

THE AIR QUALITY IN ROMANIAN FOSTER CARE HOMES AFTER THE NEW LEGISLATION

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Abstract

Our research investigates the effect of the anti-tobacco legislation on air quality in Romanian foster care units. There were made measurements in 41 foster care homes from three Romanian countries. We recorded data three times measuring the indoor and outdoor PM 2.5 level with a TSI Aerosol Monitor Sidepak AM device. A moderate positive correlation can be observed every year between indoor and outdoor PM 2.5 values. After the new anti-smoking legislation it was observed a significant difference in the outdoor values and less difference in the indoor values. The new anti-tobacco legislation from 2016 has lightly influenced the indoor air pollution level, while the outdoor PM2.5 was increased significantly. The results suggest that the residents and the employees in the foster care homes are smoking more outside the house after the new tobacco law.

Keywords: smoking, anti-tobacco legislation, air quality, PM 2.5, foster care home

1. INTRODUCTION

Life would be impossible without air which is a basic need for plants, animals and humans [1]. Normally a person breaths in and out an amount of 7500 ml (15x500), of which 78.08% is nitrogen, 20.95% oxygen, 0.93% argon, 0.04% carbon dioxide and other toxic and non-toxic gases, and pollutions [2, 3]. Air pollution affects mostly people in the urban area, it is estimated that affects a number of 3.5 billion people, according to predictions, this number may increase to 6 billion, by the time we reach 2050 [4]. Air pollution causes 7 million premature deaths annually and it is still increasing [5]. There are two types of air pollution: indoor air pollution (sources may be: burning wood, coal, dung, crop, cigarette, cigar, e-cigarette and cooking fireplaces) and outdoor air pollution (sources may be: fossil fuel, smelting, metal processing) [6, 7]. According to a 2014 WHO research, premature deaths caused by air pollution were more than 4.3 million, which could be prevented with dropping smoking and second-hand smoking, of course without the cooking and heating, which are necessary. In those indoor areas, where open flame is not used for cooking, the source of indoor air pollution is indoor smoking [8].

The US Environmental Protection Agency (EPA) in case of air pollution specified the main causes of air pollution in the Air Quality Indexes (AQIs), as they are: Particular Matter (PM), which can be measured with the PM2.5 and PM10 standards, and other standards also for ozone, nitrogen oxides, carbon monoxide. These standards are unified for the whole world and are known as the National Ambient Air Quality Standards (NAAQS) [9]. Nowadays, the most popular and easily accessible for everyone is the Particular Matter, of which the PM2.5, due to its small size ($\leq 2.5 \mu\text{m}$ in aerodynamic diameter) can get to the deepest parts of the lungs, in form of organic, and inorganic particles. These factors may harm the person's health, it has an impact on the respiratory system and is also a risk for cardiovascular diseases [10]. PM2.5 is categorized by the AQI as the following: good (0-15.4), moderate (15.5-40.4), unhealthy for sensitive groups (40.5-65.4) $\mu\text{g}/\text{m}^3$, unhealthy (65.5-150.4) $\mu\text{g}/\text{m}^3$, very unhealthy (150.5-350.4) $\mu\text{g}/\text{m}^3$, hazardous (350.5-500.4) $\mu\text{g}/\text{m}^3$ [11].

According to WHO out of the first 10 death causes, smoking and second-hand smoking have a role in 7 [12]. Ischemic Heart Disease is 3 times more common in case of smokers, and this number is 2.5 times more in case of stroke and 20x or more in case of trachea, bronchus and lung cancers, also 2.9x more in case of tuberculosis. Taking chronic respiratory infections into consideration, an 80% of the patients were smokers or former smokers. It is an important risk factor for lower respiratory infections

and increases the risk of getting type 2 diabetes mellitus, with increasing the resistance to insulin [13,14,15]. This is how smoking is called the main preventable cause of the premature death worldwide, as according to WHO 6 million people die annually because of smoking, and as this trend continues this number may reach 10 million by 2025 [16,17,18].

In Romania smoking in public spaces was present even after the 20-th century, as according to data collected between 2003 and 2007, where they measured 32 countries, Romania occupied the second place in air pollution (PM_{2.5} was 366 mg/m³), in contrast with the lowest values, measured in New Zealand (8 mg/m³) [7,19]. For fight off smoking in closed areas and public spaces in Romania was implemented the anti-smoking legislation, on 17 may 2016 (Law no. 15/2016). This, together with the 349/2012 law bans smoking in public spaces and closed areas.

In disadvantaged categories smoking is still present in a higher rate, compared to the average population. This is also proved by the Schmidt et al. study, in which in 2016 they placed 20.156 children in National Authority for the Protection of the Rights of the Child and Adoption in Romania foster care home and smoking between the foster care parents was 30-45% [20].

The primary source of air pollution in foster care units is smoking, as open flames are not used for heating. We aimed to study the impact of implementation of the anti-smoking legislation (2016) on air pollution in a part of foster care homes in Romania.

2. MATERIALS AND METHODS

Our prepared and trained team (doctors, and medical students) were doing the measurements personally in three counties of Romania (Covasna, Harghita, Mures) in foster cares owned by the National Authority for the Protection of the Rights of the Child and Adoption in Romania, three times (2014, 2016 – six months after the implementation of the anti-tobacco legislation, 2019). The measurements were not done during the heating season. In the three counties they were measured a total of 41 foster care units (CV – 13, HR – 8, MS - 20). For the more precise air quality definition, we measured two different bedrooms per house, taking into consideration the average of the two results, we measured with a one second recording of 10 minutes, after that measurements were done with a one second recording of one minute in front of the house (outdoor), where we excluded any source of PM_{2.5}. In some houses they used open flame for cooking before or during the measurement, so we excluded these extreme values.

