

Review Article

The Impact of Maternal Smoking on Fetal Outcome in Residents of the State of Hesse, Germany

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Submitted: 15 March 2017

Accepted: 19 May 2017

Published: 21 May 2017

ISSN: 2333-665X

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Keywords

- Maternal smoking
- Fetal growth
- Duration of pregnancy
- Fetal malformation
- Smoking-dose-relationships

Abstract

The consequences of maternal smoking of pregnant mothers on the fetus have been investigated in a population in the state of Hesse, Germany from 1990-2015. For the investigation a routine data collection with a total of 301.506 deliveries were analyzed. During the years 2011-2015 the investigation was focused on fetal malformation in relation to smoking (254 948 deliveries) and on the impact of smoking on duration of pregnancy and fetal weight.

Throughout the years 1990 -2015 the number of smokers decreased in the group of heavy smokers who smoked 10-19 and 20-29 cigarettes per day from 5.8 to 2.1 % and 2.3 to 0.4 % respectively, probably as a result of the antismoking campaign in Germany. The incidence of fetal malformations in relation to smoking mothers was not significantly elevated. Smoking had however a significant impact on the duration of pregnancy and the weight of the baby depending on the number of cigarettes smoked per day.

The decrease of smoking women during pregnancy during the past years is going to let us hope that women have realized the deleterious effect of smoking on their babies.

INTRODUCTION

Smoking during pregnancy has decreased over the past years in most of the countries. More than 1000 publications in Pub Med show that the problem of smoking during pregnancy has been recognized. With the present paper we would like to show how the smoking habit developed in a State of Germany (Hesse) during the past years. The perinatal survey in the State of Hesse, Germany provided the opportunity to study the impact of maternal smoking in a population of about five million people over 25 years. The data collection has been introduced in 1981. It started in 10 community hospitals (state hospitals) guided by a head obstetrician (Chefarzt) and eight non-resident hospitals cared for by non-resident doctors. According to the Munich perinatal review (1975-1997) [1], the aim of the data collection at this time was to reduce the comparatively high perinatal mortality of 1.07 % by a comprehensive quality assurance in obstetrics by a continuous data collection and review of the data throughout the following years. As a consequence it was in addition to get some information about habits which might have an influence on the outcome of pregnancy, such as maternal smoking. Since 1990 all

hospitals in the State of Hesse participated in the data collection, so that a comprehensive view regarding maternal behavior was possible.

MATERIAL AND METHODS

The present report on the impact of maternal smoking on pregnancy outcome is based on the continuous data collection from 1990 until 2015. It comprises three University hospitals (Giessen, Frankfurt and Marburg), 41 hospitals with major departments of gynecology and 8 non-resident hospitals in the State of Hesse (status in 2015). The investigation was focused on **three phases of the data collection:**

Part 1: Smoking habits of pregnant women from 1990 until 2015.

Part 2: Incidence of malformations in relation to smoking during the years 2011- 2015.

Part 3: Duration of pregnancy throughout the years 2011-2015.

In 2011-2015 a total of 254 948 women could be evaluated.

There were missing data regarding smoking in 25.4% of the cases related to an incomplete questionnaire. For statistical test (Chi²) SPSS 23.0 was used.

RESULTS

Cigarette consumption during pregnancy: Results from 1990 - 2015

The results of the analyses of smoking habits are shown in Table 1. The results show evidently a steady fall of cigarette smokers during the time of observation from 1990 to 2015 as well as the amount of cigarettes that were smoked. In 1990 about 5.8% and 2.3% of pregnant women smoked 10-19 and 20-29 cigarettes per day and in 2015 only 2.1% and 0.4% smoked a similar amount of cigarettes. Non-smokers increased during the same time from 84.7% to 94.3%. This might be the result of an ongoing campaign against smoking in pregnant women published in cinema, television and newspaper.

