Original Article

A study on the effects of smoking during pregnancy on pregnant women and the newborn

Cihat Dağlı, Yasemin Korkut, Cemil Işık Sönmez, Tuğba Karadağ, Basri Furkan Dağcıoğlu, Feruza Sönmez, Naim Ünsal

[1] Aksaray Sıtmapınarı Family Healty Center
[2] Dumlupinar University Evliya Çelebi Research and Education Hospital, Department of Family Medicine, Kütahya
[3] Community Health Center, Aksaray
[4] Mamak Community Health Center, Ankara
[5] Şavşat District State Hospital, Artvin
[6] Aksaray State Hospital, Aksaray
[7]Bahçelievler Medicana Hospital, İstanbul

Abstract

Introduction: Smoking has been well-researched agent,which causes intrauterine growth retardation. We recorded pregnancy history and smoking status of all women that gave birth in our clinic. We tried to identify the effects of smoking on pregnancy and the newborn. **Materials and Methods:** A total of 295 women that gave birth in our hospital between 38th and 42nd weeks of pregnancy were analyzed regarding their age, height, weight, gravidity, parity, histories of miscarriage, preterm labor and pregnancy, smoking status, week of pregnancy determined according to ultrasonography and last menstrual period, and premature membrane rupture; whether any labor induction method and episiotomy were performed; and the sex, height, weight, 1st and 5th minute APGAR scores of the infant. 142 of the participants smoked during pregnancy and 153 were nonsmokers as the control group. **Results:** The average weight of women who were smoking>5 cigarettes/day was higher compared to the women smoking ≤5 cigarettes/day and the nonsmoking women (respectively 73.2±9.4kg, 69.9±7.9kg, 69.9±4.0kg, p<0,05). The difference regarding birth weight, sex and 1st and 5th minute Apgar scores was not statistically significant. However, the babies of smoking women were taller (p=0.022). The differences regarding the number of cigarettes were not significant in paired comparisons of the groups. **Conclusion:** The weight of the newborns of smoking mothers was lower compared to the babies of nonsmoking mothers, which was more evident for the mothers smoking more than 5 cigarettes/day. The study did not show any statistically significant difference between LBW of the newborn and smoking during pregnancy, given the number of cigarettes/day and the length of smoking.

Keywords: Newborn, Pregnancy, Smoke

Correspondence Address: Dr. Yasemin Korkut. Dumlupinar University Department of Family Medicine. Evliya Celebi Training and Research Hospital. Kutahya / Turkiye.

Introduction

Fetal growth and development is characterized by the differentiation, maturation and enlargement of fetal tissues and organs (1). The main factors that affect fetal growth and development are fetal genetic structure, uteroplacental function and maternal

environment. Under the circumstances where all these factors are favorable, a healthy fetus intrauterine completes its somatic growth. In the case that the circumstances are not suitable, fetal growth and development may be affected negatively and may be restricted. Abnormal maternal, fetal and placental factors may individually or altogether have negative impacts on fetal growth and development (2, 3). There are many factors that affect the growth and development of fetus. Among these factors, smoking and exposure to smoke are of particular importance because of being common and preventable (4, 5). Despite all efforts, the rate of smoking among women has been increasing rapidly particularly in developing countries. Smoking has been one of the well-researched agents, whose activity was shown with dose-response curves, as it causes intrauterine growth retardation (IUGR) (6, 7). There has also been research revealing that the babies of nonsmoking mothers that are exposed to smoke suffer from the same problems of the babies of smoking mothers. For the purpose of the present study, we recorded pregnancy history and smoking status of all pregnant women that presented to and gave birth in our clinic. With detailed medical examination of the newborn, we tried to find out the effects of smoking on pregnancy and the newborn. According to the World Health Organization data, about 20% of women in developed countries and about 9% of women in developing countries are smokers (8). The majority of these women continue smoking when they become pregnant. This is a major public health problem in that smoking is harmful to women's health, and may also cause pregnancy complications and serious health problems for the newborn. It has been reported that quitting smoking at any stage of pregnancy has positive impacts on the pregnancy process (9).

