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Knowledge of Passive Smoking among Pregnant Women and Histological Changes in their Placenta in Al-Dawadmi, Saudi Arabia

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ABSTRACT

Objectives: *This study aimed to throw some light on knowledge, attitude and the histological changes in human placenta exposed to passive smoking.* ***Methods:*** *Hospital-based studies were conducted to assess the knowledge and attitude of passive smoking in pregnant women and non-smoker controls (n=50) were selected. A structured questionnaire was used for data collection. Differences between the 2 groups were determined by the Chi-square test and the significance level was set at $p<0.05$. Total 50 placentas were collected immediately from interviewed pregnant women after delivery (38-40 weeks of gestation) from the Department of Obstetrics and Gynecology. According to the result yielded from the questionnaire 20 out of 50 placentas, showed no history of exposure to tobacco smoke, or consumption of tobacco in any form, and were labeled as controls. About 30 placentas were collected from passive smokers mostly exposed to smoke. The pregnant mother exposed to tobacco used by a chain-smoking husband or very close relative in a nuclear family was designated as a passive smoker.* ***Results:*** *The study indicated that there are significant statistical differences found among the pregnant women's on their knowledge, attitude in term of pregnancy outcome and adverse effect on labor. The placenta exposed to passive smoking showed an increase in the connective tissue stroma in chorionic villi (intravillous fibroid) and some of them lost their trophoblastic covering. Also, the lumen of blood capillaries appeared obliterated and irregular.* ***Conclusion:*** *Our findings suggested that quantitative parameters of the placenta significantly showed changes in placenta from the passive smoker group compared to the controls. These changes can probably be associated with pregnancy complications in smoking mothers and may affect the development and survival of the fetus and even it's future.*

Keywords: Knowledge, Attitude, Passive smoking, Placenta, Histology

INTRODUCTION

The placenta is an organ that connects the developing fetus to the wall of the uterus to allow nutrient uptake, provide thermo-regulation to the fetus, waste elimination, and gas exchange through the blood supply of the mother's to protect the fetus from internal infection and produce hormones to support pregnancy. It provides oxygen and nutrients to growing babies and removes waste products from the blood of the babies [1].

Smoking is a leading cause of preventable morbidity and mortality worldwide. The harmful consequences of smoking on health have been well documented. Data from recent studies have confirmed the quantitative relationship between smoking and many diseases such as coronary artery disease, lung cancer, bladder cancer, oral cancer, pulmonary emphysema and chronic bronchiolitis [2,3]. Smoking is very harmful to pregnant women and to their babies whether as an active or as a second-hand (passive) smoking, leading to stillbirth, low birth weight, congenital anomalies and contribute significantly to respiratory tract infections in infants [4].

The World Health Organization (WHO) has estimated that 5 million deaths occur annually due to tobacco use. This number of deaths is expected to reach more than 8 million by the year 2030, with most of the tobacco-related morbidity and mortality occurring disproportionately in low and middle-income countries [5].

In Saudi Arabia, the prevalence of smoking has been reported to be as high as 52.3%, among school and university students. It has reached an alarming rate of 30% and 50%, respectively [6-9]. Furthermore, tobacco consumption rates in Saudi Arabia have risen from 21.9% of males and 0.6% of females in 1996 to 37% of males and 6% of males in 2012 [10]. Healthcare professionals (HCPs) are in an ideal position to advise and educate patients about the dangers of smoking. Moreover, they act as visible role models and may unintentionally affect the smoking behavior of others [11]. The WHO Framework Convention on Tobacco Control emphasizes on the role of professional healthcare providers and organizations in reducing tobacco consumption [12]. The WHO encourages HCPs, including physicians, dentists, nurses, and pharmacists, to take a leadership role in reducing the use of tobacco [13].

The term "passive smoking" usually refers to the inhalation of smoke that is either exhaled by a smoker or released as side stream smoke from a burning cigarette. Another name for passive smoking is "involuntary smoking" because the person who inhales it often has no choice in the matter. The World Health Organization has defined passively inhaled smoke like the smoke that individuals breathe when they are located in the same airspace as smokers [14].