During the air quality inspection, we measured the values of PM_{2.5} with a TSI Aerosol Monitor Side Pak AM device.

Statistical analysis

The normality test of the continuous variables was made using Shapiro-Wilk test. The variables are expressed as mean $\pm$ standard deviation and compared using t-test. Pearson correlation was also performed to calculate the correlation coefficient between the indoor and outdoor values for each year. The statistical analysis was performed using the IBM SPSS Statistic 25 (IBM Corporation, USA) program.

3. RESULTS

In average the PM_{2.5} value was 9.85 ± 4.6 mg/m³ outdoor and 13.32 ± 5 mg/m³ indoor, between a range of 1.08 mg/m³ to 23.8 mg/m³ after excluding extreme values. We found significant differences depending on the place and year of measurement.

According to our results there was a higher PM_{2.5} indoor value for each year with significant differences as shown in Table 1. Based on the results of the study the indoor and outdoor PM_{2.5} values are also moderately positively correlated for each year: 2014 ($r = 0.674$, $p = 0.033$), 2016 ($r = 0.561$, $p = 0.01$), 2019 ($r = 0.657$, $p < 0.001$).

	2014	2016	2019
Indoor*	10.72 ± 5.59	13.02 ± 5.50	12.57 ± 3.67
Outdoor*	4.71 ± 2.41	10.75 ± 2.98	10.62 ± 4.98
R value	0.674	0.561	0.657
P value	0.033	0.01	< 0.001

Table 1. The PM2.5 value measured every year in the foster care units indoor and in front of the house (outdoor). r – correlation coefficient, p – correlation significance

* PM 2.5 value measurement place

Analyzing the impact of the implementation of the anti-smoking legislation (Table 2) we found a slight increase between 2014 and 2016 in the indoor measurements, with no significant difference. The outdoor measurements between data set of 2014 and 2016 showed a significant difference, with a higher PM2.5 value in 2016 ($10.75 \pm 2.98 \text{ mg/m}^3$ vs. $4.71 \pm 2.41 \text{ mg/m}^3$, $p < 0.001$).

	2014	2016	P value
Indoor*	10.72 ± 5.59	13.02 ± 5.50	0.105
Outdoor*	4.71 ± 2.41	10.75 ± 2.98	< 0.001

Table 2. The PM2.5 value measured indoor and outdoor in the foster care units before and after the implementation of the anti-smoking legislation

* PM 2.5 value measurement place

Comparing the values measured after the implementation of the legislation we found no difference in either indoor or outdoor values, as shown in Table 3.

	2016	2019	P value
Indoor*	13.02 ± 5.50	12.57 ± 3.67	0.403
Outdoor*	10.75 ± 2.98	10.62 ± 4.98	0.897

Table 3. The PM2.5 value measured indoor and outdoor in the foster care units at 6 months (2016) and 3 years (2019) after the implementation of the anti-smoking legislation.

* PM 2.5 value measurement place

4. DISCUSSION

This study examines the effectiveness of the Romanian Anti-Smoking Law (2016) in the foster care units by examining air pollution measurement data. To measure the indoor and outdoor air pollution we used an air quality monitor PM2.5, a globally used standard, which is also recommended and used by the NAAQS [9]. Monitoring the PM2.5 it is beneficial and recommended, several studies had demonstrated, that during breathing a person may inhale particles smaller than $2.5\mu\text{m}$, which had been associated with several diseases (respiratory diseases, cardiovascular diseases, oxidative stress, inflammatory processes etc.) [21,22].

By the categories of the AQI [11], our PM2.5 values were in the good category both in indoor and outdoor places, but in some buildings the air quality was moderate or even unhealthy. The open flame

cooking's impact on the values of PM_{2.5} were demonstrated in other studies, so it is recommended to exclude these kinds of PM_{2.5} sources [23]. As a person spends 85% of its time indoor, the indoor PM_{2.5} values are worrisome [24]. The anti-tobacco legislation was implemented in 2016 in Romania, and it bans indoor smoking (in foster care homes too). Our results show that values from 2014 to 2016 did not differ significantly. These results contradict to the awaited effect of the anti-smoking law, as it was expected that indoor air pollution would decrease. It opposes to the global trend too, which shows that there was a 23% drop of the values of PM_{2.5} between 2010 and 2019 [25]. An explanation for the non-decreasing indoor air pollution may be the so called third-hand smoke. Third-hand smoke means that the contamination of tobacco smoke remains on the internal surfaces (including the walls) and in the dust after the cigarette has been smoked. The tobacco smoke contaminated indoor surfaces are containers of indoor air pollution and pollute the air for up to several months [26,27].

Analyzing the outdoor air quality, there is a significant growth of data sets between 2014 and 2016, which is explained by smoking next to the foster care buildings. By today it is proven that cigarette smoke directly influences the increasing tendency of outdoor PM_{2.5} values [28]. A study from France proves that after the implementation of anti-tobacco legislation the number of smokers near the buildings had increased [29]. Our results also show, that there is a moderate positive correlation regarding to the quality of indoor and outdoor air, in all three years. This means that indoor air quality has an influence of the outdoor air quality near the buildings.

Between 2016 and 2019 there was a slight, but non-significant decrease in the indoor values of PM_{2.5}, but the outdoor values remained the same.

5. CONCLUSIONS

Our study did not find any differences regarding the indoor air pollution (PM_{2.5} values) of foster care units before, after 6 months, and after 3 years of the implementation of the anti-tobacco legislation. The increased outdoor PM_{2.5} values suggest that the residents of the foster care homes are smoking more in front of the house after the introduction of the 2016 anti-tobacco legislation. Overall, it can be said, that in short and long terms, the legislation is directly linked with increased outdoor PM_{2.5} values.

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