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Secondhand smoke exposure at home in a representative sample of adults in Poland in 2024: A cross-sectional survey

Mateusz Jankowski, Prof. Ph.D. MD
Department of Population Health, School of Public Health, Centre for Medical Postgraduate Education, Warsaw, Poland
ORCID: 0000-0002-7142-5167
ul. Kleczewska 61/63, 01-826 Warszawa, Polska.
Email: mateusz.jankowski@cmkp.edu.pl
Phone: +48 22-5601-150

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Abstract

Secondhand smoke (SHS) is the smoke produced when tobacco products – such as cigarettes – are burned; SHS is harmful to health. This study assesses secondhand smoke exposure at home in a representative sample of adults in Poland and identifies factors associated with secondhand smoke exposure at home. This study is based on data from a nationwide cross-sectional survey (February 2024). Self-reported exposure to SHS at home was assessed using a questionnaire. The study population was comprised of 1,080 adults aged 18 years and over, of which 36.2% smoked cigarettes or used e-cigarettes or heated tobacco in the past 30 days. Exposure to secondhand smoke at home was declared by 25.1% of all respondents, including 41.2% among smokers and 16.0% among non-smokers. Among all respondents, the factors significantly associated with higher odds of exposure to secondhand smoke at home were living in rural areas (OR: 1.84, 95%CI: 1.07–3.17, p=0.03), having three or more household members (OR: 2.63, 95%CI: 1.37–5.06, p=0.004), having bad economic status (OR: 1.68, 95%CI: 1.03–2.72, p=0.04), smoking cigarettes (OR: 2.26, 95%CI: 1.62–3.16, p<0.001), and using e-cigarettes or heated tobacco products (OR: 2.18, 95%CI: 1.49–3.20, p<0.001). Among non-smokers (n=689), the factors significantly associated with exposure to secondhand smoke at home were living in rural areas (OR: 2.35, 95%CI: 1.10–5.02, p=0.03) and having three or more household members (OR: 2.42, 95%CI: 1.01–5.81, p=0.04). This study revealed that SHS exposure at home remains a significant public health problem in Poland.

Keywords: secondhand smoke; exposure; tobacco smoke; smoke-free policy

Introduction

Secondhand smoke (SHS) is the smoke produced when tobacco products, such as cigarettes, are burned (Okoli & Kodet, 2015; Flor et al., 2024). SHS exposure happens when people inhale smoke expelled by smokers or from tobacco products (Okoli & Kodet, 2015; Lee et al., 2022; Flor et al., 2024). SHS is harmful to human health: it is estimated that 1 million deaths annually are caused by SHS exposure [2]. Non-smokers exposed to SHS are at higher risk of cardiovascular diseases, lung diseases, and cancers (Lee et al., 2022). Moreover, in children, SHS exposure can evoke asthma attacks and respiratory infections (Mbulo et al., 2016). There are no safe levels of secondhand smoke exposure, so only policies aimed at completely eliminating SHS from the environment can effectively protect the population.

In Poland, between 2009 and 2019, a significant decrease in SHS exposure in public places was observed, as a consequence of the smoke-free law adopted in 2010 (Jankowski, Rees, et al., 2020). The greatest progress in protecting against SHS exposure was observed in transport services, where the percentage of adults in Poland exposed to SHS decreased from 45.7% in 2009 to 11.7% in 2019 (Jankowski Rees, et al., 2020). A similar decrease was observed in bars/pubs: from 45% in 2009 to 7% in 2019 (Jankowski et al., 2020). In September 2019, SHS exposure at home (in the past 30 days) was reported by 6.1% of respondents, including 11.5% of smokers and 4.5% of non-smokers (Jankowski, Pinkas, et al., 2020). Between 2019 and 2022, the percentage of households in Poland that implemented fully smoke-free homes decreased from 66.1% to 60.6% (Ostrowska et al., 2023). The following sociodemographic groups were more likely to have a fully smoke-free home: males, non-smokers, those with higher education, and those who live alone (Ostrowska et al., 2023). In 2024, 44.1% of adults in Poland declared support for the new law to institute a smoking ban on private balconies (Grudziąż-Sękowska et al., 2024). Public health interventions based on legal regulations are one of the most effective forms of action that protect non-smokers from exposure to SHS.