According to the US Surgeon General 2006 report, people are exposed to passive smoke at home, in the workplace, and in other public places such as bars, restaurants, and recreation venues. It is harmful and hazardous to the health of the general public and particularly dangerous to children. It is also a known human carcinogen; cancer-causing agent [15]. Passive smoking, which is breathing other people's smoke, is also considered equally injurious to health as it contains approximately the same toxic substances and free radicals that are present in mainstream tobacco smoke [16]. Tobacco smoke contains over 4000 chemicals including carbon monoxide, nicotine, tar, ammonia, arsenic, cyanide, and lead [17]. Smoking during pregnancy causes severe metabolic, biochemical changes and adaptive response in fetuses leading to increased incidence of maternal and fetal complications [18]. Some of the complications are preterm labor, premature ruptures of membranes, extrauterine gravidity (GEU), placental complications, spontaneous abortions, intrauterine fetal death, also sudden newborn death syndrome, low neonatal birth weight, intrauterine fetal growth retardation, the "fetal tobacco syndrome" and long-term chronicle complications [6].

Therefore, the present study was designed to investigate the knowledge, attitude, and histological changes in human placenta exposed to passive smoking.

MATERIALS AND METHODS

Total 50 pregnant women (38-40 weeks of gestation) attended the Department of Obstetrics and Gynecology (Al-Dawadmi General Hospital), they were interviewed using the designed questionnaire and their placenta was collected immediately after delivery. Out of these 50 placentas, 20 were collected from healthy pregnant women's with no history of exposure to tobacco smoke, or consumption of tobacco in any form after the interview, and was labeled as controls. About 30 placentas were collected from passive smokers mostly exposed to smoke.

Only mothers exposed to tobacco smoke within the house or office (assessed via questionnaire) were considered for the study. Normal mothers were defined, as those who haven't been exposed to tobacco smoke within the house or workplace.

Both the exposed and non-exposed mothers should not have had any history of illness such as diabetes mellitus, hypertension, and anemia and without complications before and after labor. The pregnant mother exposed to tobacco used by the chain-smoking husband or very close relative in a nuclear family was designated as a passive smoker. The study was conducted in two part: the first part include the knowledge and attitude on passive smoking and their effect on the placental structure on the targeted respondents which was based on data collected through a structured questionnaire. The second part of the study includes the study of histological changes on the placenta.

Part 1

A structured questionnaire was used for data collection. Factors associated with the level of understanding of the possible effects of passive smoking exposure were analyzed. The questionnaire was designed in English, translated into Arabic and back into English again.

A questionnaire was given to the mothers before labor to assess their knowledge about the harmful effects of passive smoking on the pregnant woman and her unborn child. Passive smoking is defined as the exposure that occurred when a pregnant woman did not smoke at all during the index pregnancy but lived with family members (husband, son, daughter, or other relatives) who were reported to have smoked during her pregnancy.

Women who could not read or write were interviewed by one of the authors using the same questionnaire. The first part of the questionnaire was designed to collect data on the demographic variables of the women including nationality (Saudi, non-Saudi), age, educational level, occupational, number of parity, abortion, gestational age, duration of exposure to passive smoking per day and histological changes in the placenta and degree of fibrosis. The second part reveals the information regarding the knowledge of the effects of passive smoking on a woman's health, on pregnancy and on the placenta. The question was "What do you know about passive smoking?", "Are you feeling there's any harm to your health when people smoke?", "Exposure to passive smoking affects the unborn baby's health and causes miscarriage?", "Exposure to passive smoking results in early delivery before the due date or leads to the delivery of a small baby?", "Exposure to passive smoking causes birth defects.

Regarding the part of the behavior and attitude towards passive smoking the questions including "During your pregnancy, about how many hours a day, on average, were you in the same room with another person who was smoking?", "Do you have any smoking rules at your house?", "Are there any changes in smoking rules during your pregnancy?". The average time for the completion of the questionnaire was 15-20 min. The questionnaire was piloted on 10 women from the same target population (subsequently excluded from the analysis).

Part 2

Immediately after the expulsion of the placenta, the umbilical cord was cut 5 cm away from the site of the insertion, and membranes were trimmed. The clots were removed from the maternal surface and it was gently blotted dry with filter paper. Small pieces from the maternal surface of the placental disc, 1 cm thick sections, were taken and fixed in neutral buffered formalin for 24 hours. Routine processing was carried out for the preparation of paraffin blocks. Five micron thick sections were cut and stained with Hematoxylin and Eosin. Maternal and neonatal data such as the mother's body weight on admission, height, gestational age, parity, diseases, birth weight and length of the newborn were obtained from the hospital and antenatal records.