Materials and Methods

The participants of our study are 295 pregnant women that gave birth in our hospital between the 38th and 42nd week of their pregnancy. In the group of participants, 142 women smoked during their pregnancy and 153 women were selected from among nonsmokers as the control group. The pregnant women were grouped as follows by their smoking status:

I. Group: Women that never smoked during pregnancy

II. Group: By the number of cigarettes they smoke in a day

a). Those smoking ≤5 cigarettes per day

b). Those smoking>5 cigarettes per day

III. Group: By the length of smoking (in years)

a). Those smoking for ≤4 years

b). Those smoking for >4 years

On research forms, we recorded all participants' age, height, weight, gravidity, parity, stories of miscarriage, preterm labor and pregnancy, smoking status, week of pregnancy determined according to ultrasonography (USG) results and last menstrual period (LMP), and premature membrane rupture (PMR);whether any labor induction method and episiotomy were performed; and the sex, height and weight of the infant, and 1st and 5th minute Apgar scores.The criteria specified for exclusion from this study were delivery by caesarean section, preeclampsia, deep anemia, diabetes, SLE or any cardiac disorder in mother, and any abnormality of the infant.

Right after the birth, all the newborn were examined in a detailed way, and their weight, height, sex and Apgar scores in the 1st and 5th minutes were recorded. The week of pregnancy was determined. The infants born before the 37th gestational week were defined as preterm, born between the 37th and 42nd gestational week were defined as term, and born in or after the 42nd gestational week were defined as post term. In this study, SPSS for Windows 11.5 was used for data analysis. Shapiro Wilk test was used to check whether continuous variables showed normal distribution. For the purpose of descriptive statistics, mean ± standard deviation or median (minimum – maximum) were used for continuous variables, and number of observations and (%) were provided for nominal

variables. In order to find out whether there was statistically significant difference between independent groups of normally distributed continuous variables, student's t test was used in the case that there were two independent groups and one-way ANOVA was used in the case that there were more than two independent groups. In order to find out whether there was statistically significant difference between independent groups of continuous variables that were not distributed normally, Mann-Whitney U test was used when there were two independent groups and Kruskal Wallis test was used when there were more than two independent groups. In the case that ANOVA or Kruskal Wallis test results were found significant, post hoc Tukey and non-parametric multiple comparison tests were employed respectively to determine the group or groups causing the significant difference. Nominal variables wereevaluated by Pearson's Chi-square test and Fisher's exact probability test. The $p<0.05$ results were accepted statistically significant.

Results

For the purpose of this study, we evaluated prospectively 295 women that had normal spontaneous delivery in our clinic and their newborn infants. The distribution of our participants by smoking status is provided in below figures.