SHS exposure at home remains a significant public health problem (Okoli & Kodet, 2015; Lee et al., 2022; Flor et al., 2024). A home is an indoor environment where people spend most of their time. It is particularly important to protect vulnerable populations (especially children) from SHS exposure in the home (Mbulo et al., 2016; Lee et al., 2022; Possenti et al., 2024). Analyzing current levels of SHS exposure at home and identifying factors associated with SHS exposure at home may inform policymakers about further needs for anti-tobacco interventions and other actions to protect non-smokers from exposure to SHS (Possenti et al., 2024).

This study assesses secondhand smoke exposure at home in a representative sample of adults in Poland and identifies factors associated with secondhand smoke exposure at home.

Material and methods

Study design and measures

This study is based on data from the nationwide cross-sectional survey on the attitudes of Poles towards smoking and the use of novel nicotine-containing products. Data were collected in February 2024 by a dedicated public opinion company – Nationwide Research Panel Ariadna (Jankowski et al., 2024) – using computer-assisted web interviews. The questionnaire was available online on the research platform managed by Nationwide Research Panel Ariadna and all participants received invitations via e-mail and text message. Respondents were selected (quota sampling method) from over 100,000 adult users of the company's services. The study sample was selected following the stratification model that included gender, age, and size of the place of residence in line with the Demographic Yearbook published annually by Statistics Poland.

Secondhand smoke exposure at home was assessed with the following question: "In the last 30 days, have you been exposed to secondhand smoke in the home where you live (someone smoked in your presence)?" (yes/no).

Questions on socioeconomic characteristics were also addressed (Jankowski et al., 2024).

Non-smokers were defined as those who did not use cigarettes, e-cigarettes, or heated tobacco products in the last 30 days at least (even once).

The study protocol was approved by the Ethical Review Board at the Center of Postgraduate Medical Education (No. 403/2023) as of 23 August 2023. All procedures were in line with the Declaration of Helsinki.

Data analysis

The data were analyzed using IBM SPSS Statistics version 29 and are presented with frequencies and proportions. The chi-squared test was used to analyze differences between qualitative variables. Multivariable logistic regression models were prepared to identify factors associated with secondhand smoke exposure at home in a general population, as well as among non-smokers (dependent variable). In bivariable analysis, all variables were analyzed separately. The variables which were found to be statistically significant in the bivariable analysis were included in the multivariable logistic regression model. Odds ratios (OR) and 95% confidence intervals (95%CI) were used to present the results of regression analysis. The threshold for statistical significance was set at $p<0.05$.

Results

The study population was comprised of 1,080 adults aged 18 years and over, of whom 30.4% were cigarette smokers (in the past 30 days), 15.2% had used e-cigarettes at least once in the past 30 days, and 10.9% had used heated tobacco products at least once in the past 30 days (Table 1). Exposure to secondhand smoke at home was declared by 25.1% of all respondents. Younger respondents (18–29 years) more often declared exposure to secondhand smoke at home (p=0.001). Moreover, the highest exposure was declared by those with elementary education (33.3%; p=0.04), those in informal relationships (36.1%; p=0.02), and those living in rural areas (29.1%; p=0.04). Higher percentages of respondents exposed to SHS at home were observed among those living with at least two other people (31.0%; p<0.001), those living with children at home (29.9%; p=0.01), and those with active occupational status (27.6%; p=0.02). Moreover, those who currently smoked or used e-cigarettes or heated tobacco products (p<0.001) more often declared exposure to secondhand smoke at home (Table 1).

