ORIGINAL ARTICLE

Tanaffos (2010) 9(2), 43-49

Factors Associated with Secondhand Smoke Exposure in Infants

Azam Baheiraei [1], Roghieh Kharaghani [1], Afshin Mohsenifar [2], Anoshirvan Kazemnejad [3], Ali Mota [4], Hooman Sharifi Milani [5], Siamak Alikhani [6]

[1] Department of Reproductive Health, Tehran University of Medical Sciences, [2] Department of Toxicology, [3] Department of Statistic, [4] Department of Clinical Biochemistry, Tarbiat Modares University, [5]Tobacco Prevention and Control Research Center, Shahid Beheshti University M.C., [6]Iranian Ministry of Health and Medical Education, TEHRAN-IRAN.

ABSTRACT

Background: *Determining the factors associated with secondhand smoke (SHS) exposure in children provides valuable information for smoking control strategies. This study aimed to assess factors related to SHS exposure in infants based on urinary cotinine measures.*

Materials and Methods: *A cross-sectional analysis of the data that were collected as part of the randomized controlled trial was conducted. Participants were 130 smoking households with children under the age of 1 year attending a health care center in southern Tehran. Eligible parents consented to participate in this study and completed a questionnaire including demographic data, questions regarding smoking at home, smoking status and Fagerström test through face-to-face interview. The Infants' urinary cotinine level was measured using gas chromatography, adjusted with urinary creatinine level and reported as cotinine (ng)/ creatinine (mg). Factors related to infants' SHS exposure were assessed using the multivariate logistic regression model based on standard cut-point (30 ng of urinary cotinine/mg creatinine).*

Results: *The final multivariate logistic regression model showed that social status (p=0.002), home smoking restriction (p=0.05) and the infant's age (p=0.01) were associated with the infants' SHS exposure determined based on urinary cotinine levels.*

Conclusion: *These results support the influence of social status, home smoking restriction and infant's age on the exposure of infants to SHS.* ***(Tanaffos2010; 9(2): 43-49)***

Key words: *Secondhand smoke exposure, Infant, Cotinine*

INTRODUCTION

Secondhand smoke exposure is a major health hazard, especially among infants (1). According to the World Health Organization (WHO) report, passive smoking threatens the health of nearly half of the world's children. Forty-seven percent of children in the Eastern Mediterranean region and 58% of them in South Eastern Asia are passive smokers (2). A recent study conducted in China showed that 76.5% of smoking parents smoked in the presence of their children (3). Exposure of infants to secondhand

Correspondence to: Baheiraei A

Address: P.O. Box 15745-1453 Tehran, Iran

Email address: abaheiraei@gmail.com

Received: 30 December 2009

Accepted: 18 March 2010

smoke results in respiratory diseases, otitis media, asthma, allergy and sudden infant death syndrome (SIDS) (4). Passive smoking also increases health care costs in the first years of life (5). Smoke exposure can result in the accumulation of toxic materials not only in adult smokers, but also in infants because of their higher respiratory rates and lower body weights (6).

Numerous factors contribute to secondhand smoke exposure in children and are different in various populations. Recognizing these factors can provide valuable information to design strategies for reduction of secondhand smoke exposure and smoking cessation programs (7). Some studies have shown that factors like social status, educational level of parents and factors related to smoking status such as the number of smokers, the number of cigarettes smoked in the presence of nonsmokers and restrictions of indoor smoking, can affect secondhand smoke exposure in children (8,9-11).

Few studies have been performed in this regard in Iran. A study conducted in Isfahan showed that smoke exposure in single, divorced individuals and students is more than others. In addition, the results of one study carried out in Tehran indicated that children living with parents with a lower educational level had higher exposure to cigarette smoke.

None of these two studies evaluated the factors related to smoke exposure of infants based on the biologic marker of cigarette smoke and only relied on the parents' report which is not a reliable source of information (12,13). The aim of this study was to determine the factors related to secondhand smoke exposure of infants according to urinary cotinine measures.

MATERIALS AND METHODS

The data in the present study were collected as part of a randomized controlled trial on a secondhand smoking reduction intervention in Tehran, Iran in 2008. Participants were 130 smoking households with children under the age of 1 year attending a health center in southern Tehran. The inclusion criteria were smoking at least one cigarette per day, having telephone access, residing with the infant at the same house and completing an informed consent form. Parents who reported usage of other addictive substances or being under smoking cessation treatment were excluded from the study. The study protocol was approved by the Ethics Committee of Tehran University of Medical Sciences.

