RESEARCH ARTICLE

Pre and postnatal effect of maternal environmental tobacco smoke exposure on infant's growth parameters

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Abstract

Objective: To determine the association between environmental tobacco smoke exposure and growth parameters of infants.

Method: The observational, comparative study was done in rural areas of the Al-Karkh sector of Baghdad, Iraq, from December 2021 to March 2022 after approval from the ethics review committee of the College of Dentistry, University of Baghdad, and comprised mothers aged 20-35 years having infants aged up to one year. Those exposed to environmental tobacco smoke were in group A, while non-exposed mothers were in group B. Along with socio-demographic data, a second-hand smoke exposure scale was used. Weight-for-height, height-for-age and weight-for-age indices, as well as head circumference values, were used to measure growth parameters. Data was analysed using SPSS 22.

Result: Of the 150 mothers, 67(44.7%) were in group A with mean age 27.8±4.7 years and 83(55.3%) were in group B with mean age 26,1±4.6 years. The mean age of the children was 9.4±3.1 years in group A and 9.2±2.3 years in group B. Husband was the primary source of smoking at home 55(82.08%). When it came to exposure duration, 58(86.57%) had been exposed for years and 9(13.43 %) for months. The mean Z-score for all growth measurements was higher in group B infants compared to group A ($p<0.05$) except weight-for-height ($p>0.05$).

Conclusion: Mothers' exposure to environmental tobacco smoke was found to have a significant harmful effect on the growth parameters of infants.

Key Words: Pollution, Demography, Dentistry, Smoking,

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Introduction

Environmental tobacco smoking (ETS), also known as second-hand smoking (SHS) or passive smoking, is produced by active smokers burning the tip of a cigarette and breathing by non-smokers. According to studies, over 600,000 non-smokers die each year in the world due to passive smoking, with the majority of these deaths occurring in children[1].

Infants born to smoking mothers have been found to have lower weight and head circumference (HC) at birth, and they remain smaller until they are two years old, compared to infants born to non-smoking mothers[2]. SHS exposure is expected to produce some or all of the complications caused by active smoking but at a lower relative risk. Prenatal exposure to SHS has been linked to lower birth weight (LBW) as well as shorter body length and a smaller HC at childbirth.[3]

Cigarette smoke includes a variety of chemicals, including nicotine, lead, cadmium, carbon monoxide and other particles, all of which have direct and indirect harmful effects on placental function and foetal blood supply, with negative developmental consequences. Nicotine, which is derived from tobacco smoke, is found on home surfaces and floating around in the air along with dust, and it is one of the primary elements that has been shown to have a negative impact on embryonic growth. It easily crosses the placenta, with foetal concentrations 15% higher than maternal levels, as well as a reduction in oxygen flow and other nutrients across the placenta, which might cause neurotoxic effects on the foetal brain throughout the intrauterine development process.[4]

Infants and children are more likely than adolescents and adults to be exposed to ETS because they sit closer to their smoking parents, putting them closer to the source of the smoke. Because their detoxifying abilities differ from older children and adults, infants and young children are more vulnerable to toxic exposures because their enzyme systems and clearance mechanisms are immature. In addition to increased metabolic rates, they inhale substantially more air per kilogramme of body weight than adults[5].

To our knowledge, there is no study done in Iraq concerning the effect of mother's exposure to ETS on

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their infant's growth outcomes. The current study was planned to fill the gap in the literature by determining the association between ETS exposure and growth parameters of infants. The null hypothesis was that ETS had no effect on growth parameters

Subjects and Methods

The observational, comparative study was done in rural areas of the Al-Karkh sector of Baghdad, Iraq, from December 2021 to March 2022. After approval from the ethics review committees of the College of Dentistry, University of Baghdad, and the College of Medicine, Mustansiriyah University, Baghdad, the sample size was calculated using G*Power[6] 3.1.9.7 with power of study 95%, alpha error of probability 0.05 and effect size 0.5 (medium). The sample was raised using simple random sample technique. Those included were mothers aged 20-35 years having infants aged up to one year. The exclusion criteria comprised mothers with complicated pregnancy (placental complications during pregnancy leading to intrauterine growth retardation), both mothers and children with medical problems (respiratory disease, especially reactive airway disease, that necessitate steroid usage) and those on prolonged medication. Only healthy women were recruited.