Data Analysis

The data obtained were computerized and tabulated. SPSS version 18 was employed for data analysis. Chi-square was used to present the findings and to compare the different groups in relation to pregnancy and postpartum, $p<0.05$ was considered statistically significant.

Questionnaires and Consent

A form was given to mothers before labor. Questions included basic info like smoking habits of mother and different household or office members, occupation and medicine. Written consent was obtained from every eligible pregnant woman who was willing to permit her placenta for analysis purposes.

Approval was obtained from the Faculty of Applied Medical Sciences, Al-Dawadmi, Shaqra University (KSA). Ethical consent was obtained before the study was conducted.

RESULTS

Part 1

A total of 50 pregnant women were enrolled in this study after the interview. About 30 were found exposed to passive smoking and 20 were not, their demographic characteristics are shown in Table 1. It shows that pregnant women ages ranged from 20-40 years. Around 30 out of 50 participants were passive smokers (n=30), 50% of their age ranged between 25-40 years. The same table indicated that the percentage of the housewife's among passive smokers group

is a bit higher (50%) than the other occupation categories in the same group. As shown in Table 1 there are highly significant differences (p=0.000) regarding the time of the exposure to passive smoking between the 2 groups, more than 80% of passive smokers have exposed to smoking 1-5 hours daily. The parity numbers have increased in the non-smoker group about 75% of them have more than 2 parity, more than 66% of the passive smoker has only 1-2 parity compared to a non-smoker. Table 1 also indicated that 90% of passive smokers mothers experienced abortion which showed a significant difference (p=0.016) from the non-smoker (60%). A considerable number of passive smokers pregnant women (33%) have shown a decrease in their gestational age to less than 37-weeks comparable to an increased gestational period (between 37-40 weeks) among non-smokers.

Table 1 The demographic and characteristics of the pregnant women exposed and not exposed to passive smoking

Characteristics of respondents	Non-smoker 20 (40%)	Passive Smoking 30 (60%)	Total	p-value
Age (Years)				
>25	4 (20.0%)	9 (30.0%)	13 (26.0%)	0.457
25-40	11 (55.0%)	15 (50.0%)	26 (52.0%)	
>40	5 (25.0%)	6 (20.0%)	11 (22.0%)	
Education				
Secondary	13 (65.0%)	17 (57.0%)	30 (60.0%)	0.305
university	2 (10.0%)	8 (27.0%)	10 (20.0%)	
post graduate	5 (25.0%)	5 (16.0%)	10 (20.0%)	
Occupation				
Student	0 (0.0%)	5 (17.0%)	5 (10.0%)	0.004
Employee	0 (0.0%)	10 (33.0%)	10 (20.0%)	
Housewives	20 (100.0%)	15 (50.0%)	35 (70.0%)	
No of Parity				
1-2	5 (25.0%)	20 (66.0%)	25 (50.0%)	0.028
2-5	10 (50.0%)	5 (17.0%)	15 (30.0%)	
>5	5 (25.0%)	5 (17.0%)	10 (20.0%)	
Abortion				
Yes	12 (60.0%)	27 (90.0%)	39 (78.0%)	0.016
No	8 (40.0%)	3 (30.0%)	11 (22.0%)	
Stage of Pregnancy (Gestational Age)				
Less than 37 weeks	0 (0.0%)	10 (33.0%)	10 (20.0%)	0.004
37-40 weeks	20 (100.0%)	20 (67.0%)	40 (80.0%)	
Duration of Exposure to Passive Smoking Per Day				
0 hours	20 (100.0%)	0 (0.0%)	20 (100.0%)	0.000
1-2 hours	0 (0.0%)	15 (50.0%)	15 (50.0%)	
>3 hours	0 (0.0%)	15 (50.0%)	15 (50.0%)	
Histological Changes in the Placenta and Degree of Fibrosis				
Normal	20 (100.0%)	0 (0.0%)	20 (100.0%)	0.000
Mild	0 (0.0%)	10 (33.3%)	10 (33.3%)	
Moderate	0 (0.0%)	15 (50.0%)	15 (50.0.0%)	
Severe	0 (0.0%)	5 (16.6%)	15 (50.0%)	

A highly statistically significant difference was also found between smoking status and histological changes in the placental degree of fibrosis (p=0.000).

