SMOKING GENERATED PM $_{2.5}$ EXPOSURE AMONG TRANSYLVANIAN STUDENTS

Zsuzsánna Szász [1,3], Annamária Demeter [3], L. Bíró [1], H. Moldovan [1,3], Z. Ábrám [2], P. Boțianu [3], Paula Gliga [1]
University of Medicine and Pharmacy Târgu Mureş
Faculty of Medicine
1. Department of Occupational Health Medicine
3. Mureş County Hospital –
Compartment of Occupational Diseases
2. Department of Hygiene

SMOKING GENERATED $PM_{2.5}$ EXPOSURE AMONG TRANSYLVANIAN STUDENTS (Abstract)**:** A WHO project initiated in 2004, tries to identify and reduce the number of smoking third year university students attending medical training in Medicine, Dentistry, Pharmaceutical sciences as these participants can become role models that patients can look up to. **Aim**: we proposed to make a general view regarding smoking and exposure to smoke within our medical University, in contrast with the existing legislation regarding smoking within public institutions of the Universities. Along with the investigations held at our university we extended these to other tree, non medical universities. **Materials and methods:** using an TSI Pack Aerosol Monitor unit to measure the total PM $_{2.5}$ we determined the air quality in several target locations of our University in holiday season and during full didactical periods. The average values were later compared and assessed in a series of statistical tests. **Results:** analyzing the holiday period our university head the most polluted air showing the P.M. 2.5 of 0.016 mg/m^3. In the following there were analyzed the recordings from the didactic period where the registered values were significantly higher ($p<0.0001$) in comparison with the readings from the holiday season. From several points within the universities there were reading 7 times higher than in the holiday season. **Conclusions:** the results show two evident conclusion, that there is smoking within the buildings of the universities and within our university the non-smoking students are totally exposed to exhaled cigarette smoke. **Keywords:** SMOKING, STUDENT, PM $_{2.5}$, SECOND HAND SMOKING EXPOSURE.

According to WHO estimates, about 6 million people die annually due to smoking, of which about 5.5 million smokers, and the remaining 500.000 people due to passive smoking. WHO initiated a study in 2004 (called Global Health Professions Student Survey), which reached until 2010 approximately 50 countries and focused on identifying smokers and reducing smoking among students of medical universities (medicine, pharmacy, dentistry, nursing, etc.) starting from their 3rd year of studies, considering that as they will become doctors, dentists, pharmacists, they will be considered role models by thousands of patients. Romania joined this study in 2010 (1).

Another recent study performed in Romania identified smoking as an important issue among young adults aged over 19 years. This even called tobacco smoking a lifestyle component of young people in Romania, its incidence increasing by 15% from the age group of 14-18 years to the age group of over 19 years (2).

Among the toxic emissions of smoking there are several substances, some of which are known carcinogens. Additionally, cigarette combustion products are known to be small, suspended particles, especially those under 2.5 μm (fine particle - PM $_{2.5}$) that penetrate as deep as the alveoli. A significant association between these particles and premature mortality has been reported in several studies. Worsening of chronic cardiovascular and respiratory diseases have been reviewed, as well as the occurrence of impaired lung function and airway irritation syndrome, with symptoms such as cough, shortness of breath, wheezing in otherwise healthy children and adults. This is why exposure to passive smoking - second hand smoking receives a special importance in the etiology of many diseases, not only among smokers, but also among non-smokers (3).

In support of non-smokers from all over Europe come a series of laws that prohibit smoking in somewhat restricted or more extensive areas. According to 2013 WHO reports, smoking prevalence in Romania is 25% and it is proving to be a European country to make some efforts in the adoption of laws to protect its citizens, both non-smokers and smokers (4).

Nevertheless, legislation in force still allows smoking in bars, restaurants, discos, and in public places, even in public institutions, in specially designated areas (5). This means that the Romanian citizen could be protected to some extent by legislation from exposure to cigarette smoke.

Since the strengthening of the smoking habit occurs somewhere around 18-19 years of age, and because students from medical universities may be key figures for future patients, we focused on this population, establishing certain key questions (research question).

The study evaluates compliance with the regulations against smoking in universities in Romania that aim to protect non-smoking students and employees. It will answer the question whether the University of Medicine and Pharmacy complies with the above mentioned legislation more or less than other, non-medical universities?

