

Using the questionnaire and cotinine concentration in urine for study smoking habit and exposure to ETS of pregnant women

Zastosowanie kwestionariusza ankiety i pomiar kotyniny w moczu do oceny nałogu palenia i ekspozycji na ETS kobiet ciężarnych

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The aim of this study was to evaluate the exposure of pregnant women to tobacco smoke on the basis of a standardised survey questionnaire, and determination of cotinine in urine. In the study participated 133 women delivering, checked in at the Obstetric Department of Independent Public Health Care Unit in Srem in 2003. The all women fill in the questionnaire forms referring smoking and exposure to ETS (Environmental Tobacco Smoke). In the tested group 22.6% were smoking during pregnancy. Only 5 pregnant women quit smoking, however around 60% of smokers reduced the number of cigarettes. Near 56% of women were exposed to ETS, mainly during social events. In case of women, who declared smoking the mean concentration of cotinine was 2164 ng/mg of creatinine. Passive smokers had cotinine concentration between 10 and 50 ng/mg of creatinine. Cotinine may be used to validate tobacco smoke exposure assessment from surveys.

Introduction

It is estimated that over 30% of world population in the age exceeding 15 smoke cigarettes, which means that there are over 1.1 billion smokers [25]. In Poland the use of tobacco products was increasing from the beginning of 50s until the end of 70s. In 80s the tendency stopped in order to drop in 90s. The statistical data from 2002 show that in Poland 42% of men and 22% of women smoke tobacco on a daily basis. As many as 60% of non-smokers are exposed to environmental tobacco smoke (ETS). Also, extremely disturbing is the increased popularity of smoking among pregnant women among who 30% are smokers [6]. The exposition of foetus, newborn and child to environmental tobacco smoke is a special problem.

One of the first effects of smoking by women is a decreased fertility [8]. It results from the abnormality of many mechanisms, including a disturbance of gametogenesis, ovulation, impregnation, fallopian tube trans-

Celem pracy była ocena narażenia kobiet ciężarnych na dym tytoniowy w oparciu o opracowany kwestionariusz ankiety i pomiar kotyniny w moczu. W badaniach wzięły udział 133 kobiety rodzące, które zgłosiły się do Oddziału Porodowego w Samodzielnym Publicznym Zakładzie Opieki Zdrowotnej w Śremie. Pacjentki wypełniły kwestionariusz ankiety dotyczący palenia tytoniu i narażenia na dym zawarty w środowisku (ETS). W badanej grupie było 22,6% kobiet, które paliły w czasie ciąży. Tylko 5% kobiet przerwało palenie w czasie ciąży, natomiast około 60% pacjentek ograniczyło liczbę wypalanych papierosów dziennie. Prawie 56% kobiet było narażonych na ETS podczas ciąży. Stężenie kotyniny w moczu kobiet deklarujących palenie wynosiło średnio 2164 ng/mg kreatyniny, a u kobiet narażonych na dym tytoniowy w środowisku stężenie to wahało się od 10 do 50 ng/mg kreatyniny. Oznaczanie kotyniny może być wykorzystywane do weryfikacji odpowiedzi ankietowych dotyczących palenia tytoniu.

port, implantation and formation of placenta. The risk of infertility for smoking women rises to 21% [7,17].

It has also been proven that smoking women are at an increased risk of miscarriage (approximately 1.5-2 times) [7], premature repature of placenta (23-86%) or placenta previa (25-92%) [23]. An increased risk of extrauterine pregnancy by 40 % and of ectopic pregnancy was also observed [2,3,10].

Many studies proved that the children of smoking mothers are born lighter, on the average by 200-300 g, shorter (~0.9 cm), and have a smaller head and chest circumference [9,11,20,24].

A very important effect of smoking tobacco during the pregnancy is an increased probability (1.5 fold) of congenital malformation in newborn [14].

It was found that in case of newborn by smoking women, the sudden infant death syndrome occurs 4 to 5 times more often, and increase with the number of cigarettes

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smoked by the mother.

For evaluation the active and passive tobacco smoking, a number of methods are used, including: surveys, determination of same chemicals in the air, and biological markers (cotinine, thiocyanate, carboxyhemoglobin and protein and DNA adducts. Individual monitoring and biomarker determination are direct techniques of measurement, while surveys and air measurements are indirect methods. Cotinine is the most frequently used biomarker for distinguishing active and passive smoking, because it is specific for tobacco smoke and has a relatively long biological half-life [18,19].