After obtaining written informed consent from the participating mothers, data was collected using a proforma related to socio-demographic information, such as age, educational level, employment, manner of delivery, feeding pattern, and baby's age and gender. Those exposed to ETS formed group A, while non-exposed mothers formed group B. Also collected was data related to the duration of the exposure (years or months), the smoking person (husband or others), and the type of exposure (cigarettes and hookah). The number of cigarettes smoked per day was calculated using a second-hand smoke exposure scale (SHSES)[7].

With the consent of the mothers, their infants were subjected to a complete clinical examination to rule out any congenital defect or chronic or disabling disorder. Data regarding anthropometric measurements of the infants was collected and calculated by using The World Health Organisation (WHO) Anthro software version 3.2.2 based on the Infant Growth Percentiles (<36 months) of the National Centre for Health Statistics (NCHS unit of the Centres for Disease Control and Prevention (CDC).[8]

For length measurement, an infant meter was used with a stable headpiece, horizontal backboard, and moveable foot piece. Concerning weight measurement, a digital scale was used to weigh the infants with only diapers on. For HC measurement, any hair accessory on the infant's head was removed, and an HC tape was wrapped around the infant's head above the eyebrows perpendicular to the face's long axis, over the ears and over the occipital prominence at the back of the head[9]. Weight-for-height, height-for-age and weight-for-age indices, as well as HC values, were used to measure growth parameters.

Data was analysed using SPSS 22. Data was expressed as frequencies and percentages, or as mean ± standard deviation, as appropriate. Inferential analyses were done using chi-square and independent sample t-test, as appropriate. $P<0.05$ was considered significant.

Results

Of the 150 mothers, 67(44.7%) were in group A with a mean age of 27.8±4.7 years and 83(55.3%) were in group B with a mean age of 26,1±4.6 years. The mean age of the children was 9.4±3.1 years in group A and 9.2±2.3 years in group B ($p>0.05$) (Table 1).

Table-1: Socio-demographic characteristics.

Variable	Exposed (N=67)	Non-Exposed (N=83)	p value
Age of mother (years)	27.8±4.7	26.1±4.6	0.168
Age of child (months)	9.4±3.1	9.2±2.3	0.925
gender of child (male)	31(46.26 %)	38(45.79 %)	0.953
gender of child (female)	36(53.22)	45(54.22 %)	
Breast Feeding pattern	26(38.81)	33(39.76)	0.955
Bottle feeding pattern	24(35.82)	28(33.73)	
Mixed feeding	17(25.37)	22(26.51)	

All 67(100%) mothers and infants in group A were exposed to ETS at home. In addition, 23(34.32%) and 22(32.83%) subjects were also exposed while in vehicles and at public places, respectively. The least exposure was at work 8(11.94%).

The husband was the primary source of smoking at home 55(82.08 %). Duration of exposure in 58(86.57%) cases had been for years and it was for months in 9(13.43%)

Table-2: Smoking exposure parameters.

Variable	Category	N=67
Smoking person		
	Husband	55(82.08%)
	Others than husband	12(17.92%)
Duration of exposure		
	years	58(86.57%)
	months	9(13.43%)
Type of the exposed Smoking		
	Cigarette only	51(76.11%)
	Cigarette and Hookah	16(23.89%)

cases. Also, 51(76.11 %) subjects were exposed solely to cigarette smoke, while 16(23.89 %) were exposed to both cigarette and hookah smoke (Table 2).