The incidence of congenital malformations in cigarette smokers

Table 2 shows the distribution of malformations between non-smokers and smokers. The incidence of malformations is according to table 3 slightly increased by smokers (1,0%) compared to nonsmokers (0,7%). In order to obtain differentiated results, the odds ratio was also calculated. With an odds ratio of 1.4, children of smokers have an almost 40 percent higher probability of developing a malformation than children of non-smokers. The results are significant at 5 percent significance level.

The impact of maternal smoking on pregnancy outcome

Duration of pregnancy and preterm delivery following smoking: The relationship between smokers and non-smokers

and gestational age is demonstrated in Table 3. For a gestation period of less than 32 weeks, there appears to be no difference between those two groups. For both non-smokers and smokers, 1.3% of the cases were born before the 32nd week of pregnancy. With a gestation period of between 32 and 36 weeks, however, it can be seen that a preterm delivery occurs more frequently in the group of smokers (6.9% for non smoker vs. 7.8% for smoker). This corresponds to a percentage difference of almost one percentage point. The differences become more obvious when evaluating the number of cigarettes smoked during the pregnancy. Although there is no large statistical difference between gestational age and smokers as well as non-smokers resp. significant differences however can be shown if the amount of cigarettes is considered by evaluating the impact of smoking on gestational age (Table 4 and Figure 1).

In non-smoking women 1.3% of the pregnancies are ended at <32 weeks, 6.9% at 32-36 weeks and 91.8% at > 36 weeks, whereas in *heavy smokers* of 20-29 and >30 cigarettes per day duration of pregnancy is reduced: 9.3% and 11.0% of these women are going to be delivered at 32-36 week of gestation (Table 4 and Figure 1).

The influence of smoking on birth weight

Shortening of pregnancy is paralleled by a reduction of birth weight. If the weight of the newborn is less than the 10th percentile the fetus is by definition retarded in his growth. The impact of smoking during pregnancy on birth weight of the infant is considered to be a major contributor.

There are many factors which can influence the fetal weight, such as maternal nutrition, duration of pregnancy and all factors which have an impact on the oxygen delivery to the fetus, i.e. smoking. Smoking is reducing the oxygen transport capacity by a reduction of uterine blood flow, so that the reduction of birth weight is a logical consequence (Figure 2).

Table 1: Maternal smoking in the State of Hesse, Germany from 1990 until 2015 - a result of a comprehensive information campaign. For the interpretation of the relationship of the various parameters Pearson's chi-squared test (χ^2 test =4084,715) was used. Empirical significance level = 0,00%.

		Years					
		1990	1995	2000	2005	2010	2015
Cigarette consumption during pregnancy	No cigarettes	47686	50535	52013	47675	35509	38201
	%	84,7%	87,7%	89,9%	93,2%	93,0%	94,3%
	<10 cigarettts	3837	3046	2526	1512	1305	1253
	%	6,8%	5,3%	4,4%	3,0%	3,4%	3,1%
	10 - 19 cigarettts	3245	2762	2299	1404	1059	866
	%	5,8%	4,8%	4,0%	2,7%	2,8%	2,1%
	20 - 29 cigarettts	1285	1102	893	484	272	162
	%	2,3%	1,9%	1,5%	,9%	,7%	,4%
	>30 cigarettts	221	182	144	57	36	25
%	,4%	,3%	,2%	,1%	,1%	,1%	
Total t	n	56274	57627	57875	51132	38181	40507
	%	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%

Table 2: Smoking during pregnancy and its impact on congenital malformations. There is an increased incidence of malformation in smokers. Pearson's chi-squared test was used (χ^2 test = 41,865). Empirical significance level = 0,00%.

			Cigarette consumption	
			Non-smoker	Smoker
Malformation	No	N	579 822	46 486
		%	99,3%	99,0%
	Yes	N	4 171	460
		%	0,7%	1,0%
Total	N	583 993	46 946	
	%	100,0%	100,0%	

Table 3: Duration of pregnancy in non-smokers and smokers. Chi-Quadrat-Test (χ^2 test = 126,571) (empirical significance level = 0,00%).

