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THE IMPACT OF SECONDHAND SMOKE ON NEONATAL BIOMETRIC OUTCOMES AND GESTATIONAL AGE IN HUNGARY

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Summary

Introduction. Prenatal secondhand tobacco smoke (SHS) is a substantial problem in Hungary's four underdeveloped northeastern counties, where a considerable ethnic Roma population resides.

Aim. We aimed to explore the correlation of at-home SHS exposure and consequences on neonatal outcomes in the four Hungary's northeastern counties.

Material and methods. Data were collected from mothers in Hungary's four underdeveloped counties who were delivered of live born babies in years 2009-2011 (n = 16,859). The neonates' biometric parameters (birth weight, body length, head and chest circumference, gestational age) were obtained from medical records. Demographic and sociocultural data of mothers were obtained from in-person surveys. The response rate was 74.5%. We conducted binary logistic regression analysis of maternal variables for SHS exposure, frequency analysis for central tendencies and dispersion and t-probes for comparing the means of neonatal measurements using significance level $p < 0.05$ (IBM-SPSS v. 23 software).

Results. In the non-smoking sample (n = 8,497), pregnant women exposed to SHS were typically less educated (OR = 3.32, 95% CI = 2.64-4.18), of Roma ethnicity (OR = 1.71, 95% CI = 1.36-2.15), living without amenities (OR = 1.70, 95% CI = 1.37-2.11) and of extramarital status (OR = 1.52, 95% CI = 1.27-1.82). The negative difference of birth weight following foetal SHS exposure was 154.9 grams (95% CI = -188.5 – -121.3), the difference of body length – 0.8 cm (95% CI = -1.06-0.6), and of head and chest circumference – 0.5 cm (95% CI = -0.6-0.3 and -0.7-03, respectively). Gestational age was shortened by mean 0.4 week.

Conclusions. At-home SHS exposure has an impact on biometric and obstetrical parameters of newborn babies. Tobacco cessation programs for pregnant women must also focus on lowering SHS exposure, especially in households with lower socioeconomic status, where such exposure is prevalent.

Keywords: secondhand smoke during pregnancy, newborns' biometric data, mothers' social status

INTRODUCTION

Tobacco smoking is responsible for nearly 6 million deaths each year worldwide, including 600,000 non-smokers exposed to secondhand smoke (SHS) (1). An estimated 700,000 deaths are annually attributable to smoking in the European Union (EU) alone (2). Fourteen percent of non-smoking EU citizens are exposed at home to other people's tobacco smoke every day or almost every day (3).

In Hungary, tobacco smoking imposes a significant strain on public health and on the national economy. Based on the representative studies conducted in the 2000s, the prevalence of regular and occasional smoking in Hungary's adult population is 36-38%, which is one of the worst outcomes of all the European nations (4). In 2010, the direct and indirect expenditures caused by smoking accounted for more than 441 billion HUF in Hungary, which equals approximately 1.63 billion USD (5). Since the early 1990s, the Hungarian government enacted a series of anti-tobacco laws, such as the obligation to appoint separated smoking areas in workplaces (1993), banning advertising of tobacco products (1997) and prohibiting selling them to underage buyers (1999) (6). After 2004, when Hungary joined the EU, tax revenues rose substantially due to the increase of the excise taxes on tobacco products. By

2008, it mounted to 350 thousand millions HUF (approx. 1.3 billion USD), which accounted for 4% of the whole state budget (5). In 2012, Hungary implemented very strict legislation, banning smoking in all confined public places, such as restaurants, workplaces, health care and educational facilities, as well as in specific outdoor public places, including bus stops and playgrounds (7). Recent data suggest decreasing prevalence of smoking, as it was reported to be 29% in 2014 (8).

It is well-established that factors of the environment act on the maternal-foetal blood supply by influencing the hemodynamic and vascular functions of the mother, as well as the microstructure and function of the placenta. This way, maternal smoking during the pregnancy is harmful for mother and foetus alike (9). This leads to more frequent ectopic pregnancies, spontaneous abortions, abnormal placental adhesions, stillbirths, preterm birth and low-birth-weight babies and the occurrence of intrauterine growth restriction after repeated tobacco exposure (10, 11). Although SHS results in lower concentrations of harmful compounds than mainstream smoke, its harms, e.g. increased risk of sudden infant death syndrome, preterm birth and low birth weight, are also well-documented (12, 13). Thus, the health impact is similar to that of the active smoking and depends on the time of exposure and the SHS concentration caused by the smoking frequency of workplace colleagues and partners or relatives smoking in the pregnant women's house. Non-smoking family members, mainly infants and children, are at a higher risk of SHS consequences (14).