Table 1: Characteristics of the study population by exposure to secondhand smoke at home in the past 30 days (n=1,080)

Variable	Secondhand smoke exposure at home in the past 30 days		
	Yes n (%)	No n (%)	p-value
Overall	271 (25.1)	809 (74.9)	
Gender			
female (n=572)	149 (26.0)	423 (74.0)	0.4
male (n=508)	122 (24.0)	386 (76.0)	
Age [years]			
18–29 (n=140)	50 (35.7)	90 (64.3)	**0.001**
30–39 (n=211)	51 (28.9)	150 (71.1)	
40–49 (n=201)	49 (24.4)	152 (75.6)	
50–59 (n=203)	52 (25.6)	151 (74.4)	
60 and over (n=325)	59 (18.2)	266 (81.8)	
Education			
primary (n=18)	6 (33.3)	12 (66.7)	**0.04**
vocational (n=132)	39 (29.5)	93 (70.5)	
secondary (n=461)	128 (27.8)	333 (72.2)	
higher (n=469)	98 (20.9)	371 (79.1)	
Marital status			
single (n=214)	52 (24.3)	162 (75.7)	**0.02**

Variable	Secondhand smoke exposure at home in the past 30 days		
	Yes n (%)	No n (%)	p-value
married (n=619)	142 (22.9)	477 (77.1)	
informal relationship (n=147)	53 (36.1)	94 (63.9)	
divorced (n=52)	15 (28.8)	37 (71.2)	
widowed (n=48)	9 (18.8)	39 (81.3)	
With children			
yes (n=732)	175 (23.9)	96 (27.6)	0.2
no (n=348)	557 (76.1)	252 (72.4)	
Place of residence			
rural (n=416)	121 (29.1)	295 (70.9)	**0.04**
city with fewer than 20,000 residents (n=137)	28 (20.4)	109 (79.6)	
city with 20,000–99,999 residents (n=211)	50 (23.7)	161 (76.3)	
city with 100,000–499,999 residents (n=187)	50 (26.7)	137 (73.3)	
city with more than 500,000 residents (n=129)	22 (17.1)	107 (82.9)	
Number of household members			
1 (living alone) (n=134)	18 (13.4)	116 (86.6)	**<0.001**
2 (n=414)	88 (21.3)	326 (78.7)	
3 or more (n=532)	165 (31.0)	367 (69.0)	
Children in the home			
yes (n=345)	103 (29.9)	242 (70.1)	**0.01**
no (n=735)	168 (22.9)	567 (77.1)	
Occupational activity			
employed/self-employed (n=656)	181 (27.6)	475 (72.4)	**0.02**
passive (unemployed or retired) (n=424)	90 (21.2)	334 (78.8)	
Self-declared economic status			
good (n=330)	77 (23.3)	253 (76.7)	0.08
moderate (n=606)	147 (24.3)	459 (75.7)	
bad (n=144)	47 (32.6)	97 (67.4)	
Cigarette smoking (past 30 days)			
yes (n=328)	133 (40.5)	195 (59.5)	**<0.001**
no (n=752)	138 (18.4)	614 (81.6)	
E-cigarette use (past 30 days)			
yes (n=164)	83 (50.6)	81 (49.4)	**<0.001**
no (n=916)	188 (20.5)	728 (79.5)	
Heated tobacco use (past 30 days)			
yes (n=118)	56 (47.5)	62 (52.5)	**<0.001**
no (n=962)	215 (22.3)	747 (77.7)	

Among smokers, 41.2% were exposed to secondhand smoke at home, compared to 16.0% of non-smokers (Table 2). Smokers exposed to secondhand smoke more often had primary or secondary education (p=0.007). Moreover, non-smokers who lived in rural areas (53.6%) were more often exposed to secondhand smoke at home than smokers who lived in rural areas (38.5%; p=0.004).