The aim of this study was to evaluate the exposure of pregnant women to tobacco smoke on the basis of a standardised survey questionnaire, and determination of cotinine in urine.

Materials and Methods

In the study participated 133 women who checked in at the Obstetric Department of Independent Public Health Care Unit in Srem in 2003. The study protocol was approved by the Bioethics Committee at the University of Medical Sciences of Poznan. The conducted study was in compliance with the Helsinki Declaration of 1975. The participation in the study was voluntary.

In order to determine active and passive tobacco smoking, a survey was conducted with a standardised questionnaire (23 questions). The questions referred to socio-economic conditions of the women, their smoking habit, and passive exposure to tobacco smoke.

A time of admission to hospital, from all the women (smokers, passive smokers and non-smokers not exposed) urine samples were taken and cotinine was determined by previously described high performance liquid chromatography method [16].

Statistical analysis

For statistical evaluation of results the analysis of variance was used, and differences in distribution of variables examined were assessed with the use of Chi² test.

Results and Discussion

In the study (n=133) most of the women

were in the age of 25-29 and below 25 (respectively: 38.4% and 34.6 %). With regard to education, 43.6% declared secondary (collage) education and 36.8% vocational education. Women surveyed were mainly physical workers (43.6%) or housewives (33.8%), and their monthly income per member of the family was usually low (50.3%). The polled were mainly inhabitants of villages (49.6%) or small towns (46.4%). The largest group were married women (91.7%).

In the tested group, smoking before pregnancy was declared by 28.6% of the women, (figure 1) which is a result higher by approx. 7% than the average for Poland.

Most frequently the smokers were the surveyed in the age of 30-34 (40.1%), with an elementary education (50.2%). The place of residence or income per member of the family did not influence significantly the frequency of smoking, although a higher number of smokers among women with the lowest income (42.3%, compared to 27.4% among people with the highest material status) and living in the city (30.2% compared to inhabitants of villages. Among the surveyed a majority (70.3%) smoked fewer than 10 cigarettes per day. Detailed data are shown in table 1 and on the figure 2.

The relations between tobacco smoking and level of education are present in the data of Central Statistics Office of Poland [11]. It indicates that smoking women with elementary (more than 40%) and vocational education (by ca. 30%) prevail over those with secondary (by ca 15%) or higher education (by ca. 10%). A similar relation was observed between the income level and tobacco smoking frequency, the lower the income, the more popular tobacco smoking. In other European countries, with a higher level of living than in Poland the situation is reversed, more women smoke in families with high income levels [6].

In the studied group 22.6% of surveyed were smoking during their pregnancy (figure 1). The highest percentage of smokers was among women aged 30 to 34 (42.3%), and the lowest was among women below 25 years (11.0%). It was shown that the percentage of smokers among the least educated persons was the highest 52.2%, whereas better educated women (with secondary or higher education) smoked less, 13.3% and 9.3% respectively. Also a small increase in the frequency of smoking was observed among women with the lowest income and living in the cities. During the pregnancy there was a increase in the number of women smoking a lower number of cigarettes (>5 cigarettes per day) – from 31.5% before pregnancy to ~60 % during the pregnancy, which indicate by reduction of smoking by pregnant women (table 1, figure 2).

When compared to the results of Hanke (14.7% of women smoking during the pregnancy) in the year 2001, an increased frequency of smoking among the surveyed can be observed once again [9]. Szamatulska's studies show that in different regions of Poland the percentage of smoking women is similar. The studies also confirmed the thesis that smoking during the pregnancy significantly reduces the birth weight of newborns [11]. A survey among pregnant women in northern Poland (Bydgoszcz) showed that as many as 31.1% smoked tobacco during the pregnancy, and that the percentage of newborns with a lower birth mass, body length and head circumference increased in that group. In other studies conducted in the same part of Poland (Gdansk) it was noted that 38.7% of pregnant women were smoking, and a statistically significant increase in the number newborns with lowered birth parameters was observed in that group [24]. Findings from studies conducted in Sweden show that propagation of smok-