AIM

The aim of this study was to describe the sociodemographic characteristics of women exposed to SHS in their houses and to evaluate the influence of SHS exposure on the neonatal gestational age and biometric data.

MATERIAL AND METHODS

Human subjects' approval of our survey was issued by the Ethics Committee of Semmelweis University in Budapest, Hungary (TUKEB 103/2009). This retrospective cohort study targeted all women that delivered of live born babies in Hungary's four northeastern counties within the years 2009-2011 (n = 16,859). The target area is the most underdeveloped region of the country with a considerable Roma population. Data included neonates' and mothers' biometric data abstracted from medical records by local nurses of Maternity and Child Health Care (MCHC). MCHS also conducted questionnaire-based interviews among women (response rate 74.5%, n = 12,587). Questionnaires were excluded from this analysis if a big part of the data was missing (n = 35) or the women had twins and triplets (n = 81) due to the confounding influence of multiple births on gestational age and biometric data of the neonates.

Non-smoking status of mothers was defined if they did not smoke prior to the pregnancy (including never smokers and former smokers) or stopped smoking as soon as they had learned they were pregnant. It was asked if their husband or partner was a smoker. SHS was defined as at-home SHS exposition generated by regularly or occasionally smoking husband or partner in confined places of the household. We defined non--exposition as a situation when a woman had a non--smoking husband/partner or smoking husband/partner that never smoked in confined places of the household during the pregnancy.

Demographic data of the mothers included age (life-years), Body Mass Index calculated from the body weight and height found in medical records (BMI = body weight in kg divided by squared body height in meters), self-admitted education (basic: eight or less than eight classes, middle school, college or university), marital status (married, cohabitation, single, divorced). Dwellings were divided into following cathegories: having full amenities (central heating, connection to the water supply system and to the sewage system), having partial amenities (lacking of one of the three components mentioned above), and having no amenities (lack of all the components). Dichotomous variables were determined by dividing the patients into groups according to the age: under 18 and 18 or over years of age, to BMI: underweight and normal, overweight and obese ($\leq$ 18.49 v. $\geq$ 18.5), to education: eight or less basic classes and more than eight basic classes, to marital status: cohabitation, single, divorced and married. Two variables were originally dichotomous as being Roma and non-Roma by self-identification, and settlement type classified as rural and non-rural.

Neonatal biometric data (body weight in grams, body length, head and chest circumference in centimeters) and gestational time (in weeks) were recorded by the MCHS nurses using medical records.

Using IBM-SPSS v. 23 software, we conducted a binary logistic regression analysis of sociodemographic characteristics of maternal-foetal SHS exposure with odds ratios (ORs) 95% confidence intervals (95% CI) as well as a frequency analysis of newborn babies' biometric data indicating central tendency (means, medians, modes), dispersion (standard deviations) and independent samples t-tests for comparing the results between groups (mean differences, standard errors, 95% confidence intervals).

RESULTS

8,497 mothers have not smoked during their pregnancy. Half of the respodents reported that they had never smoked or had only smoked a single cigarette in their lifetime (50.3%). The overall prevalence of smoking during pregnancy was 26.8%. It is worth to note that it was almost two times higher in women who self-identified as Roma (51.3%). 20.1% of the respondents were of Roma ethnicity. The age was from 13 to 47 years of age. 2.8% of the respondents were aged less than 18. The BMI ranged from 12.89 to 62.72, with 7.5% of respondents in the underweight category. 24.3% had only basic or less than basic education, 49.9% – medium, and 25.4% – higher education. 60.5% of the participants were married, 34.8% lived in cohabitation, and 4.7% were single. 49.4% of the respondents lived in rural areas, 50.6% in the cities. 72.9% of the participants had their houses equipped with full amenities, 15.4$ with partial amenities, and 11.7% lived in households without amenities.