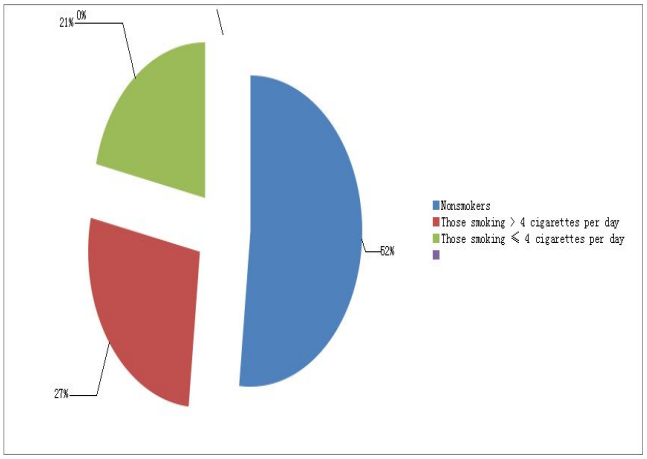

Figure 1. Distribution by length of smoking

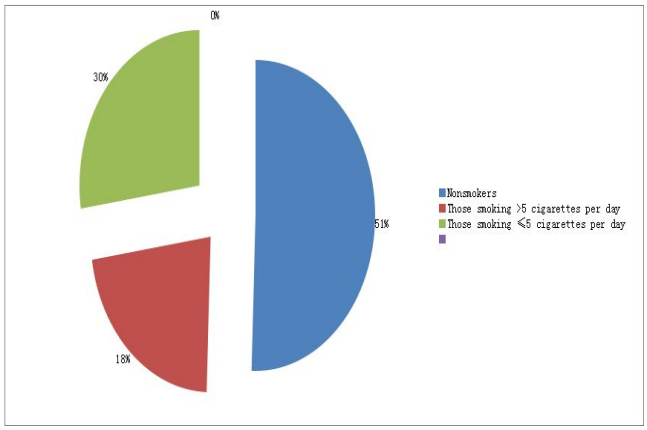

Figure 2. Distribution by number of cigarettes per day

Mothers that smoked during their pregnancy were compared with mothers that never smoked during pregnancy in terms of age, height, weight, number of past miscarriages and preterm histories. There was no significant difference between smoking and nonsmoking women with regard to height, weight, number of past miscarriages and preterm histories.

The average age of smoking participants was 27.1±5.5, and that of nonsmokers was 24.9±4.9. The average age of smoking participants was higher compared to that of nonsmokers. The difference in age average between the two groups is statistically significant ($p<0.001$). Furthermore, the average age of the participants smoking >5 cigarettes per day was higher compared to the participants smoking ≤5 cigarettes per day and nonsmoking participants (the average age was respectively 29.4±5.3, 25.7±5.1, 24.9±4.9). The difference is statistically significant ($p<0.05$, $p<0.05$). Given the length of smoking, the study results revealed that the average age of the participants smoking for >4 years was higher than that of the participants smoking for ≤4 years and the nonsmoking participants (the average age was respectively 29.3±4.7, 24.2±5.1, 24.9±4.9). This difference is found significant in statistical terms ($p<0.001$). In sum, the number of cigarettes smoked per day and the length of smoking are directly proportional to the age of pregnancy. Given the body weight of pregnant women, we found that the weight of women smoking >5 cigarettes per day was higher compared to the women smoking ≤5 cigarettes per day and the

nonsmoking women (the average body weight was respectively 73.2±9.4kg, 69.9±7.9kg, 69.9±4.0kg). The difference is statistically significant (p<0.05, p<0.05).

Table 1. Demographic data of the groups.

Variables	Non-smokers (n=153)	Smokers (n=142)	p
Age	24.9±4.9	27.1±5.5	**<0.001**[a]
LMP	39.5 (29.3-42.4)	39.3 (31.2-41.5)	**0.021**[b]
USG	38.3 (29.0-41.2)	38.0 (30.0-40.4)	**<0.001**[b]
Induction	65 (%42.5)	28 (%19.7)	**<0.001**[c]
Episiotomy	96 (%62.7)	72 (%50.7)	**0.037**[c]

[a] Student's t test. [b] Mann Whitney U test.
[c] Pearson's Chi-square test.

We also considered the distribution of the week of pregnancy, determined according to LMP and USG, by smoking status of the participants. Accordingly, the average pregnancy week of smokers was respectively 39.3 (31.2-41.5) weeks – 38.0 (30.0-40.4) weeks, and that of non-smokers was respectively 39.5 (29.3-42.4) weeks – 38.3 (29.0-41.2) weeks. Thus, the week of pregnancy, determined according to LMP and USG, was lower in smoking women. The difference was found statistically significant (respectively p= 0.021, p<0.001).