A questionnaire consisting of three parts, 14 questions on demographic characteristics, 5 questions on home situation and 15 questions on smoking status, was completed through a face to face interview. The questionnaire was adapted from the tool used by Wakefield et al. with permission of the principal investigator (10). An acceptable one-week reliability test with the least Kappa coefficient of 0.88 for qualitative variables and the least Pearson correlation coefficient of 0.82 for quantitative variables was obtained.

To determine the nicotine dependency, the Fagerström test was used. The social status of the family was determined according to the Registrar General Model of Social Class, and participants were classified into six groups (14). An index was calculated to describe population density of the households by dividing the total number of family members by the total number of rooms in the home. The index was scored as low (scores 0–1), moderate (scores 2–3) or high (score > 3) (15). To estimate the infant secondhand smoke exposure rate, daily cigarette consumption in presence of the infant on weekdays and weekends was ascertained (10).

Urine samples collected from infants using a urine collection bag were immediately frozen and transported to the Toxicology Laboratory at Tarbiat Modares University and stored at -20ºC until analysis. The lab tests were performed with no

knowledge of the parental reports. Urinary cotinine was analyzed using the gas chromatography method based on the methods of Feyerband and Russle, with some modifications (16). The cotinine in the urine was adjusted for creatinine to overcome dilution effects. The detection limit was 1 to 3 ng/mg. The standard cut-off point of 30 ng/mg of cotinine to creatinine ratio was used for determining an infant's exposure to secondhand smoke (17-19).

Factors related to infants' secondhand smoke exposure

Factors related to secondhand smoke exposure of infants included the socio-demographic characteristics of households (age, gender, weight, breast feeding, level of education, occupation, social status, home and car ownership and number of children), home characteristics (crowding index, access to outdoor areas and a separate room for the infant), the number of cigarettes smoked per day by the parents, daily consumption of cigarettes in the presence of the infant, the day of urine collection from the infant, nicotine dependency status of smoker fathers and smoking restrictions in the home which were all obtained by questionnaires and urinary cotinine levels were evaluated in infants.

Data analysis

The factors related to smoke exposure of infants were evaluated based on the standard cut point of urine cotinine of infants using multivariate logistic regression analysis. All the data were analyzed using SPSS version 16.0 and p values <0.05 were considered statistically significant.

RESULTS

The characteristics of the study population

Most infants were males (60.8%) with a mean age of 4.2±3.8 months. Ninety percent of them did not have a separate room. The mean age of mothers and fathers was 27.3±5.4 yrs and 32.3±5.9 yrs, respectively. The majority of mothers were housewives. In terms of the educational level, 17.7% of mothers and 23% of fathers were illiterate or only had elementary school education. Only 19.2% of families were homeowners and 59.2% did not own a car. All participants were from low socioeconomic status and there were no high or middle class families among them. The crowding index was 2-3 persons per room in 46.2% of families (Table 1).

Table 1. Socio-demographic characteristics of families

Characteristic	No.	Percent
Infant's gender (male)	79	60.8
Infant's age (month)	4.2±3.8*	-
Separate room for infant (yes)	13	10
Mother's age (yrs)	27.3±5.4*	-
Father's age (yrs)	32.3±5.9*	-
Mother's occupation (housewife)	128	98.5
Mother's educational level		
Illiterate or elementary school	23	17.7
Middle school or high school	48	36.9
Diploma and higher	59	45.4
Father's educational level		
Illiterate or elementary school	30	23
Middle school or high school	63	48.5
Diploma and higher	37	28.5
Car ownership (yes)	53	40.8
Social status		
Employer, junior employee or lower	17	13.1
Skilled worker	63	48.5
Semi-skilled or unskilled worker	50	38.5
Crowding index		
2>	20	15.4
2-3	60	46.2
3<	50	38.5

*Mean± standard deviation

Smoking status

In 96.9% of the households, only the father smoked; in 0.8% of households, only the mother smoked; and in 2.3% of households, both parents smoked; 36.2% of the fathers smoked more than 10 cigarettes per day. There were no other smokers in the households. Complete smoking ban in the home was only considered by 12.3% of the parents. Of the

53 (40.8%) participants who owned a car, only 5.7% considered smoking restriction in the car.

Among the 52 families who reported that smoking was restricted in their home, 36 families (69.2%) did not follow the restrictions when their friends or relatives were present (63.9%), the infant was not at home (33.3%) or was asleep (28%). In addition, smoking was allowed in the car in situations like long trips (28.6%), when another smoker was present in the car (28.6%), when the car windows were down (28.6%) or all of the above cases (14.2%).