The mean Z-score for all infants' growth measurements was higher in group B compared to group A ($p<0.05$) except weight-for-height (Table 3).

Table-3: Z-score (mean ± SD) of growth measurements in relation to environmental tobacco smoking (ETS) exposure.

Vars.	Environmental tobacco smoke (ETS) exposure					
	Exposed mothers		Non-Exposed mothers			
	Mean	±SD	Mean	±SD	T test	P value
Weight-for-height	0.285	1.356	0.634	0.702	1.915	0.059
Height for age	-0.016	1.447	0.432	0.597	2.377*	0.020
Weight-for-age	0.238	0.974	0.552	0.566	2.342*	0.021
Head circumference	0.367	1.008	0.731	0.647	2.561*	0.012

SD: Standard deviation. *Significant P≤0.05.

Discussion

The current study, to our knowledge, is the first in Iraq evaluating the growth of infants exposed to ETS based on SHSES[7]. The mothers who participated in the study were housewives from rural areas, and the most prevalent location of exposure was at home, with the husband being the primary source of exposure. These findings are consistent with a previous study[10]. Simple explanations for these findings include the various social and cultural norms in rural communities that make them vulnerable to male dominance. Additionally, living in a rural area with a lower level of education increases the risk of ETS exposure at home, as well as long periods of parental stay at home due to early day-hours of work and a lack of outdoor recreational activities in rural areas compared to urban areas. The research found that nicotine and other tobacco smoke particles contaminated 88% of surfaces in both living rooms and newborns' bedrooms[11].

The current study revealed that the mean of the Z-score for infants' growth parameters was higher among the non-exposed infants. This result is strongly supported by an earlier study which showed that ETS exposure during the pre- or post-natal period had a negative impact on weight, height and HC outcomes in childhood[12]. Other studies found that ETS was strongly associated with the risk of wasting and stunting[13-15]. Other studies, however, found no association between birth weight/height and ETS exposure[2,16].

The result regarding HC also resonates with another study that found a significant association between SHS exposure and lower HC in children[2,17] However, one post-natal study found no significant differences in this regard[16].

There are several potential mechanisms on how ETS influences growth in children. Nicotine infusion, a very effective vasoconstrictor that has been demonstrated to concentrate in the placental tissues, was shown to dramatically reduce the volume of the placenta in one study[18]. Another study found that tobacco smoke exposure during pregnancy may affect childhood body mass index (BMI) by limiting foetal development due to vasoconstriction and hypoxaemia[19].

Polycyclic aromatic hydrocarbons (PAHs), tobacco-specific nitrosamines N'-nitrosonornicotine (NNN) and 4-(methylnitrosamino-)1-(3, pyridyl)-1-butone (NNK) are among the more than 4,000 chemicals found in ETS cases. PAHs and NNK may pass through the placenta and have a direct effect on the hypothalamic centres of the children, delaying their growth[20]. The hypothalamus is recognised to play an important role in weight control by regulating food intake, energy output, and body fat storage[21]. Furthermore, PAHs and NNK may affect the volume of the foetus' anterior cingulate area, which may result in a smaller HC. Head growth throughout pregnancy and infancy is critical since it is linked to subsequent intelligence quotient (IQ) development, and determines how effectively cognitive talents are maintained in old life[22].

A study showed that the height of children exposed to ETS grew lower because cadmium in the smoke interferes with zinc absorption[23]. Another factor might be that exposed children have poor nutrition as a result of family income being spent on cigarettes rather than food[12,24]. ETS is a common source of health complications in newborns and children, and, according to the United Nations Children's Fund (UNICEF) conceptual framework on child malnutrition, recurrent illness is one of the primary causes of undernutrition in children[25].

Limitation: The current study has a limitation as it had no follow-up of the subjects.

Conclusion

ETS was found to have a significant harmful effect on newborns' development, indicating the need to implement a complete smoking ban in the presence of infants.

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Conflict of Interest: None.

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