The groups were also compared with regard to labor induction. Labor induction was performed on 65 (42.5%) of 153 nonsmoking women. On the other side, only 28 (19.7%) of 142 smoking women had induced labor. Therefore, the rate of smokers that required labor induction was lower. This difference is statistically significant (p<0.001). Episiotomy was performed during labor on 96 (62.7%) of 153 non-smoking women and 72 (50.7%) of 142 smoking women. Thus, the rate of nonsmoking pregnant women that had episiotomy during labor was higher than that of smoking women. This difference is statistically significant (p=0.037).

The smoking participants were regrouped according to the number of cigarettes they smoked per day, and paired comparisons were performed with respect to the week of pregnancy determined by LMP and USG, PMR, labor induction and episiotomy. Comparing the groups by the week of pregnancy determined according to LMP and USG, we found that the pregnancy week of women smoking >5 cigarettes per day was lower compared to that of womensmoking ≤5 cigarettes per day. The difference is statistically significant (respectively p= 0.042, p<0.001). Comparing the groups by whether labor induction was performed, we found that the application of labor induction was less frequent in women smoking >5 cigarettes per day than in nonsmokers. The difference is statistically significant (p<0.05). Furthermore, there is a statistically significant difference in terms of labor induction between the women smoking ≤5 cigarettes per day and the nonsmoking women (p<0.05). The results showed that the use of labor induction was less frequent in women smoking ≤5 cigarettes per day than in nonsmokers. The groups were also compared in terms of the application of episiotomy during labor. Accordingly, the rate of episiotomy was lower among women smoking >5 cigarettes per day compared to the women smoking ≤5 cigarettes per day and the nonsmoking women. The differences are statistically significant (respectively p<0.05, p<0.05). With regard to PMR, the paired comparisons between the groups have not revealed any statistically significant differences. The smoking participants were regrouped according to the length of smoking (in years), and paired comparisons were performed with respect to the week of pregnancy determined by LMP and USG, PMR, labor induction and episiotomy. Comparing the groups by the week of pregnancy determined according to LMP and USG, we found that the pregnancy week of the women smoking for >4 years was lower compared to that of the nonsmoking

women. The difference is statistically significant ($p<0.05$). Furthermore, given the week of pregnancy determined according to USG, the study showed that the pregnancy week of the women smoking for ≤4 years was lower compared to that of the nonsmoking women. The difference is statistically significant ($p<0.05$). Comparing the groups by whether labor induction was performed, we found that labor induction was used less frequently in women smoking for >4 years and ≤4 years than in nonsmoking women. The difference is statistically significant ($p<0.05$). The paired comparisons between the groups have not revealed any statistically significant differences with respect to PMR and use of episiotomy.

Table 2. Newborn demographic data according to the groups.

Variables	Non-smokers (n=153)	Smokers (n=142)	p
Weight	3280 (1390-4610)	3215 (1670-4220)	0.069[a]
Length	50 (38-54)	50 (40-54)	**0.022**[a]
Gender (F / M)	71 / 82	72 / 70	0.460[a]

[a] Mann Whitney-U test.

In this study, we also dealt with certain variablesrelated to the newborn babies of participants. We compared birth weight, birth length, sex and 1st and 5th minute Apgar scores of the newborn babies of smoking and nonsmoking mothers. Between the groups, there is no statistically significant difference with regard to baby birth weight, sex and 1st and 5th minute Apgar scores. However, the babies of smoking womenwere tallercompared the babies of nonsmoking mothers, and the difference is statistically significant ($p= 0.022$).

The above variables were reconsidered in view of the number of cigarettes the mothers smoked per day and the length of smoking. Paired comparisons were conducted between the groups with respect to baby weight, baby length, baby sex and 1st and 5th minute Apgar scores. The differences regarding the number of cigarettes were not significant. Yet, given the length of smoking, while the differences regarding other variables were not significant, the length of babies of mothers smoking for >4 years was longer than that of nonsmoking mothers' babies. The difference is statistically significant ($p< 0.05$).