Week of gestation			Cigarette consumption		Total
			Non smoker	Smoker	
< 32 weeks	n	14.137	1.606	15.743	
	%	1,3%	1,3%	1,3%	
32 - 36 weeks	n	77.777	9.647	87.424	
	%	6,9%	7,8%	7,0%	
> 36 weeks	n	1.028.532	112.489	1.141.021	
	%	91,8%	90,9%	91,7%	
Total	n	1.120.446	123.742	1.244.188	
	%	100,0%	100,0%	100,0%	

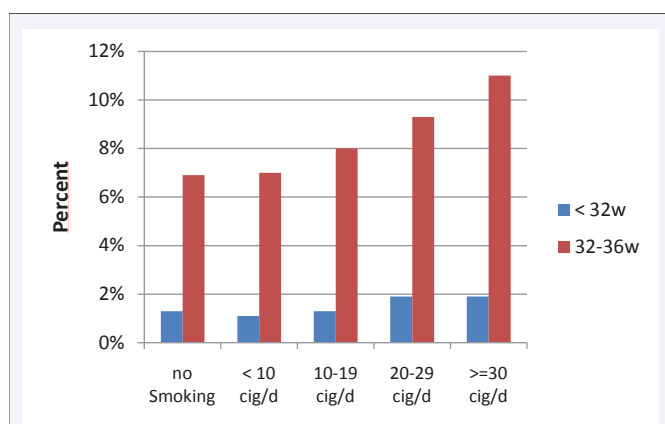


Figure 1 The impact of smoking habits on duration of pregnancy. With rising amount of cigarettes smoked per day duration of pregnancy is shortened to <32 weeks and to 32-36 week of gestation by 1% and 6-12 % respectively. The figure is based on table 4.

DISCUSSION

Smoking has in various groups of the society a long tradition. Smoking became widely accepted at all levels of the society. However in recent years medical research focused on the negative influence of tobacco consumption and smoking on the development of cardiovascular diseases, lung cancer and the impact on the developing child in utero [2].

As shown in investigations, smoking during pregnancy can result in a number of diseases, such as congenital heart defects, [3], ADHD in offspring [4-6], disturbances of social-emotional

development [7], in stillbirth [8,9], congenital malformation [10], neonatal outcome and disturbances of neuro-behavior [11-14], and fetal heart rate characteristics [15]. Smoking nearly doubles the risk of low birth weight babies [16-18].

The most important impact on the fetus is that nicotine in cigarette smoke constricts the blood vessels of the utero-vascular system and the placenta leading to a reduced oxygen delivery to the fetus. These effects account for the fact that, on average,

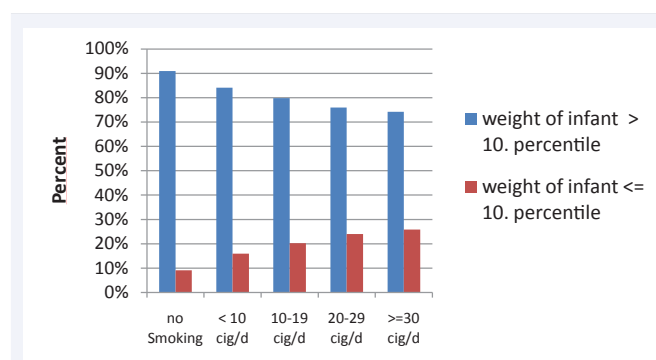


Figure 2 The relationship between fetal birth weights of more than 10th percentile (blue columns) and below the 10th percentile (red columns) in non smokers and heavy smokers of 30 and more cigarettes per day. The red columns demonstrate clearly the impact of heavy smoking on the fetal intrauterine development regarding fetal birth weight. (the gestation period, multiple births and gender were considered while evaluating the 10th percentile) Pearson's chi-squared test was used (χ^2 test = 12898,508). Empirical significance level = 0,00%.