Table 2: Socioeconomic differences between smokers and non-smokers exposed to secondhand smoke at home

Variable	Secondhand smoke exposure at home in the past 30 days (yes)		
	Smokers, e-cigarette users and heated tobacco users n=391	Non-smokers (any nicotine product) n=689	p-value
	n (%)	n (%)	
Overall	161 (41.2)	110 (16.0)	
Gender			
female	89 (55.3)	60 (54.5)	0.9
male	72 (44.7)	50 (45.5)	
Age [years]			
18–29	36 (22.4)	14 (12.7)	0.2
30–39	31 (19.3)	30 (27.3)	
40–49	30 (18.6)	19 (17.3)	
50–59	31 (19.3)	21 (19.1)	
60 and over	33 (20.5)	26 (23.6)	
Education			
primary	5 (3.1)	1 (0.9)	**0.007**
vocational	32 (19.9)	7 (6.4)	
secondary	73 (45.3)	55 (50.0)	
higher	51 (31.7)	47 (42.7)	
Marital status			
single	32 (19.9)	20 (18.2)	0.2
married	77 (47.8)	65 (59.1)	
informal relationship	33 (20.5)	20 (18.2)	
divorced	12 (7.5)	3 (2.7)	
widowed	7 (4.3)	2 (1.8)	
With children			
yes	103 (64.0)	72 (65.5)	0.8
no	58 (36.0)	38 (34.5)	

Variable	Secondhand smoke exposure at home in the past 30 days (yes)		
	Smokers, e-cigarette users and heated tobacco users n=391	Non-smokers (any nicotine product) n=689	p-value
Place of residence			
rural	62 (38.5)	59 (53.6)	**0.004**
city with fewer than 20,000 residents	12 (7.5)	16 (14.5)	
city with 20,000–99,999 residents	36 (22.4)	14 (12.7)	
city with 100,000–499,999 residents	38 (23.6)	12 (10.9)	
city with more than 500,000 residents	13 (8.1)	9 (8.2)	
Number of household members			
1 (living alone)	10 (6.2)	8 (7.3)	0.7
2	50 (31.1)	38 (34.5)	
3 or more	101 (62.7)	64 (58.2)	
Children in the home			
yes	65 (40.4)	38 (34.5)	0.3
no	96 (59.6)	72 (65.5)	
Occupational activity			
employed/self-employed	112 (69.6)	69 (62.7)	0.2
passive (unemployed or retired)	49 (30.4)	41 (37.3)	
Self-declared economic status			
good	48 (29.8)	29 (26.4)	0.2
moderate	81 (50.3)	66 (60.0)	
bad	31 (19.9)	15 (13.6)	

The factors which were significantly associated with a higher probability of exposure to SHS at home were living in rural areas (OR: 1.84, 95%CI: 1.07–3.17, p=0.03), having three or more household members (OR: 2.63, 95%CI: 1.37–5.06, p=0.004), having bad economic status (OR: 1.68, 95%CI: 1.03–2.72, p=0.04), smoking cigarettes (OR: 2.26, 95%CI: 1.62–3.16, p<0.001) and using e-cigarettes or heated tobacco products (OR: 2.18, 95%CI: 1.49–3.20, p<0.001) (Table 3).

Table 3: Factors associated with SHS exposure at home in a representative sample of adults in Poland