The pregnant women's knowledge and attitude about passive smoking are shown in Table 2. About 50% of participants have considerable knowledge regarding passive smoking. Majority of them (70%) feel it has there is a hard to their health when other people smoke (p=0.003). Out of 50 participants who responded to this question, 40 reported that they don't have problems with their pregnancy (80%, p=0.003). Most of the participants were well aware that smoking affects the fetus health and causes miscarriage. However, 70% don't have any smoking rules in their houses (p=0.000). A small number of those commenting that during pregnancy, they make changes in smoking rules in their houses (p=0.07).

Table 2 Knowledge and attitude on active/passive smoking

Knowledge and Attitude Questions	Yes	No	p-value
Do you know about passive smoking?	23 (46%)	27 (54%)	0.810
Do you feel there is any harm to your health when other people smoke?	35 (70%)	15 (30%)	0.030
Exposure to passive smoking affects the unborn baby's health and causes miscarriage?	45 (90%)	5 (10%)	0.057
Do you have any smoking rules at your house?	15 (30%)	35 (70%)	0.000
Are there any changes in smoking rules during your pregnancy?	20 (40%)	30 (60%)	0.070
Do you have any problems with your pregnancy?	10 (20%)	40 (80%)	0.003

Part 2

Using H and E stained sections revealed that the placenta of a normal woman not exposed to passive smoking was formed of chorionic villi separated from each other by maternal blood (Figure 1). The histological structure of chorionic villi consists of a central connective tissues core containing collagen fibers, connective tissues cells, and fetal blood capillaries and was covered by trophoblastic cell layers.

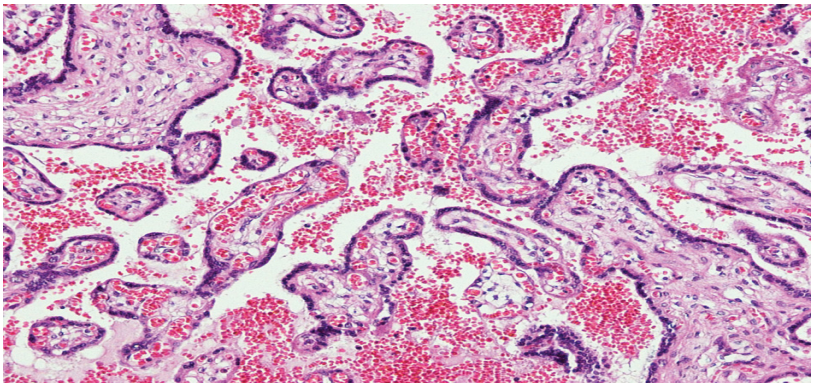

Figure 1 A magnified part of the previous section showing; the chorionic villi surrounded by trophoblast and containing fetal blood capillaries in connective tissue stroma (H and E stain X200)

The trophoblast was formed of inner cytotrophoblast and outer syncytiotrophoblast. The syncytiotrophoblast was continuous with each other. The nuclei were irregular in shape and darkly stained with condensed chromatin material inside it. At some places, they were scattered in the cytoplasm, and at other places, they were present in groups or protrude into the intervillous space forming syncytial knots (Figure 2).