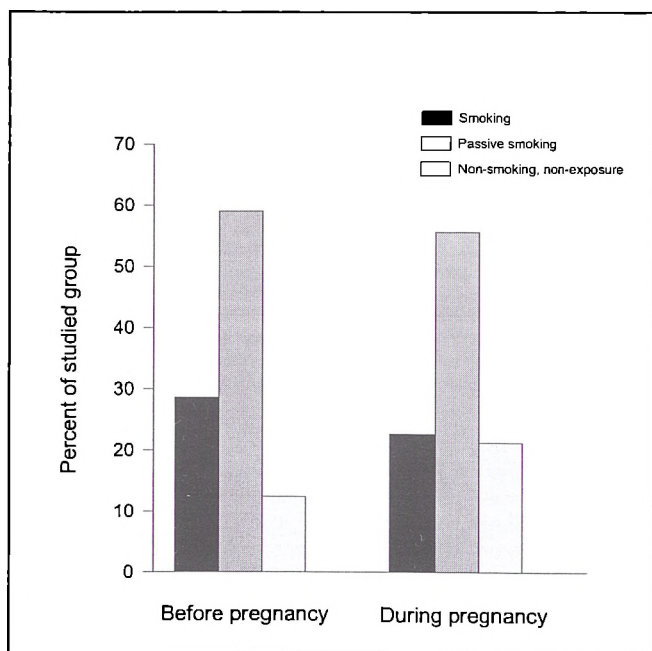


Figure 1
Cigarettes smoking and exposure to ETS before and during pregnancy.
Procent kobiet palących i narażonych na ETS przed i w czasie ciąży.

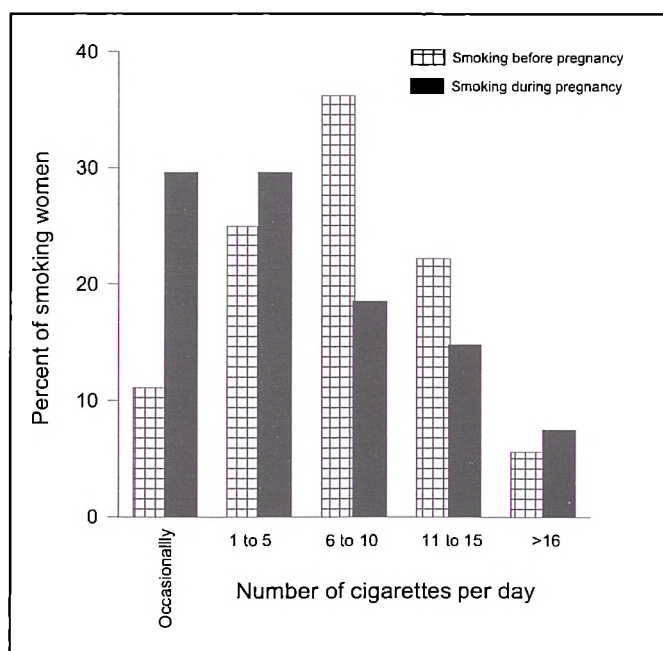


Figure 2
Numbers of smoked cigarettes by women before and during pregnancy.
Liczba wypalanych papierosów dziennie przed i w czasie ciąży.

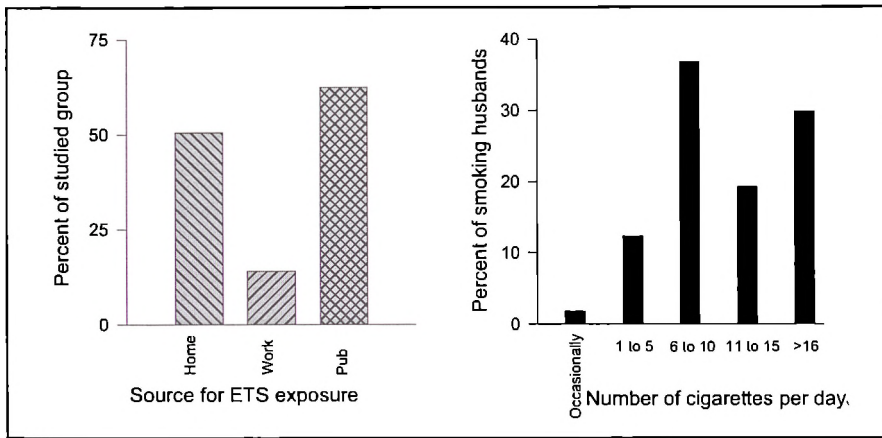


Figure 3
Source of exposure to ETS of pregnant women (left) and numbers of smoked cigarettes by husband or partner (right).
 Źródło narażenia na ETS kobiet ciężarnych (lewy) i liczba wypalanych papierosów przez męża/partnera (prawy).

