse pregnancy inhibits fetal growth and results in significant weight loss at term pregnancy. Moreover, exposure to cigarette smoke during the post-implantation period of intrauterine development causes a decrease in the crown–rump length of the fetus and does not exert a significant effect on the fetal weight. In contrast to mass indicators, the crown–rump length decreased equally regardless of the period of exposure to tobacco smoke. Intrauterine exposure to tobacco smoke possibly induces a delay in intrauterine osteogenesis, which contributes to a delay in the intrauterine growth (height) of the fetus. Regardless of the period of exposure to tobacco smoke, minor ossification defects were detected. In our study, 16 fetuses of pregnant smokers had a retardation in the growth of the femoral bones (length <5th percentile), six of them showed impaired growth of the femoral bones with an assumed weight of the fetus of more than the 10th percentile, and three fetuses had retardation in the growth of femoral and humeral bones (length <5th percentile). Since bone growth retardation in these six fetuses was not accompanied by low estimated fetal

weight, isolated fetal bone growth retardation is probable. Prabhu et al. (2010) demonstrated a linear dose–response relationship between exposure to tobacco smoke in the first trimester and slowed growth of the femoral bone in the second trimester of pregnancy.

Mukhopadhyay et al. (2010) revealed significant changes in the gene expression in brain tissues in mice exposed to tobacco smoke. Tobacco smoke influenced changes in the expression of a number of genes that regulate key processes in the hippocampus, such as synaptic function, axonal control, neurogenesis, and apoptosis. In the absence of small weight and height for gestational age, significant changes in the expression of genes associated with the development and function of the hippocampus were noted [25]. These findings are consistent with other studies showing changes in the fetal brain development after prenatal exposure to tobacco, even in the absence of LWGA [26]. In our study, all fetuses with a low presumed weight had HC less than the 5th percentile. Low indices of the HC are combined with low indices of the size of bones and abdomen and indicated a symmetrical type of FGR, which is combined with a normal AC/HC ratio in nine fetuses. In one fetus, whose mother smoked during the entire pregnancy, Doppler examination revealed AC/HC ratios of more than the 95th percentile, which indicates the risk of fetal microcephaly [10, 11].

In the smoking group of pregnant women whose 14 fetuses do not have signs of bone growth retardation and with an estimated fetal weight more than the 10th percentile, the HC values were less than the 5th percentile with AC/HC ratios more than the 95th percentile. This allows us to suspect growth retardation of the fetal head [7]. Our data are consistent with literature data, as Marroun et al. [27] revealed that cigarette smoking by mothers can lead to a decrease in the volumes of the brain, cortical gray matter, and white matter in children; Roza et al. showed that smoking during pregnancy can negatively affect fetal head growth [28].

Currently, many studies have confirmed that smoking during pregnancy causes fetal damage, and its molecular mechanism remains unclear [25, 29]. Several scientific works provide evidence that it is associated with aberrant epigenetic modifications [30, 31]. Owing to the widespread use of tobacco and the harmful effects of tobacco smoke products, measures should be taken to create a smoke-free environment for pregnant women. Providing education about the danger of smoking during pregnancy is necessary, and women of reproductive age should be motivated to quit smoking at the stage of pregnancy planning.

CONCLUSIONS

1. Low estimated fetal weight (less than the 10th percentile) for gestational age was recorded only in the smoking group of pregnant women (p = 0.001) and in 90.0% of cases with low tobacco dependence. It was accompanied by low bone sizes and was found in 10.0% in the group of women who stopped smoking in the first trimester and in 15.0% in the group of women who were smoking throughout the pregnancy, which confirms the early formation of symmetric FGR.
2. In the smoking group, at 30–34 weeks of gestation, low (less than the 5th percentile) values of fetometric parameters of bone growth were significantly more frequent, namely, length of the femoral bones (p = 0.01), length of the shin bones (p = 0.035), length of the shoulder bones (p = 0.004), biparietal diameter of the head (p = 0.006), and HC (p = 0.002).
3. In the absence of signs of fetal bone growth retardation and the estimated weight of the fetus is within the 10th–95th percentile, low HC values for gestational age (less than the 5th percentile) were recorded significantly more often in the smoking group (p = 0.027) than in the nonsmoking group, that is, in 29.8% of cases, and the fetuses of these women had high AC/HC ratios that indicated retardation in fetal head growth.
4. Fetometry data are confirmed by anthropometric indicators of newborns at term delivery, that is, the height of full-term newborns born from smoking mothers is significantly low (p = 0.040).

ADDITIONAL INFORMATION

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Conflict of interest. The authors declare no conflict of interest.

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