Smoke exposure of infants

Based on the parents' report, 55.4% of infants were exposed to cigarette smoke. Parents smoked 3±5.1 cigarettes in the presence of infants. The number of cigarettes smoked per day by parents in the presence of infants was 2.97±5.17 during weekends and 3.05±5.20 during work days.

The mean level of urine cotinine was 43.5 (first quartile=29 and third quartile=66.5) (range 3-330 ng/mg). Considering the standard cut point of 30ng/mg (urinary cotinine), 70.2% of infants were exposed to cigarette smoke.

Factors related to infants' secondhand smoke exposure

To evaluate the factors related to secondhand smoke exposure in infants, the variables including the infant's age and weight, assigning a separate room for the infant, father's level of education, social status, number of children and smoking restrictions at home were entered into logistic regression model. The multivariate regression model showed that the secondhand smoke exposure of infants increased 1.19 times as they grew up (p=0.01). Infants of employers and junior employees were exposed to cigarette smoke 9.84 times less than those of semi-skilled and unskilled workers (p=0.002). Additionally, infants whose parents reported that they only smoked in the absence of the infant, showed 3.15 times less exposure to cigarette smoke than those whose parents smoked in the home without following any restrictions (p=0.05) (Tables 2-4).

Table 2. Association between socio-demographic characteristics and urinary cotinine levels using univariate regression analysis

Variable	OR (95% CI)*
Infant's age (months)	0.88 (0.78-1.00)
Infant's gender	
Female	1.03 (0.43-2.13)
Male (reference)	-
Infant's weight (kg)	0.83 (0.68-1.03)
Breast feeding	
Yes	0.00 (0.0-)
No (reference)	-
Mother's age (yrs)	0.98 (0.91-1.05)
Father's age (yrs)	0.98 (0.92-1.05)
Mother's educational level	
Illiterate or elementary school	0.63 (0.20-1.99)
middle school or high school	0.88 (0.37-2.06)
Diploma and higher	-
Father's educational level	
Illiterate or elementary school	0.49 (0.16-1.45)
middle school or high school	0.41 (0.17-1.01)
Diploma and higher	-
Mother's occupation	
Housewife	0.40 (0.02-6.61)
Employed (reference)	-
Social status	
Employer and junior employees or lower	5.57(1.63-18.96)
Skilled workers	1.85 (0.74-4.61)
Semi-skilled or unskilled worker	-
Type of housing	
Homeowner	0.52 (0.14-1.93)
Rent	1.25 (0.51-3.05)
Others (reference)	-
Car ownership	
Yes	0.77 (0.35-1.37)
No (reference)	-
Number of children	
One	0.53 (0.24-1.16)
Two and more (reference)	-
Crowding index	
2>	0.53 (0.15-1.87)
2-3	0.90 (0.39-2.09)
3< (reference)	-
Access to outdoor area	
No	1.14 (0.25-5.08)
Yard	0.73 (0.28-1.94)
Backyard, balcony or roof (reference)	-
Separate room for infant	
Yes	0.20 (0.02-1.61)
No (reference)	-

*Odds ratio (confidence interval)

Table 3. Association between smoking status and secondhand smoke exposure in infants based on urinary cotinine: Univariate regression analysis.

Variable	OR (95% CI)*
Daily number of cigarettes smoked by parents	
1-10	0.74 (0.32-1.68)
>10 (reference)	-
Parents' report of infant's exposure to cigarette smoke	
Yes	0.00 (0.0-)
No	0.06 (0.0-)
Unclear (reference)	-
Day of urine collection	
Saturday	1.39 (0.55-3.49)
Other days (reference)	-
Nicotine dependency status of smoker fathers	
Very low and low	0.27 (0.61-5.50)
Moderate and high (reference)	-
Smoking restrictions at home	
Complete restriction	1.35 (0.39-4.67)
Restriction with exception	0.54 (0.18-1.58)
Smoking in rooms where infant is not present	2.98 (1.04-8.55)
No restriction (reference)	-

*Odds ratio (confidence interval)

Table 4. Association between secondhand smoke exposure in infants and its determinants: Multivariate regression analysis.

Variable	OR (95% CI)*
Infant's age (month)	1.19 (1.04-1.36)
Social status	
Employer, junior employee and lower	9.84 (2.33-41.46)
Skilled workers	2.14 (0.80-5.73)
Semi-skilled or unskilled workers (reference)	-
Smoking restrictions at home	
Complete restriction	1.28 (0.33-4.87)
Restriction with exception	0.36 (0.11-1.18)
Smoking in rooms where infant is not present	3.15 (1.00-9.92)
No restriction (reference)	-

*Odds ratio (confidence interval)

DISCUSSION

This study showed that social status, smoking restrictions at home and the infant's age are associated with the infants' exposure to cigarette smoke. The majority of infants were exposed to cigarette smoke in the home and car and the smoker parent was mainly the father. These results showed that smoker fathers should be the target group for health warnings (20).