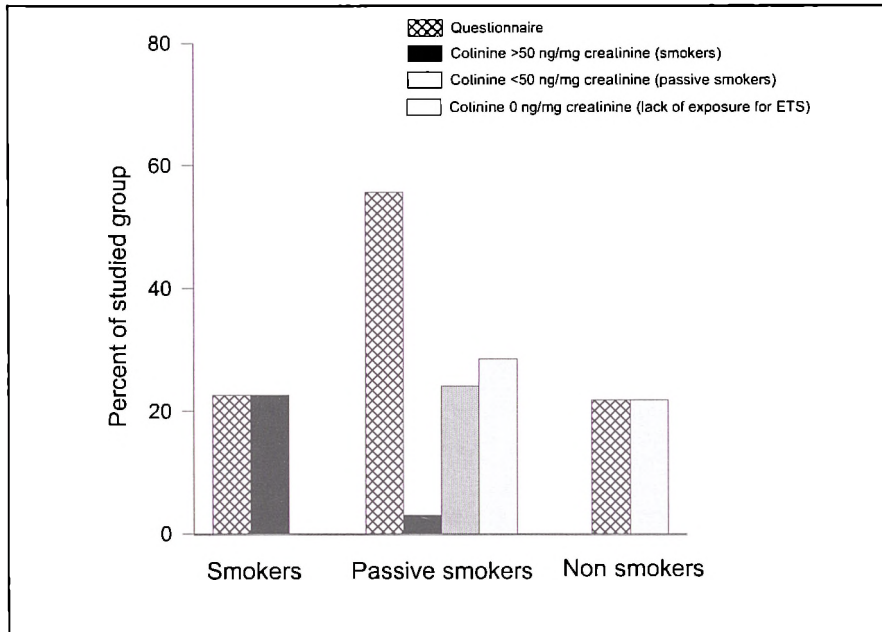


Figure 4
Classification on smokers, passive smokers and non-smokers on the base of questionnaire and cotinine concentration in urine.
 Podział na kobiety palące, narażone na ETS i niepalące w oparciu o oznaczone stężenie kotyniny w moczu.

Table I
Demographic data of smoking and exposure for ETS woman.
 Dane demograficzne kobiet palących i narażonych na ETS.

Data	Percent of smokers /ETS in studied group		
	Before pregnancy	During pregnancy	Exposure for ETS
Age (years)			
< 25	18.6	11.0	24.9
25 -29	18.8	18.0	24.6
30 -34	40.1	42.3	27.0
> 35	22.5	28.7	23.5
Education			
Basic	50.2	52.2	30.0
Vocational	19.2	24.8	25.6
Secondary (Collage)	16.9	13.7	23.7
High (High school)	13.7	9.3	20.7
Place of residence			
City > 100 000 inhabitants	30.2	53.4	25.6
Town < 100 000 inhabitants	42.8	26.3	36.5
Village	27.0	20.3	37.9
Income			
Low	42.3	47.0	36.7
Medium	30.3	31.2	30.5
High	27.4	21.8	32.8

ing depends on the type of profession; usually it was physical workers (25%) and housewives (21%) who were addicted, and

least frequently the habit related to women with a high social status (4%) [12].

The current study shown a slightly higher

frequency of smoking among women from urban areas. Such a result can be also found in other studies, showing that in the countryside 15% of pregnant women smoke, and in the cities – approximately 25% [26].

In the studied group of women in 43% of cases the partner of the pregnant was a smoker (figure 3) and approximately 50% of them have smoked more than 10 cigarettes per day.

Near 56% of women were exposed to passive smoking (figure 1) and approx. 50% of tat women were exposed to it at home, 14% at the workplace, and 62 % during recreation and social meetings (figure 3). The highest exposure to tobacco smoke was found among women aged 30 to 34 (27%), with elementary education (30%). Neither the place of living nor income significantly influenced the ETS exposure, although women from small towns and villages were more exposed to tobacco smoke (table I).