	Bivariable Logistic Regression		Multivariable Logistic Regression	
Overall	OR (95%CI)	p-value	aOR	p-value
Gender				
female	1.11 (0.85–1.47)	0.4		
male	Reference			
Age [years]				
18–29	2.51 (1.60–3.91)	<0.001	1.55 (0.85–2.85)	0.2
30–39	1.83 (1.22–2.76)	0.004	1.24 (0.72–2.16)	0.4
40–49	1.45 (0.95–2.23)	0.09	0.97 (0.55–1.70)	0.9
50–59	1.55 (1.02–2.37)	0.04	1.07 (0.66–1.74)	0.8
60 and over	Reference		Reference	
Education				
higher	Reference		Reference	
less than higher	1.50 (1.13–1.99)	0.005	1.27 (0.93–1.74)	0.1
Marital status				
single	1.39 (0.63–2.06)	0.4	1.30 (0.53–3.18)	0.6
married	1.29 (0.61–2.73)	0.5	1.32 (0.56–3.09)	0.5
informal relationship	2.44 (1.10–5.43)	0.03	2.17 (0.88–5.36)	0.09
divorced	1.76 (0.69–4.50)		2.49 (0.87–7.10)	0.09
widowed	Reference		Reference	
With children				
yes	0.83 (0.62–1.10)	0.2		
no	Reference			
Place of residence				
rural	2.00 (1.20–3.31)	0.007	1.84 (1.07–3.17)	**0.03**
city with fewer than 20,000 residents	1.25 (0.67–2.32)	0.5	1.34 (0.69–2.59)	0.4
city with 20,000–99,999 residents	1.51 (0.87–2.64)	0.2	1.28 (0.70–2.32)	0.4
city with 100,000–499,999 residents	1.78 (1.01–3.11)	0.04	1.53 (0.84–2.80)	0.2
city with more than 500,000 residents	Reference		Reference	
Number of household members				
1 (living alone)	Reference		Reference	
2	1.74 (1.01–3.01)	0.04	1.74 (0.91–3.31)	0.09
3 or more	2.90 (1.71–4.92)	<0.001	2.63 (1.37–5.06)	**0.004**

	Bivariable Logistic Regression		Multivariable Logistic Regression	
Children in the home				
yes	1.44 (1.08–1.92)	0.01	0.82 (0.54–1.24)	0.3
no	Reference		Reference	
Occupational activity				
employed/self-employed	1.42 (1.06–1.89)	0.02	1.24 (0.86–1.79)	0.2
passive (unemployed or retired)	Reference		Reference	
Self-declared economic status				
good	Reference		Reference	
moderate	1.05 (0.77–1.44)	0.8	1.24 (0.88–1.75)	0.2
bad	1.05 (0.77–1.44)	0.04	1.68 (1.03–2.72)	**0.04**
Cigarette smoking (past 30 days)				
yes	3.04 (2.28–4.05)	<0.001	2.26 (1.62–3.16)	**<0.001**
no	Reference		Reference	
E-cigarette or heated tobacco use (past 30 days)				
yes	3.70 (2.68–5.12)	<0.001	2.18 (1.49–3.20)	**<0.001**
no	Reference		Reference	

Among non-smokers (n=689), living in rural areas (OR: 2.35, 95%CI: 1.10–5.02, p=0.03) and having three or more household members (OR: 2.42, 95%CI: 1.01–5.81, p=0.04) were significantly associated with exposure to secondhand smoke at home (Table 4).

Table 4: Factors associated with SHS exposure at home among non-smokers (n=689)

	Bivariable Logistic Regression		Multivariable Logistic Regression	
Overall	OR (95%CI)	p-value	aOR	p-value
Gender				
female	1.01 (0.69–1.52)	0.9		
male	Reference			
Age [years]				
18–29	1.65 (0.81–3.34)	0.2		
30–39	2.20 (1.24–3.91)	0.07		
40–49	1.42 (0.75–2.68)	0.3		
50–59	1.62 (0.87–3.01)	0.1		

	Bivariable Logistic Regression		Multivariable Logistic Regression	
60 and over	Reference			
Education				
higher	Reference			
less than higher	1.23 (0.85–1.93)			
Marital status				
single	2.14 (0.47–9.73)	0.3	1.92 (0.41–8.92)	0.4
married	2.33 (0.54–10.07)	0.3	1.82 (0.41–8.10)	0.4
informal relationship	4.10 (0.89–18.86)	0.1	3.49 (0.74–16.51)	0.1
divorced	1.39 (0.21–9.01)	0.7	1.69 (0.25–11.25)	0.6
widowed	Reference		Reference	
With children				
yes	0.90 (0.58–1.38)	0.6		
no	Reference			
Place of residence				
rural	2.36 (1.12–4.98)	0.03	2.35 (1.10–5.02)	**0.03**
city with fewer than 20,000 residents	1.61 (0.67–3.86)	0.3	1.68 (0.69–4.08)	0.3
city with 20,000–99,999 residents	1.11 (0.46–2.69)	0.8	1.23 (0.50–3.01)	0.7
city with 100,000–499,999 residents	1.08 (0.43–2.70)	0.9	1.08 (0.43–2.72)	0.9
city with more than 500,000 residents	Reference		Reference	
Number of household members				
1 (living alone)	Reference		Reference	
2	1.71 (0.77–3.81)	0.2	1.57 (0.82–3.94)	0.3
3 or more	2.71 (1.25–5.88)	0.01	2.42 (1.01–5.81)	**0.04**
Children in the home				
yes	1.35 (0.87–2.08)	0.2		
no	Reference			
Occupational activity				
employed/self-employed	1.22 (0.80–1.85)	0.4		
passive (unemployed or retired)	Reference			
Self-declared economic status				
good	0.67 (0.34–1.32)	0.2		
moderate	0.86 (0.46–1.59)	0.6		
bad	Reference			