Table 4: Cigarette smoking and duration of pregnancy. With rising amount of cigarette- smoking the duration of pregnancy is going to fall. Pearson's chi-squared test was used (χ^2 test=371,58). Empirical significance level= 0,00%.

Duration of pregnancy			Cigarette consumption				
			no cigarettes	<10 cigarettes	10 - 19 cigarettes	20 - 29 cigarettes	> 30 cigarettes
<32 weeks	n		14.137	584	645	327	50
	%		1,3%	1,1%	1,3%	1,9%	1,9%
32 - 36 weeks	n		77.777	3.874	3.846	1.636	291
	%		6,9%	7,0%	8,0%	9,3%	11,0%
>36 weeks	n		1.028.532	50.975	43.541	15.670	2.303
	%		91,8%	92,0%	90,6%	88,9%	87,1%
Total	n		1.120.446	55.433	48.032	17.633	2.644
	%		100,0%	100,0%	100,0%	100,0%	100,0%

babies born to smoking mother are usually born too early and have low birth weight of less than 2,500 grams as shown in the present investigation. It is more likely that the baby of heavy smokers will become sick or even die [19], if not freed from its hostile environment.

Prematurity and low birth weight babies face an increased risk of serious health problems. Newborns are threatened and visage a chronic lifelong disability by cerebral palsy, having an impact on fetal motor conditions causing physical disabilities, mental retardation and learning difficulty.

CONCLUSION

The article examined how the consumption of cigarettes during pregnancy affects fetal outcome in the state of Hesse, Germany. For this purpose, various analyzes were made on the basis of data records from Hessian hospitals which were collected between 1990 and 2015. The aim of the article was to examine the influence of cigarette consumption on congenital malformations, the duration of pregnancy, preterm deliveries and fetal birth weight in Hesse, Germany and how the cigarettes consumption in Hesse, Germany developed over the last 25 years.

Overall, this evaluation has shown that the consumption of cigarettes during pregnancy in Hesse, Germany has fallen significantly in the last 25 years. However, the effects of cigarette consumption on the fetal outcome are still relevant. Especially the number of smoked cigarettes plays an important role in the duration of pregnancy and the birth weight.

Nevertheless, the decrease of smoking mothers as shown by the present study let us hope that the problem has been recognized. The task to stop this habit to prevent the deleterious effects on the baby is the challenge of the future.