MATERIAL AND METHODS

Measurements of PM $_{2.5}$ particle concentrations were performed with an AM510 TSI Pack Aerosol Monitor device (6, 7). Recordings of PM $_{2.5}$ values came from central buildings of four universities. These buildings were previously evaluated, and potentially contaminated sites were identified (4-5 for each). Then, for each of the four to five predefined sites, monitoring was performed for 10-14 minutes by recording data every second. This has been done first during the holidays (minimum, constant employee activity), thus obtaining a baseline data for the following: site A - 3521 data from the central building of a state held medical university (medicine, pharmacy, dentistry, nursing) in Transylvania; site B- 3426 data from a state held university with non-medical profile, site C - 3045 data from a private university, site D - 3483 data from another private university with environmental profile. The averages of the PM $_{2.5}$ measurement values of the four universities were compared. Data were processed using Microsoft Office Excel.

The next step was to carry out measurements at site A (medical university) during full teaching activities, between

Tuesday and Thursday, from 10 to 12 and 14 to 16 hours, maintaining the sites of measurement. Recording was performed every 30th second. The evolution of the PM $_{2.5}$ particles from the first to the second measurement was noted and compared using statistical tests for nonparametric, unpaired data (Mann Whitney U) using the Graph Pad Instat software.

In case of the A university, the evolution of values from the teaching period compared to the holidays was also analyzed for each measurement site.

RESULTS

In the first phase, a pre-screening of the central buildings of the four universities has been performed, in order to establish potentially contaminated sites. Following establishment of these sites, the aerosol monitor has been deployed. The results of concentration measurements of fine particles during holidays placed site A (Transylvanian medical university) first. The 3521 measurements performed at five different areas, with a total measurement time of 58 minutes and 41 seconds averaged a value of 0.0168 mg/m^3. Second place, very close to the first, was taken by the non-medical state held university (site B). Its 3426 measurements collected from five different points in 57 minutes and 6 seconds, resulted an average of 0.0153 mg/m^3. In case of the private university – site C – the average value was 0.0140 mg/m^3 from 3045 measurements performed in four areas, and a total measurement time of 50 minutes and 45 seconds.

The lowest concentration was found at site D, (private university with environmental profile), where an average of 0.0059 mg/m^3 was calculated from 3483 measurements collected from five different points in 58 minutes and 7 seconds. All measurements from all areas were recorded every second (tab. I).

TABLE I

Average PM $_{2.5}$ measurements of the four universities in Transylvania

No.	University	Meas. No.	Meas. time	Average mg/m^3
1.	A –state held medical	3521	58:41	0.0168
2.	B –state held non-medical	3426	57:06	0.0153
3.	C – privately held	3045	50:45	0.0140
4.	D –privately held ecological	3483	58:07	0.0059

Next we went on to monitor the teaching period of university A. In order to obtain the most relevant results, we focused on maximum activity intervals during the week (Tuesday, Wednesday and Thursday), between 10 and 12, and 14 and 16 hours. The second set of measurements was not taken in the same place on the same day. Results obtained in the interval between 10 and 12 were compared for each measurement area with those recorded between 14 and 16 hours on another day (tab. II).

E- stair case 1st-2nd level, administrative zones neighborhood, next to a coffee machine; F- men's restroom, 1st floor; G- women’s restroom, 1st floor; H- ground floor corridor, doorman rooms neighbor- hood

TABLE II

Comparison of PM $_{2.5}$ value medians of the measurement areas

No.	Meas. area	Meas. No. 10-12/14-16	Median 10-12 h mg/m^3	Median 14-16 h mg/m^3	Mann W.U. test
1.	E	246/238	0.0258	0.0513	p<0.0001
2.	F	240/240	0.01051	0.01058	p=0.413
3.	G	237/240	0.0105	0.0124	p<0.001
4.	H	237/238	0.0258	0.0513	p<0.0001

Significant increase	No significant result	Significant decrease

So we see that in two of the above areas (E and G) the values increase significantly, there is no change (F) in one area and in one area (the one next to the doorman's room) (area H) there is a decrease during the second interval.

The next step was to compare the values obtained during the holidays with those obtained during full teaching activities for each of the measurement areas. For the teaching period, we used the values of both of recorded time intervals from one measurement area. The results show a significant increase in all recorded parameters at each measurement area; in one area there is even a 7-fold increase compared to the holiday period (tab. III).

DISCUSSION

Although in 2010 Romania joined the project initiated by the WHO - Global Health Professions Student Survey (GHPSS) – its results, the country report cannot be found between the reports from the other participating countries. This would provide information about smoking habits of students of the medical university, and about their desire to stop this habit. In their knowledge effective prevention programs could be developed. This is why the value of this study is important, because it shows objectively the presence of PM $_{2.5}$ particles from tobacco smoke inside the main building of the evaluated university (A) (1).