Discussion

The age, height and weight of the pregnant women were taken into consideration in this study. Cesur et al. found in their study that the average age of smoking mothers was higher than that of non-smoking mothers, and that the difference was statistically significant (10).In our study, the participants were grouped by the number of cigarettes they smoked per day, and the difference between the two groups was statistically significant with regard to average age and body weight ($p<0.001$, $p=0.023$), and the average height in the two groups was close to each other ($p=0.711$). Comparisons within the groups showed that the average age of women smoking more than 5 cigarettes per day was significantly higher than that of women smoking 5 or fewer cigarettes per day and nonsmoking women($p<0.001$ and $p<0.001$). Given the length of smoking, the results showed that the difference between the two groups is statistically significant with regard to average age ($p<0.001$), but the average height and weight in two groups are close to each other ($p=0.205$ and $p=0.433$).

We further examined in our study whether smoking had effects on the week of pregnancy calculated according to LMP and USG and whether any possible effect was statistically significant. The differencesare statistically significantamong the groups divided by the number of cigarettes smoked per day and among the groups divided by the length of smoking. A study revealed that smoking during pregnancy upregulated the expression of oxytocin-receptor mRNA, and thus the myometrium increased its

contractile sensitivity and activity in response to oxytocin (22). This result may mean that labor induction should be performed less frequently on smoking pregnant women. In our study, the pregnant women were followed during labor in order to make a statistical analysis of whether there is a link between smoking and the frequency of performing labor induction and episiotomy. Given the number of cigarettes smoked per day, there is a statistically significant difference between the groups, with regard to the distribution of induction ($p<0.001$), and also with regard to the distribution of episiotomy ($p=0.006$). Given the length of smoking, the same data did not provide a statistically significant difference between the groups, with regard to episiotomy ($p=0.106$). There is nevertheless a significant difference between the groups in labor induction ($p<0.001$). As a result, the negative effects of smoking on fetal growth may result from vasoconstrictor effect of nicotine and carbon monoxide and hence fetal hypoxia; orfrom inadequate release of certain hormones that play a role in fetal growth and development due to the restriction of enough food transport to fetus because of placental pathologies contingent on smoking or adverse impacts of smoking on cyto and syncytiotropho blasts.

There have been plenty of studies showing that smoking augments complications of pregnancy. Among these complicationsthat may result from smoking during pregnancy are increased abortion risk, growth restriction, PMR, preterm labor, stillbirth (11, 12, 13, 14, 15, 16). As our study does not include early pregnancy and focuses only on live and normal spontaneous deliveries, we do not provide herein the rates of abortus risk, placenta praevia, placental detachment and stillbirth. Various researchers have argued that smoking during pregnancy increased PMR risk (4, 13, 17, 18). Yet, our study has not provided any correlation between smoking and PMR in consideration of both the number of cigarettes smoked per day and the length of smoking. This may be because the number of cases involved in our study was limited. More enlightening results may be obtained with studies that comprise greater number of participants. There have been studies revealing that smoking increases incidence of preterm birth (4, 13, 19, 20, 16). Particularly smoking in the third trimester is significantly associated with premature birth. Nukui et al. found that especially women that lack genes that ensure the metabolization of mutagens and carcinogens linked with smoking were under higher risk of giving premature birth (21).Egawa et al. reported that smoking increased the number of oxytocin receptors in myometrium and thus increased contractile response of myometrium to oxytocin, leading to a higher risk of premature birth (22). Bilir et al. published an article in 2005, reporting that %7 of the smoking pregnant women gave birth to their babies before the 37^{th} week of pregnancy, and that increase in the number of cigarettes smoked per day multiplied this risk (23). As our study covered women in the 38^{th} and 42^{nd} week of pregnancy, we cannot provide statistics on any difference between smoking and nonsmoking women with regard to the incidence of preterm birth. However, taking into consideration the preterm stories of our participants, we found no significant difference with respect to both the number of cigarettes smoked per day and the length of smoking. This may be because the number of women with preterm birth history was low in the study. Studies with a greater number of participants may provide different results.