REFERENCES

- Münchner Perinatal-Studie 1957-1977, Daten, Ergebnisse, Perspektiven. Zentralinstitut für die kassenärztliche Versorgung Deutschland, Deutscher Ärzte-Verlag. Wissenschaftliche Reihe Band 17.
- Anderka M, Paul AR, Lixian S, Druschel C, Suzan C, Shaw G, et al. Patterns of tobacco exposure before and during pregnancy. *Acta Obstet Gynecol Scand.* 2010; 89: 505-514.
- Sullivan PM, Dervan LA, Reiger S, Buddhe S, Schwartz SM. Risk of congenital heart defects in the offspring of smoking mothers: a population-based study. *J Pediatr.* 2015; 166: 978-984.
- Langley K, Heron J, Smith GD, Thapar A. Maternal and paternal smoking during pregnancy and risk of ADHD symptoms in offspring: testing for intrauterine effects. *Am J Epidemiol.* 2012; 176: 261-268.
- Zhu JL, Olsen J, Liew Z, Li J, Niclasen J, Obel C. Parental smoking during pregnancy and ADHD in children: the Danish national birth cohort. *Pediatrics.* 2014; 134: e382-388.
- Melchior M, Hersi R, van der Waerden J, Larroque B, Saurel-Cubizolles MJ, Chollet A, et al. Maternal tobacco smoking in pregnancy and children's socio-emotional development at age 5: The EDEN mother-child birth cohort study. *Eur Psychiatry.* 2015; 30: 562-568.
- Bjørnholt SM, Leite M, Albieri V, Kjaer SK, Jensen A. Maternal smoking during pregnancy and risk of stillbirth: results from a nationwide Danish register-based cohort study. *Acta Obstet Gynecol Scand.* 2016; 95: 1305-1312.
- Joseph M, Åshild V, Siri HO, Torleiv OR. Objective measurements of nicotine exposure in victims of sudden infant death syndrome and in other unexpected child deaths. *J Pediatrics.* 1998; 133: 232-236.
- Leite M, Albieri V, Kjaer SK, Jensen A. Maternal smoking in pregnancy and risk for congenital malformations: results of a Danish register-based cohort study. *Acta Obstet Gynecol Scand.* 2014; 93: 825-834.
- Bakker R, Kruihof C, Steegers EA, Tiemeier H, Mackenbach JP, Hofman A, et al. Assessment of maternal smoking status during pregnancy and the associations with neonatal outcomes. *Nicotine Tob Res.* 2011; 13: 1250-1256.
- Hernández-Martínez C, Arija Val V, Escribano Subías J, Canals Sans J. A longitudinal study on the effects of maternal smoking and secondhand smoke exposure during pregnancy on neonatal neurobehavior. *Early Hum Dev.* 2012; 88: 403-408.
- Hodyl NA, Stark MJ, Scheil W, Grzeskowiak LE, Clifton VL. Perinatal outcomes following maternal asthma and cigarette smoking during pregnancy. *Eur Respir J.* 2014; 43: 704-716.
- Reissland N, Francis B, Kumarendran K, Mason J. Ultrasound observations of subtle movements: a pilot study comparing foetuses of smoking and nonsmoking mothers. *Acta Paediatrica.* 2015; 104: 596-603.
- Cheryl Oncken, Henry Kranzler, Paulette O'Malley, Paula Gendreau,

- Winston A Campbell. The effect of cigarette smoking on fetal heart rate characteristics. *Obstet Gynecol.* 2002; 99: 751-755.
15. Suzuki K, Sato M, Zheng W, Shinohara R, Yokomichi H, Yamagata Z. Effect of maternal smoking cessation before and during early pregnancy on fetal and childhood growth. *J Epidemiol.* 2014; 24: 60-66.
16. Küpers LK, Xu X, Jankipersadsing SA, Vaez A, la Bastide-van Gemert S, Scholtens S, et al. DNA methylation mediates the effect of maternal smoking during pregnancy on birthweight of the offspring. *Int J Epidemiol.* 2015; 44: 1224-1237.
17. Riedel C, Schönberger K, Yang S, Koshy G, Chen YC, Gopinath B, et al. Parental smoking and childhood obesity: higher effect estimates for maternal smoking in pregnancy compared with paternal smoking-a meta-analysis. *Int J Epidemiol.* 2014; 43: 1593-1606.
18. Mourtakos SP, Tambalis KD, Panagiotakos DB, Antonogeorgos G, Arnaoutis G, Karteroliotis K, et al. Maternal lifestyle characteristics during pregnancy, and the risk of obesity in the offspring: a study of 5,125 children. *BMC Pregnancy Childbirth.* 2015; 15: 66.
19. Constantine I, Vardavas, Leda Chatzi, Evridiki Patelarou, Estel Plana, Katerina Sarri, Anthony Kafatos. Smoking and smoking cessation during early pregnancy and its effect on adverse pregnancy outcomes and fetal growth. *Eur J Pediatr.* 2010; 169: 741-748.

Cite this article

Schuster R, Misselwitz B, Künzel W (2017) *The Impact of Maternal Smoking on Fetal Outcome in Residents of the State of Hesse, Germany.* *J Addict Med Ther* 5(1): 1027.