Such a high exposure to tobacco smoke in environment (approx. 56%) shows a slightly higher exposure than in other studies, conducted earlier in Poland, for example in central Poland (Lodz) 47.2% of women exposed to ETS were registered [9]. A significantly higher exposure of women to ETS at the workplace than in the current studies was indicated in Ahlborg et. al. [1]. In his studies almost 40% of those declaring ex-

Table II

Classification of studied population on non-smokers, smokers, and passive smokers on the base of cotinine determination.

Podział badanej grupy na kobiety niepalące, palące i narażone na ETS w oparciu o wynik oznaczeń kotyniny w moczu.

	Non-smokers	Smokers	Passive smokers*
Cotinine concentration [ng/mg creatinine]	Below limit of detection	2164±563	12±15 (with "0") 25±11 (without "0")
Range of cotinine concentrations [ng/mg creatinine]	Below limit of detection	1379-3451	10 (0)-50

* Calculated without results above 50 ng/mg creatinine indicated active smoking (581±150 ng/mg creatinine, n=4)

posure to tobacco smoke pointed to that source. A similarly high exposure of women to tobacco smoke (35%) at the workplace was found in Japan, and the authors included in that group only the women that were exposed for at least 2 hours per day [15]. The results of studies conducted in Italy, similarly to this assessment, showed the highest exposition to ETS among the oldest women, with the lowest education and marital status [4].

In our study, the assessment of exposure to tobacco smoke on the basis of survey data was confirmed by cotinine determination. The level of cotinine enabled for differentiation of examined women into three groups: non-smoking and not exposed to tobacco smoke, passive smokers and active smokers. The most difficult, due to ambiguity, is the differentiation of the first two groups, due to individual differences in nicotine metabolism and frequently non-precise information about the time of last exposure to ETS.

Obtained results (table II) showed that in case of women, who declared active smoking (22.6%), the concentration of cotinine was higher than 1500 ng/mg of creatinine (mean 2164 ng/mg of creatinine). Among women who passive smoking 24.1% had concentration of cotinine 5-50 ng/mg of creatinine and in as many as 28.5% of cases the level of cotinine in urine was zero (below limit of detection). This result may be the consequence of time that passed from the admission to the hospital (that is, discontinuation of exposure to smoke) to sampling or overestimation of exposure to tobacco smoke by questioned women. In case of 3% of women that declared themselves to be non-smokers passively exposed to smoke concentration of cotinine (above 50 ng/mg of creatinine) showed that they were smokers (figure 4). The rest of women, non-smoking and not exposed to ETS (21.8%), had a zero level of nicotine metabolite.

Cummings et. al. determined in a population of 663 persons declaring themselves to be non-smokers an average concentration of cotinine in urine on the order of 8.84 ng/ml (the range was from 0 to 85 ng/ml). This author has set the boundary that differentiates smokers from non-smokers at 90 ng/ml [5].

In order to differentiate smokers from passive smokers, cotinine was used also by Jarvis et. al., who showed statistically significant differences in the concentrations of this compound in serum, saliva and urine between the above mentioned groups [13]. Wald determined cotinine in a similar manner; in active smokers the average concentration of this metabolite in urine was 1474 ng/ml of urine, and in exposed to ETS 4 ng/ml [22].

Summary and conclusion

From our studies can be conducted one can state that approximately 1/4th of examined women were smokers. They were mostly women older than 30 years, with a low education level. Other factors (place of living, income) had a lower influence on the smoking habit, although slightly more women with a lower income smoked tobacco. During the pregnancy, only 7% of women stop smoking, however major part of them reduced number of smoked cigarettes. A worrying phenomenon is the very high exposure (56%) of pregnant women to ETS. The women most frequently exposed are older than 30 years, with elementary education, living in a village or a small town.

This study confirm that, cotinine may be successfully used to validate tobacco smoke exposure assessment from surveys. It can be determined during routine biochemical examinations of blood and urine, especially in case of women with reproductive function disturbances. Making aware of health hazards due to smoking and exposure to ETS should change patients' habits and motivate their partners to smoking cessation. Such activities would allow not only improve women's health, but also reducing the harmful influence of tobacco smoke to foetus, newborn and child.

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