Table 1 shows the correlation of the maternal demographic and socioeconomic variables and the SHS exposure during pregnancy in non-smoking. Women with lower education were more than 3 times more likely to be exposed to SHS (OR = 3.32, 95% CI = 2.64-4.18). Roma ethnicity (OR = 1.71, 95% CI = 1.36-2.15) and lack of amenities (OR = 1.70, 95% CI = 1.37-2.11) also increased the risk of exposure. The type of settlement in the household also correlated with the SHS exposure, although the correlation was milder than for the factors mentioned above (OR = 1.19, 95% CI = 1.01-1.41). Maternal age proved not to be a significant factor ($p = 0.161$).

Table 2 shows the newborns' basic biometric data, including birth weigt in grams, body length, head and chest circumference in centimetres and gestational age. All of the above mentioned variables followed the normal distribution pattern, which was also confirmed by the frequency analysis, as median and mode values were equal for the body length, head and chest circumference as well as gestational age (52 cm, 34 cm, 34 cm and 39 weeks). Mean and median values of the birth weight remained comparable (3,305.5 and 3,300.0, respectively) and the mode was only 100 grams smaller.

Table 3 compares the mean difference values of the neonatal birth weight (-154.9 grams), body length (-0.8 cm), head and chest circumference (-0.5 cm for both of the variables) and gestational age (-0.4 weeks) between the children of women exposed to SHS and those whose mothers were not exposed to passive smoking. All of the biometric data were significantly impacted by the SHS exposure ($p < 0.001$).

DISCUSSION

The risk of SHS exposure is dependant on woman's demographic and social status and on her sociolcultural environment. A study about passive smoking in India demonstrated that SHS exposure during pregnancy

Tab. 1. Results of binary logistic regression model of the effects of maternal biometric and sociodemographic factors on the risk of at-home SHS exposure during pregnancy (n = 5,934)

Maternal variables	OR	95% CI	p-value
Age < 18 v. ≥ 18	0.84	0.66-1.07	0.161
BMI underweight v. normal-overweight-obese	1.36	1.08-1.70	0.008
Education ≤ 8 basic classes v. > 8 basic classes	3.32	2.64-4.18	< 0.001
Cohabitation + single v. married	1.52	1.27-1.82	< 0.001
Roma v. non-Roma ethnicity	1.71	1.36-2.15	< 0.001
Rural v. urban settlement	1.19	1.01-1.41	0.042
No amenities v. partial or full amenities	1.70	1.37-2.11	< 0.001

Tab. 2. Live-born babies' birth weight, body length, head and chest circumference and gestational age of mothers who did not smoke during the pregnancy

Variable (n)	Mean	Median	Mode	Std. deviation
Birth weight (8,466)	3,305.5	3,300.0	3,200	522.694
Body length (8,444)	51.8	52.0	52	3.242
Head circumference (8,234)	34.2	34.0	34	1.803
Chest circumference (3,998)	33.5	34.0	34	2.063
Gestational age (8,497)	39.5	39.00	39	6.396

Note: independent samples t-test

Tab. 3. The results of the analysis in the bivariate model of birth weight (grams), body length, head and chest circumference (cm) and gestational age (weeks) mean differences with potential maternal SHS exposure during the pregnancy

Variables (n/n = exp/non exp.)	Mean difference	Std. error	95% CI	p-value
Birth weight (1,060/7,053)	-154.9	17.1	-188.5-121.3	< 0.001
Body length (1,057/7,035)	-0.8	0.1	-1.0-0.6	< 0.001
Head circumference (1,037/6,855)	-0.5	0.1	-0.6-0.3	< 0.001
Chest circumference (517/3313)	-0.5	0.1	-0.7-0.3	< 0.001
Gestational age (1051/7005)	-0.4	0.1	-0.5-0.2	< 0.001

Note: independent samples t-test

was more prevalent among lower-educated expectant mothers (15). A recently published paper in Malaysia revealed a similar pattern, stating that women who are younger, less educated, and have lower income are more likely to be exposed to SHS (16). Our results on the Hungarian population are similar. However, young maternal age (< 18 years) turned out not to be a significant factor in our binary logistic regression model analysis. We confirmed that low education was the most significant risk factor for the SHS exposure. Additionally, our data show increased risk for SHS exposure in mothers with low income, as it makes them more prone to being underweight and living without dwelling amenities. Hungary's Roma communities in our target area are facing multiple problems, as it was demonstrated by a comprehensive study in 2012 (17). Thus, we interpret the Roma ethnicity as a proxy of increased at-home SHS exposure and poorer neonatal outcomes, as shown in table 1.