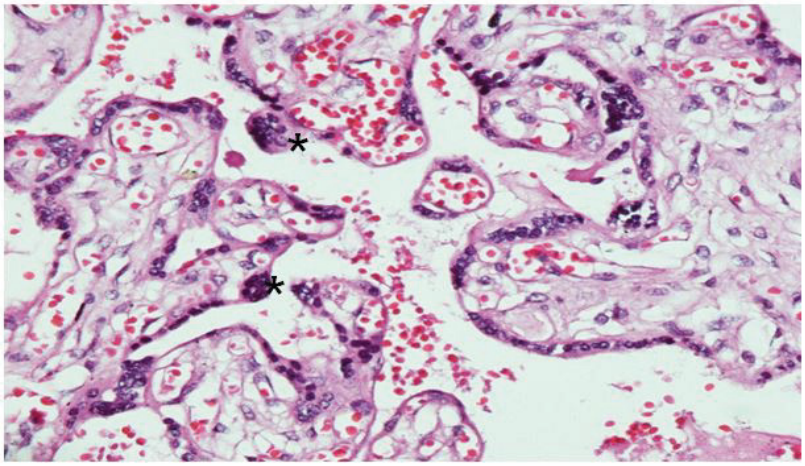

Figure 2 A photomicrograph of normal human placenta showing, chorionic villi, and maternal blood. In many areas, the nuclei of the syncytiotrophoblast layer formed clusters or knots on the surfaces of villi (star) (H and E stain X400)

The cytotrophoblast was present under syncytiotrophoblast. The blood capillaries were lined with flat endothelial cells and most of them appeared congested with blood (Figure 3).

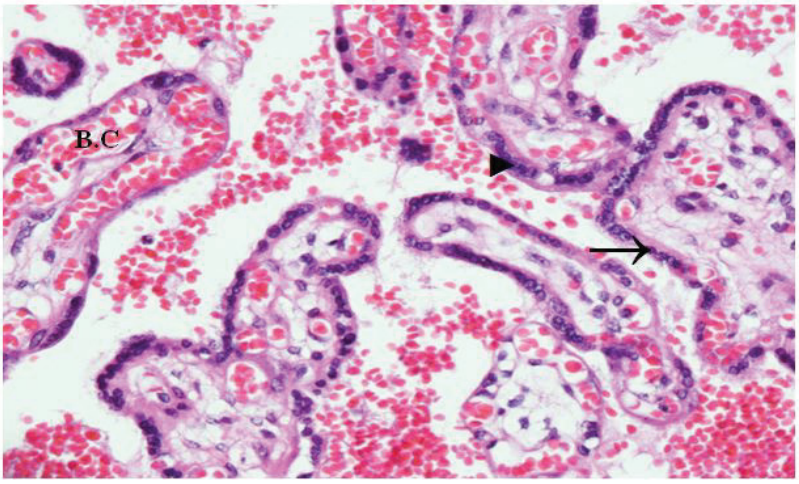

Figure 3 A magnified part of the previous section showing; the villus connective tissue surrounded by the trophoblast, including both the inner cytotrophoblast epithelium (arrow) and the outer syncytiotrophoblast (arrow head). The fetal blood capillaries (B.C) were lined with flat endothelial cells and most of them appeared congested with blood (H and E stain X400)

The placentas of woman's exposed to passive smoking exhibited marked histological changes. It has been noticed that the number of syncytial knots was more increased in passive smokers in comparison to the control. Also, the decrease in the amount of maternal blood was observed in most cases (Figure 4).

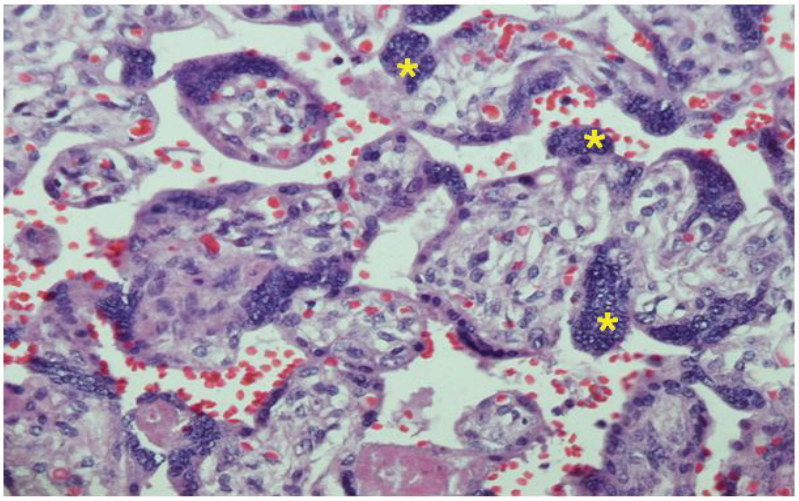

Figure 4 A photomicrograph of placenta of women exposed to passive smoking showing; increase in the number of knots (star) on the surface of chorionic villi (H and E stain X200)

Among the passive smokers' group, an increase in the connective tissue stroma in chorionic villi (intravillous fibroid) was observed, and some of them lost their trophoblast covering (Figure 5). The lumen of fetal blood capillaries appeared obliterated and irregular in some cases than normal.