Discussion

This nationwide study showed that exposure to secondhand smoke at home remains a significant public health problem in Poland. One quarter of adults, including 41.2% of smokers and 16.0% of non-smokers, declared being exposed to SHS at home. Socioeconomic differences in exposure to SHS at home were identified, of which place of residence and number of household members were the most important factors among non-smokers.

The findings from this study revealed that the percentage of adults in Poland exposed to SHS at home in 2024 was significantly higher than in 2019: 25.1% vs. 6.1% (in the past 30 days; Jankowski, Pinkas, et al., 2020). This observation may result from the fact that the 2019 study was carried out in September and the 2024 data were collected in February, as more people may have smoked at home due to the cold season. In 2024, a higher percentage of people declared being exposed to SHS at home, among both smokers (11.5% in 2019 vs. 41.2% in 2024) and non-smokers (4.5% in 2019 vs. 16% in 2024) (Jankowski, Pinkas, et al., 2020). This observation requires further investigation.

Among all respondents and in the subgroup of non-smokers, living in rural areas and having three or more household members were associated with a higher probability of exposure to SHS at home. Previously published data also suggest that rural populations are at higher risk of SHS exposure (Carreras et al., 2019; Vander Weg et al., 2021; Štěpánek et al., 2022). This observation may result from the fact that rural residents live in detached houses rather than apartment buildings and may feel more comfortable and confident smoking in their homes. Respondents in households with at least three residents reported higher SHS exposure, which may result from the fact that the risk of SHS exposure increases with the number of household members. In all respondents, bad economic status was also associated with a higher probability of SHS exposure at home. This is also in line with previously published data, as low economic status is considered an important factor associated with unhealthy behaviors and higher health risks related to environmental exposure (Milcarz et al., 2018; Vander Weg et al., 2021). As expected, smokers (users of cigarettes, e-cigarettes, or heated tobacco products) had a higher probability of SHS exposure at home. This results from the fact that these people may smoke with relatives or friends who live with or visit them. Further educational activities promoting smoke-free homes and protection against secondhand smoke should target rural populations and groups with low socioeconomic status.

This study has practical implications for health policy in Poland. Firstly, it showed that SHS exposure at home is a significant public health problem that should be addressed with public health interventions. The study also indicated priority populations for education on SHS exposure and its health effects. There is a need to increase the number of educational activities on the health effects of SHS exposure addressed to inhabitants of rural areas. Moreover, the study also revealed that smokers and users of novel

nicotine-containing products should be educated about the effects of secondhand smoke on bystanders and others in the smoker's vicinity.

The major limitations of this study are that SHS exposure was self-reported, no measurements were taken in the home, and cotinine levels were not included. Because this study was carried out with the CAWI technique, respondents without internet access were excluded. Moreover, secondhand smoke exposure was assessed generally, without distinguishing between cigarettes, e-cigarettes, and heated tobacco products.

Conclusions

This study revealed that one quarter of Poles are exposed to secondhand smoke at home. Place of residence and number of household members were the most important factors associated with a higher probability of secondhand smoke exposure at home among non-smokers. Further public health interventions are needed to protect the population and to promote smoke-free homes.

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