SHS, similarily to active smoking, is associated with lower neonatal birth weight. A Hungarian study conducted in 2006 found a birth weight difference of 60-100 grams between children whose mothers were exposed to SHS during their pregnancy and those who were not (18). In a Malaysian study, which also analysed this parameter, the difference of weight was even bigger (153 g). In the same study, the risk of giving birth to a low birth weight neonate was higher in exposed women compared to the non-exposed ones (10.0 v. 4.7%) (16). A recently published meta-analysis of 20 studies confirmed negative effects of SHS on the birthweight of infants born to exposed nonsmoking women do exist (19). Our data on neonates' biometric parameters demonstrated that women who were exposed to SHS during pregnancy had babies who were, on average, 154.9 grams lighter than women who were not exposed to SHS. These data are similar to the results of a study conducted in India, where the average weight difference equaled 138 grams (15). This is a far bigger difference than the one shown in a recent systematic review and meta-analysis of secondhand smoke exposure and birthweight, which was only 33.0 grams (20).

Danish researchers examined the added impact of SHS outside and inside the household on the babies' body length as well as head and chest circumference. The negative difference in body length was 0.8 cm, in head and chest circumference – 0.5 cm and 0.5 cm, respectively (21). In a study conducted in Saudi Arabia, the mean length of the babies whose mothers were exposed to the cigarette smoke was 0.26 cm smaller (22). In Poland, pregnant women prenatally exposed to SHS delivered babies on average 1.1 cm shorter and with the chest circumference 1.3 cm smaller (23). Our results are in perfect accordance with these of Danish researchers and near to these observed in Poland. We did not find a quantitative study of SHS impact on th gestational age, however, a recently published meta-analysis of 11 eligible studies published in the years 2008-13 demonstrated that the smoke-free legislation was associated with substantial reductions in preterm birth cases worldwide (24).

CONCLUSIONS

Supporting smoking cessation during the pregnancy should be the primary aim of the public health programs. The latest Hungarian tobacco legislation in 2012 banned smoking in all public confined places, nevertheless, non-smoking women may continue to be exposed to harmful effects of SHS through their husbands and partners in their own housing facilities, which is not protected by the national clean air legislation. We conclude that the reduction of SHS exposure, especially targeting the most vulnerable populations such as the foetus and child, should be promoted as an integral part of the cessation programs.