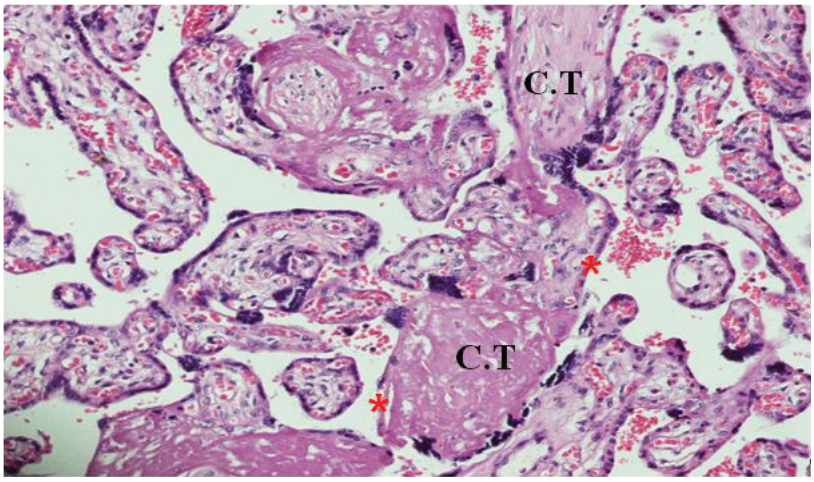

Figure 5 A photomicrograph of placenta of women exposed to passive smoking showing; increase in the number of connective tissue fibers (C.T.) inside the chorionic villi with sluphing off the covering trophoblast (star) were observed in some cases. (H and E stain X200)

Other cases showed an increase in the maternal blood and increase in the intervillous connective tissue with sluphing off the covering trophoblasts (Figure 6).

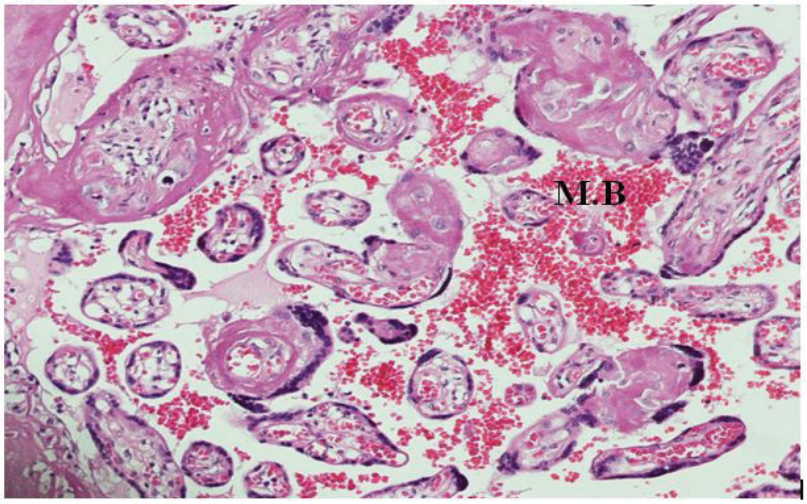

Figure 6 Some cases showed an increase in the maternal blood (M.B) and increase in the intervillous connective tissue with sluphing off the covering trophoblasts (H and E stain X100)

Other cases showed complete degenerative changes in the wall of some chorionic villi in the form of sluphing off trophoblast layer with an increase in the amount of intervillous connective tissue (Figure 7).