Numerous studies performed in different countries, showed different results regarding the relationship between the educational level and smoking status. For instance, a study conducted in Thailand showed that the higher the educational level of parents, the lower the smoke exposure in children (8). However, one study revealed contrary results in France (21). In this study, no relationship was detected between the educational level of parents and smoke exposure in infants based on urinary cotinine. The results of the present study indicated that infants of semi-skilled or unskilled workers had 10 times more exposure to cigarette smoke than those of employers and junior employees. Shiva et al. showed that the prevalence of smoking in higher social classes is less than lower ones (12). Furthermore, Kelishadi et al. reported poverty to be an important risk factor for smoking (22). The restrictions for tobacco use in higher socioeconomic working places can encourage the workers to avoid smoking in the home as well. These results show that families in lower social levels suffer more from the adverse effects of secondhand smoke exposure. Thus, establishment of tobacco control programs seems necessary in these families.

Smoke exposure in infants whose parents reported that their smoking was restricted to a place where the infant was not present, was 3.15 times lower than infants whose parents smoked without any restrictions in the home but in contrast to the Wakefield et al. study, which showed that complete restriction of smoking in the home can cause the reduction of smoke exposure in children (10), such a relationship was not found in the present study which can raise doubt about the accuracy of the parents'

report. Wakefield et al. showed that to reduce smoke exposure in children, parents should not make any exception in their smoking restriction in the home. However, about 70% of the parents in our study did not consider these restrictions in some situations and 64% reported that they did not prohibit their friends and relatives from smoking in their home.

In our study, smoke exposure in infants increased as they grew up. This result was consistent with that of Robinson and Kirkcaldy (23) showing that as children grew up, smoker parents cared less about their smoking habit in the presence of the child assuming that the child's tolerance towards cigarette smoke has increased. The majority of health interventions are limited to the first weeks and months of birth when the parents have the most contact with health care centers whereas the child will still be susceptible to cigarette smoke and parents' smoking may even encourage them to take up smoking later on in life (24). Based on present study results, it seems that changes in the behavior of parents that occur in the first days after birth will not persist, therefore, the child should be protected from cigarette smoke throughout his/her childhood.

One of the limitations of our study was that it was performed in a health care center in southern Tehran and most participants were from low socioeconomic classes, thus, performing a survey on a larger sample size from the general population is recommended. Another limitation was that the urinary cotinine level of infants was measured only once. Some researchers recommend repeated measurements for obtaining a reliable estimate of cigarette smoke exposure in infants. However, some studies have shown a correlation between one time measured urinary cotinine and cigarette smoke exposure (10).

CONCLUSION

This study supports the effect of social status, smoking restriction at home and the infant's age on secondhand smoke exposure of infants in Tehran. In order to reduce exposure to secondhand smoke, controlling its determinant factors should be considered.

Acknowledgments

This research was supported by a Tehran University of Medical Sciences and Health Services grant (grant no. 87-01-28-6870). We wish to thank all the parents who participated in this study.

REFERENCES

1. Boyaci H, Etiler N, Duman C, Basyigit I, Pala A. Environmental tobacco smoke exposure in school children: parent report and urine cotinine measures. ***Pediatr Int*** 2006; 48 (4): 382- 9.
2. Gordon B, Mackey R, Rehfuess E. Inheriting the World: The atlas of children's health and the environment. World Health Organization 2004. Available online at: http://www.archive.org/texts/flipbook/flippy.php?id=inheritingworlda00gordrich.
3. Wang CP, Ma SJ, Xu XF, Wang JF, Mei CZ, Yang GH. The prevalence of household secondhand smoke exposure and its correlated factors in six counties of China. ***Tob Control*** 2009; 18 (2): 121- 6.
4. U.S. Department of Health and Human Services. The Health Consequences of Involuntary Exposure to Tobacco Smoke: A Report of the Surgeon General. Coordinating Center for Health Promotion, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health,2006. http://www.surgeongeneral.gov/library/secondhandsmoke/
5. Leung GM, Ho LM, Lam TH. The economic burden of environmental tobacco smoke in the first year of life. ***Arch Dis Child*** 2003; 88 (9): 767- 71.
6. Matt GE, Bernert JT, Hovell MF. Measuring secondhand smoke exposure in children: an ecological measurement approach. ***J Pediatr Psychol*** 2008; 33 (2): 156- 75.
7. Blackburn C, Spencer N, Bonas S, Coe C, Dolan A, Moy R. Effect of strategies to reduce exposure of infants to

environmental tobacco smoke in the home: cross sectional survey. ***BMJ*** 2003; 327 (7409): 257.