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References

1. World Health Organization Report on the global tobacco epidemic, Enforcing bans on tobacco advertising, promotion and sponsorship 2013; 16. Available online at: http://apps.who.int/iris/bitstream/10665/85380/1/9789241505871_eng.pdf=en (accessed: 18 Nov. 2015). **2.** Special Eurobarometer 429 Attitudes of Europeans towards tobacco and electronic cigarettes EuropeanUnion, 2015; 3. Available online at: http://ec.europa.eu/public_opinion/archives/ebs/ebs_429_en.pdf=en (accessed: 20 Nov. 2015). **3.** Flash Eurobarometer Survey on Tobacco Analytical report March, European Union 2009; 12. Available online at: http://ec.europa.eu/public_opinion/flash/fl_253_en.pdf=en (accessed: 20 Nov. 2015). **4.** Pénzes M, Balázs P: Adolescecents'perceptions ont he effectivenes of tobacco control policies, Egészségtudomány (Health Science) 2013; 57(1): 57-74. **5.** Bodrogi J: Economic impact of tobacco smoking. [In:] Balázs P, Foley KL (eds.): Increasing Capacity for Tobacco Research in Hungary 2008-2013. Institute for History of Hungarian Sciences, Budapest 2013: 185-214. **6.** Paulik E: Social determinants of smoking and quitting in Hungary. [In:] Balázs P, Foley KL (eds.): Increasing Capacity for Tobacco Research in Hungary 2008-2013. Institute for History of Hungarian Sciences, Budapest 2013; 39-60. **7.** Act XLI of 2011 an amendment of Act XLII of 1999 on the Protection of Non-smokers and the Regulation of Tobacco Sales, Marketing and Use (Hungarian); http://www.kozlonyok.hu/nkonline/MKPDF/hiteles/MK11048.pdf (accessed: 26 Nov. 2015). **8.** Központi Statisztikai Hivatal Statisztikai Tükör 2015; április 30. 6. Available online at: https://www.ksh.hu/docs/hun/xftp/stattukor/elef14.pdf=en (accessed: 18 Nov. 2015). **9.** British Medical Association. Smoking and reproductive life. The impact of smoking on sexual, reproductive and child health. British Medical Association Board of Science and Education &Tobacco Control Resource Centre. London, United Kingdom, BMA 2004. Available online at: https://www.rauchfrei info.de/fileadmin/main/data/Dokumente/Smoking_ReproductiveLife.pdf=en (accessed: 18 Nov. 2015). **10.** Erickson AC, Heavy LT: Smoking during pregnancy as a marker for other risk factors of adverse birth outcomes: a population-based study in British Columbia, Canada. BMC Public Health 2012; 12: 102. **11.** Gardosi J, Madurasinghe V, Williams M: Maternal and fetal risk factors for stillbirth: population based study. BMJ 2013; 346: f108. **12.** Shah T, Sullivan K, Carter J: Sudden Infant Death Syndrome and Reported Maternal Smoking During Pregnancy. Am J Public Health 2006 Oct; 96(10): 1757-1759. **13.** Khader YS, Al-Akour N, AlZubi IM et al.: The Association Between Second Hand Smoke and Low Birth Weight and Preterm Delivery. Matern Child Health J 2011; 15: 453-459. **14.** Vadász I: Passzív dohányzás-tényleg olyan ártalmatlan? (Hungarian: Is passive smoking really harmless?) Védőnő 2000; 10(2): 14. **15.** Goel R, Radotra A, Singh I et al.: Effect of passive smoking on outcome in pregnancy. J Postgrad Med 2004; 50(1): 12-16. **16.** Norsa'Adah B, Salinah O: The Effect of Second-Hand Smoke Exposure during Pregnancy on the Newborn Weight in Malaysia. Malays J Med Sci 2014; 21(2): 44-53. **17.** Balazs P, Rakoczi I, Grenzer A, Foley KL: Risk factors of preterm birth and low birth weight babies among Roma and non-Roma mothers: a population-based study. The European Journal of Public Health 2012; 23(3): 480-485. **18.** Kovács G, Manchin R: A passzív dohányzás hatása az egészségre. Dohányzás vagy egészséges életmód? Medicina Könyvkiadó Zrt, Budapest 2006: 161-162. **19.** Hawsawi AM, Bryant LO, Goodfellow LT: Association between exposure to secondhand smoke during pregnancy and low birthweight: a narrative review. Respir Care 2015; 60(1): 135-140. **20.** Leonardi-Bee J, Smyth A, Britton J, Coleman T: Environmental tobacco smoke and fetal health: Systematic review and meta-analysis. Archives of Disease in Childhood: Fetal and Neonatal Edition 2008; 93: 351-361. **21.** Hegaard HK, Kjaergaard H, Møller LF et al.: The effect of environmental tobacco smoke during pregnancy on birth weight. Acta Obstetricia et Gynecologica Scandinavica 2006; 85: 675-681. **22.** Wahabi HA, Alzeidan RA, Fayed AA et al.: Effects of secondhand smoke on the birth weight of term infants and the demographic profile of Saudi exposed women. BMC Public Health 2013; 13: 341. **23.** Polanska K, Hanke W, Sobala W, Ligocka D: Impactt of prenatal enviromental tobacco smoke exposure on birth parameters. Przeglad Lekvars 2010; 67(10): 835-837. **24.** Been JV, Nurmatov UB, Cox B et al.: Effect of smoke-free legislation on perinatal and child health: a systematic review and meta-analysis. Lancet 2014; 383(9928): 1549-1560.

Conflict of interest
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