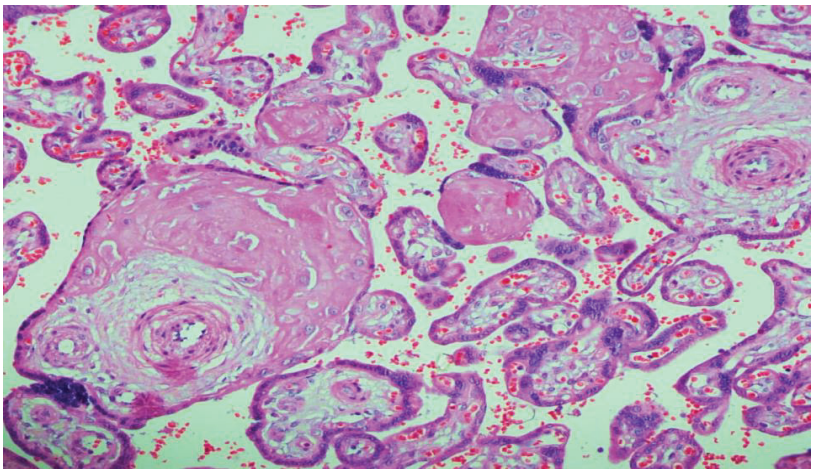

Figure 7 A photomicrograph in the placenta of smoking mothers showing; areas of fibroid necrosis, hyalinization, and calcification in chorionic villi and some of them lost their trophoblast covering (arrow) (H and E stain X200)

A significant number of syncytial knots, areas of fibroid necrosis, hyalinization and calcification were observed in smoking placentas (Figure 8).

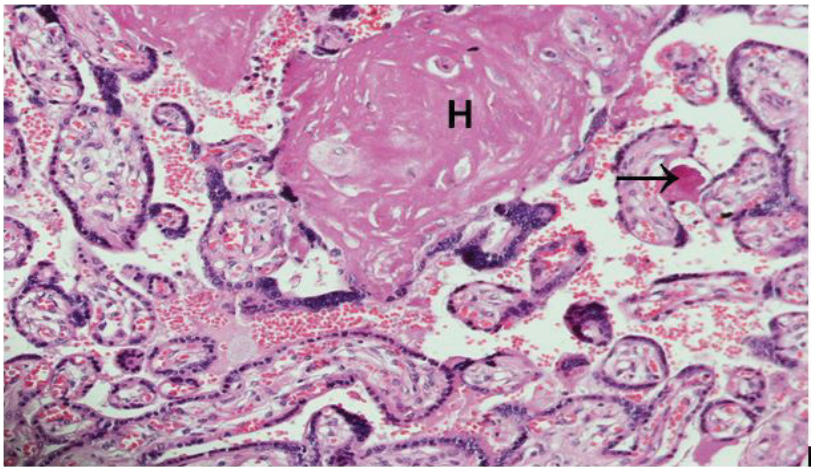

Figure 8 A photomicrograph of placenta of women exposed to passive smoking showing; connective tissue fibroid in chorionic villi, hyalinization (H)and calcification (arrow) some of the chorionic villi lost their trophoblast covering (H and E stain X200)

DISCUSSION

One of the main causes to bear passive smoke is a lack of knowledge as is shown by this study and their attitude and practice towards passive smoking. One in ten deaths of adults worldwide occurs due to smoking which comprises about 5 million deaths every year. It is predicted that in 2030, smoking will be responsible for one in six deaths which exceeds overall mortality from AIDS, drugs, road accidents and suicides combined [19,20]. Tobacco use is a major preventable disease. In many cardiovascular diseases, numerous cancers, respiratory diseases, and many other health disorders smoking represent the highest risk factor. Smoking is hazardous not only for active smokers but also for those who have to breathe involuntarily the environmental tobacco smoke (ETS).

All respondents in this study show limited awareness about the effect of passive smoking ($p=0.810$) in spite of they were well educated. These results match those observed in earlier studies [21,22]. In the present study, the interviewees had some information about the negative health impacts of active smoking, and its health consequences in general and particularly on pregnant woman and fetus. However, the majority of them don't have any rules in their houses to avoid exposure to passive smoking during pregnancy. Same findings were reported among pregnant women in North Western India, it has shown that most women believed that smoking was harmful to the developing

fetus and did not take any preventive steps to avoid exposure to environmental tobacco [21]. The outcomes of this little knowledge observed in this study and their further consequences on the pregnancy were reflected by the high significance differences (p=0.000) between passive smokers and control group on its effect on the histological structure of the placenta.

The placenta is the most important organ between mother and fetus during the prenatal period. It is likely that chronic exposure to passive smoking in early pregnancy can affect placental development directly or indirectly by reducing blood flow, which creates a pathologically hypoxic environment [23]. In the placenta, the chorionic villi are thought to control the fetal blood flow to the maternal/fetal exchange area located in the peripheral villi [24].