Intrauterine growth development (IUGD) has been a complication that is frequently associated with smoking during pregnancy (24, 25). Although IUGD and low birth weight (LBW) refer to different situations, they are very close terms and are used interchangeably in some cases. As the participants were involved in this study when they came for delivery and were not diagnosed with IUGD on examinations, we cannot provide data on IUGD but on LBW herein. The study did not show any statistically significant difference between LBW of the newborn and smoking during pregnancy given the number of cigarettes smoked per day and the length of smoking. Wang et al. found that smoking during pregnancy is associated with an average decrement of 377 grams in birth weight (26). Haddow et al. reported a decrement of 441 grams (27). In our study, although not statistically significant, the weight of the

newborn babies of smoking mothers was 103 grams lower in average compared to the babies of nonsmoking mothers. Comparing the groups, we found that the weight of the newborn babies of mothers smoking 5 or fewer cigarettes per day was 24 grams lower compared to the babies of nonsmoking mothers. Furthermore, the weight of the newborn babies of mothers smoking more than 5 cigarettes per day was 125 grams lower compared to the babies of mothers smoking 5 or fewer cigarettes per day.Given the number of cigarettes smoked per day, there was no statistically significant difference between the length of newborn babies of smoking and non-smoking mothers. However, when the mothers were grouped by the length of smoking in years, the difference between the babies of smoking and non-smoking mothers was significant with regard to birth length (p=0.029).

Although various studies have reported negative correlation between smoking and Apgar scores (28, 29), there have been studies showing that smoking does not affect Apgar scores (30). Our study did not reveal any significant difference in the 1st and 5th minute Apgar scores of the newborn between smoking and nonsmoking mothers. Under the light of numerous studies, some of which are cited above, it is unquestionable that smoking has negative impacts on fetal growth and development. In addition to its effect on the complications of pregnancy smoking considerably increases the rate of neonatal mortality and morbidity due to LBW, IUGT and preterm delivery, and the relevant costs. Maternal smoking has been associated with not only problems of the newborn but also many other problems that may emerge in further stages of life. There is obviously need to take some measures, and the common implementation of these measures in the society should be a public health policy.

References

1. www.gata.edu.tr /dahili bilimler/onkoloji/ sigara_kanser.htm.
2. King A: Unexplained fetal growth retardation: What is the cause? Arch Dis Child 70: 225, 1994
3. Ott WJ: Intrauterine growth retardation and preterm delivery. Am J Obstet Gynecol, 168:1710, 1993
4. Andres RL, Day MC: Perinatal complications associated with maternal tobacco use. Semin Neonatol. 5(3):231-41; 2000
5. Di Franza JR, Lew RA: Effect of maternal cigarette smoking on pregnancy complications and sudden infant death syndrome. J FamPract. 40(4):385-94; 1995
6. England LJ, Kendrick JS, Wilson HG, et al.: Effects of smoking reduction during pregnancy on the birth weight of term infants. Am J Epidemiol. 15;154 (8):694-701; 2001
7. Wang X, Tager IB, Van Vunakis H, et al.: Maternal smoking during pregnancy, urine cotinine concentrations, and birth outcomes. A prospective cohort study. Int J Epidemiol. 26(5):978-88; 1997
8. U.S. Department of Health and Human Services. The Health Consequences of Smoking: A Report of the Surgeon General-2004. Centers for Disease Control and Prevention, Office on Smoking and Health, Atlanta Georgia, May 2004.
9. Ashmead GG. Smoking and pregnancy. J Matern Fetal Neonatal Med. 14(5): 297-304;2003
10. Christianson RE: Gross differences observed in the placentas of smokers and nonsmokers. Am J Epidemiol. 110(2):178-87;1979
11. Ananth CV, Savitz DA, Luther ER: Maternal cigarette smoking as a risk factor for placental abruption, placenta previa, and uterine bleeding in pregnancy. Am J Epidemiol. 1;144(9):881-9; 1996
12. Armstrong BG, McDonald AD, Sloan M: Cigarette, alcohol, and coffee consumption and spontaneous abortion. Am J PublicHealth. 82(1):85-7; 1992
13. Centers for Disease Control and Prevention (CDC). Smoking during pregnancy--United States, 1990-2002. MMWR Morb Mortal Wkly Rep. 8;53 (39):911-5; 2004