8. Anuntaseree W, Mo-Suwan L, Ovatlarnporn C, Tantana C, Ma-a-Lee A. Exposure to environmental tobacco smoke among infants in southern Thailand: a study of urinary cotinine. ***Bull Environ Contam Toxicol*** 2008; 80 (1): 34- 7.
9. Blackburn CM, Bonas S, Spencer NJ, Coe CJ, Dolan A, Moy R. Parental smoking and passive smoking in infants: fathers matter too. ***Health Educ Res*** 2005; 20 (2): 185- 94.
10. Wakefield M, Banham D, Martin J, Ruffin R, McCaul K, Badcock N. Restrictions on smoking at home and urinary cotinine levels among children with asthma. ***Am J Prev Med*** 2000; 19 (3): 188- 92.
11. Martínez-Sánchez JM, Fernández E, Fu M, Pascual JA, Ariza C, Agudo A, et al. Assessment of exposure to secondhand smoke by questionnaire and salivary cotinine in the general population of Barcelona, Spain (2004-2005). ***Prev Med*** 2009; 48 (3): 218- 23.
12. Shiva F, Padyab M. Smoking practices and risk awareness in parents regarding passive smoke exposure of their preschool children: a cross-sectional study in Tehran. ***Indian J Med Sci*** 2008; 62 (6): 228- 35.
13. Kelishadi R, Javaheri J, Rouhafza HR, Sadri GHH, Eshratei B. Socio-demografic characteristic of passive smokers exposed to environmental tobacco smoke and the influence of community-based interventions on its reduction in Isfahan, Najaf abad and Arak. ***Medical journal of Hormozgan University*** 2008; 11 (4): 283- 90.
14. Currie CE, Elton RA, Todd J, Platt S. Indicators of socioeconomic status for adolescents: the WHO Health Behaviour in School-aged Children Survey. ***Health Educ Res*** 1997; 12 (3): 385- 97.
15. Nurgalieva ZZ, Malaty HM, Graham DY, Almuchambetova R, Machmudova A, Kapsultanova D, et al. Helicobacter pylori infection in Kazakhstan: effect of water source and household hygiene. ***Am J Trop Med Hyg*** 2002; 67 (2): 201- 6.
16. Feyerabend C, Russell MA. A rapid gas-liquid chromatographic method for the determination of cotinine and nicotine in biological fluids. ***J Pharm Pharmacol*** 1990; 42 (6): 450- 2.
17. Seifert JA, Ross CA, Norris JM. Validation of a five-question survey to assess a child's exposure to environmental tobacco smoke. ***Ann Epidemiol*** 2002; 12 (4): 273- 7.
18. Henderson FW, Reid HF, Morris R, Wang OL, Hu PC, Helms RW, et al. Home air nicotine levels and urinary cotinine excretion in preschool children. ***Am Rev Respir Dis*** 1989; 140 (1): 197- 201.
19. Kattan M, Gergen PJ, Eggleston P, Visness CM, Mitchell HE. Health effects of indoor nitrogen dioxide and passive smoking on urban asthmatic children. ***J Allergy Clin Immunol*** 2007; 120 (3): 618- 24.
20. Norman GJ, Ribisl KM, Howard-Pitney B, Howard KA. Smoking bans in the home and car: Do those who really need them have them? ***Prev Med*** 1999; 29 (6 Pt 1): 581- 9.
21. Kauffmann F, Tager IB, Muñoz A, Speizer FE. Familial factors related to lung function in children aged 6-10 years. Results from the PAARC epidemiologic study. ***Am J Epidemiol*** 1989; 129 (6): 1289- 99.
22. Kelishadi R, Mokhtari MR, Tavasoli AA, Khosravi A, Ahangar-Nazari I, Sabet B, et al. Determinants of tobacco use among youths in Isfahan, Iran. ***Int J Public Health*** 2007; 52 (3): 173- 9.
23. Robinson J, Kirkcaldy AJ. 'Imagine all that smoke in their lungs': parents' perceptions of young children's tolerance of tobacco smoke. ***Health Educ Res*** 2009; 24 (1): 11- 21.
24. Ino T, Shibuya T, Saito K, Ohshima J, Okada R. A passive smoking screening program for children. ***Prev Med*** 2006; 42 (6): 427- 9.