The placenta's primary role is to provide for physiological exchange between the fetal and maternal systems. In this context, the importance of the placental circulation to a successful pregnancy is exemplified by the close relationships among fetal weight, placental size, and uterine and umbilical blood flow during normal pregnancies in many mammalian species [25]. The exchange of materials between fetus and mother takes place at the fetomaternal barrier, which separates maternal blood in the inter-villous space from fetal circulation [24]. In the present study, we found that there were strong associations between smoking and histological changes in the placental degree of fibrosis (p=0.000).

The histological changes in the placental chorionic villi of passive smoking mothers were more obvious as compared to the non-smokers. Increase in the number of syncytial knots degenerated and necrotic syncytiotrophoblast. These changes are in accord with the results of Demir, et al., who noticed increased syncytial knots in the placenta of active smokers [18]. Also, the present results are in agreement with the results of Ahmed, et al., who showed a significant number of syncytial knots, areas of fibroid necrosis, hyalinization, calcification, and medial coat proliferation of medium-sized blood vessels in hypertensive placentas [26].

Degenerative and necrotic changes in the syncytiotrophoblast are in line with Vander Veen and Fox who observed that the necrosis and increased syncytial knots are the signs of degenerative changes due to ischemic conditions or hypoxia [27].

The placenta serves as an important conduit of nutrients and some toxic metabolites like nicotine and carbon monoxide from the mother to the developing fetus. Nicotine is a powerful vasoconstrictor [28]. Passive exposure to tobacco smoke causes uterine vasoconstriction, which in turn results in underperfusion of the placenta. Under perfusion of the placenta results in placental hypoxia, which in turn may be responsible for the majority of the changes observed [25].

Fibrosis of the connective tissue in the chorionic villi observed in the present study is similar to the results of Soad and Nadia, they found stromal villus fibrosis in the placenta of the diabetic women [24].

The results of the present study show an increase in the relative thickness of the connective tissue stroma in the smoke-exposed group which may be due to an increase in the connective tissue proliferation as a result of decreased oxygen availability supply to the placenta even beyond the first trimester. This view is further supported by studies which show hyperplasia of the cytotrophoblast cells upon exposure to tobacco smoke in the human placenta [17].

Results of the present studies, in the context of work from other laboratories, suggest that maternal cigarette smoking, by mechanisms that include nicotine exposure, inhibits cytotrophoblast proliferation, which could also be related to their subsequent inability to differentiate along the invasive pathway. The cumulative effects of maternal smoking on the early gestation placenta may have several untoward consequences that are likely related to a variety of factors, including the stage of pregnancy, the magnitude of the insult, and the extent to which compensatory mechanisms can ameliorate the damage. Heavy smoking (e.g., 20 cigarettes per day) before 10 weeks of gestation had the greatest effects on morphology, suggesting that this is particularly a sensitive period. If the damage outstrips potential repair mechanisms, then the possible outcomes may include abortion. This hypothesis is consistent with numerous reports that show maternal smoking substantially increases the risk of spontaneous abortion [29].

The present results are in accord with the results of Salmani, et al., who found structural changes such as a significant number of syncytial knots, areas of fibroid necrosis, areas of medial coat proliferation of medium-sized blood vessels, areas of calcification, and areas of hyalinization in hypertensive placentas [30].

A significant increase in syncytial knot formation in placental villi indicates a disturbance in the hormonal factors,

which may lead to altered morphometry of placenta resulting in pregnancy-induced hypertension in the mother and to low birth weight in the newborn.

CONCLUSION

The study showed that pregnant women breathe passive smoke at their households and do not act to avoid or minimize it. The determinants of this problem do not work separately; they are interrelated with each other, as well as with social and cultural issues.

This study supports the view that there is a strong relationship between placenta and passive smoking. Distinct histological changes were seen in placentas of passive smoking pregnant women. Pregnant women should stay away from smoking places whenever possible to maintain the health of the fetus. The main factor is a lack of information which results in poor knowledge and which in turn forms tolerant behavior towards passive smoking.

DECLARATIONS

Conflict of Interest

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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