14. Haustein KO: Cigarette smoking, nicotine and pregnancy. Int J Clin Pharmacol Ther ;37(9):417-27; 1999
15. Olsen J: Cigarette smoking in pregnancy and fetal growth. Does the type of tobacco play a role? Int J Epidemiol. 21(2):279-84; 1992
16. Wollmann HA: Intrauterine growth restriction: definition and etiology. Horm Res.; 49 Suppl 2: 1-6; 1998
17. Milnerowicz H, Zalewski J, Milnerowicz-Nabzdyk E, et al.:Effects of exposure totobacco smoke in pregnancies complicted by oligohydramnios and premature rupture of the membranes. II. Activity of brush border enzymes in human amniotic fluid. Int J Occup Med Environ Health. 14(3):275-85; 2001
18. Shubent PJ, Diss E, Iams L: Etiology of preterm premature rupture of the membrans. Obstet Gynecol Clin North Am.;19:251; 1992
19. Narahara H, Johnston JM: Smoking and preterm labor: effect of a cigarette smoke extract on the secretion of platelet-activating factor-acetylhydrolase by human decidual macrophages. Am J Obstet Gynecol. 169(5):1321-6; 1993
20. Windham GC, Hopkins B, Fenster L, Swan SH: Prenatal active or passive tobacco smoke exposure and the risk of preterm delivery or low birth weight. Epidemiology. 11(4):427-33;2000
21. Nukui T, Day RD, Sims CS, et al. Maternal / newborn GSTT 1 null genotype contributes to risk of preterm, low birth weight infants. Pharmacogenetics. 14 (9):569-76; 2004
22. Egawa M, Yasuda K, Nakajima T, et al.:Smoking enhances oxytocin-induced rhythmic myometrial contraction. Biol Reprod. 68(6):2274-80; 2003
23. Bilir N, Smoking and Reproductive Health, Proceedings of the 4th International Reproductive Health and Family Planning Congress, Congress book 20 – 23 Aprıl 2005, Bilkent Hotel and Congress Center, Ankara ss: 160 - 162
24. Albuquerque CA, Smith KR, Johnson C, et al.:Influence of maternal tobacco smoking during pregnancy on uterine, umbilical and fetal cerebral artery blood flows. Early Hum Dev. 80(1):31-42; 2004
25. Mochizuki M, Maruo T, Masuko K: Mechanism of foetal growth retardation caused by smoking during pregnancy. Acta Physiol Hung. 65(3):295-304; 1985
26. Wang X, Zuckerman B, Pearson C, et al.:Maternal cigarette smoking, metabolic gene polymorphism, and infant birth weight. JAMA. 9;287(2):195- 202; 2002
27. Haddow JE, Knight GJ, Palomaki GE, et al.:Cigarette consumption and serum cotinine in relation to birth weight. Br J Obstet Gynaecol. 94(7):678-81; 1987
28. Gomez C, Berlin I, Marquis P, Delcroix M: Expired air carbonmonoxide concentration in mothers and theirs pouses above 5 ppm is associated with decreased fetal growth. Preventive Medicine 40, 10-15; 2004
29. Iwanowicz- Palus GJ, Walentyn E, Wiktor H: Relationship between maternal cigarettes smoking and newborn birth weight and physical condition. Wiad Lek. 55 Suppl1:152-6; 2002
30. Tanaç MG, Velibeşe S, Yangın R. The Effect of Smoking on Pregnancy and the Newborn, Dirim; 64(3-4):82-85; 1989