TABLE III

Comparison of PM $_{2.5}$ value medians of the holiday period and teaching period

No.	Meas. points	Meas. No. Hol./Tea.	Holiday median (mg/ m^3)	Teaching period median (mg/ m^3)	Mann W.U. test
1.	E	801/484	0.0127	0.0383	p<0.0001
2.	F	686/480	0.00934	0.0105	p<0.001
3.	G	686/477		0.0115	p<0.001
4.	H	612/475	0.0087	0.0567	p<0.0001

E- stair case 1st-2nd floor, administrative zones neighborhood, next to a coffee machine; F- men's restroom, 1st floor; G- women's restroom, 1st floor; H- ground floor corridor, doorman rooms neighborhood

very significant-7x

Moreover, comparing the values measured at different universities, it emerged that the medical university (A) has the most polluted air in the holiday period, which incriminates the administrative and ancillary staff. Private universities have complied more rigorously with regulations (5) concerning smoking prohibition in public buildings and institutions (C and D), but it should not be neglected that these are equipped with smoke alarms. But the law is broken not only in Romania: a study using the same methodology and measurements, performed at certain hospitals in Hungary to measure PM $_{2.5}$ with a TSI Aerosol Monitor Pack, showed that employees are smoking in their premises, even if it is strictly forbidden (8). A recent study in Romania, speaks of the smoking habit of young adults as a "lifestyle component" (2). Our study demonstrates as well that besides employees, students also greatly contribute to increased values of PM $_{2.5}$. This is demonstrated both by the significant increase in two of the measurement areas (E and G) of the medians of the 10-12 and 14-16 intervals, and by the comparison of values recorded during the teaching period to the values of the holiday period, which were statistically significantly higher when students were present. Therefore a program encouraging smoking cessation, as well as enforcement of existing legislation would be welcome.

Lastly, the not so very good position of Transylvanian universities regarding clean air is suggested by a study conducted in 32 countries in 2008; the study measured and analyzed the PM $_{2.5}$ values in a total of 1822 bars and restaurants, among others, in also Romania. Unfortunately, our country was in second place regarding air pollution by PM $_{2.5}$. It is to be noted the air quality in New Zealand regarding PM $_{2.5}$ contents. The restaurants in this country have cleaner air than some of our universities (0.008 mg/m^3, as compared to 0.0168 mg/m^3 at university A, 0.0153 mg/m^3 at university B and 0.0140 mg/m^3 at university C) (9).

CONCLUSIONS

This study may add to the WHO project initiated in Romania in 2010, proving objectively the presence of smoking within the Medical University. It turned out that both employees (based on the results of the holiday period), and students (based on the results of the teaching period) smoked at the premises of the Medical University. This also reveals the importance of informing the smoker, as well as the non-smoker students to promote cessation of active smoking, and avoid secondhand smoke, and in order to develop prevention programs and effective interventions.

Legal regulations regarding smoking in public institutions are often violated by university students, and staff both at the medical university, as well as other universities. A smoke alarm system may help law enforcement, thus preventing student-employee exposure to second hand smoke. The method of measuring fine particles can be used to test a future intervention among students.

ACKNOWLEDGEMENTS: The study was supported by the Fogarty Foundation NGO in collaboration with the Davidson Medical College North Carolina and the Medical School of Semmelweis University Budapest, and it is part of an international grant “Building Capacity for Tobacco Research in Romania”. Thank you goes out to the managements of the universities for allowing the recording of the presented data.

REFERENCES

1. *** World Health Organization, 2004, extended in 2010 - *Global Health Professions Student Survey*
2. Http://Www.Euro.Who.Int/En/Health-Topics/Disease-Prevention/Tobacco/Data-And-Statistics/Effective-Surveillance-And-Monitoring/Global-Tobacco-Surveillance-System-Gtss/Global-Health-Professions-Student-Survey-Ghpss/Implementation-Of-The-Global-Health-Professions-Student-Survey
3. Apetrei S. *Tobacco smoking: Still an important lifestyle component for adolescents and adults, at European Respiratory Society E-learning resources* -annual Congress 2012
4. http://www.ers-education.org/events/annual-congress.aspx?idParent=118481
5. *** Environmental Protection Agency of US – Provisional Assessment of Recent Studies on Health Effects of Particulate Matter Exposure, 2006, 14-22 http://www.epa.gov/pm/pdfs/ord_report_20060720.pdf
6. *** Word Health Organization - *WHO report on the global tobacco epidemic*, 2013-114
7. http://apps.who.int/iris/bitstream/10665/85380/1/9789241505871_eng.pdf
8. *** Parlamentul României - Legea 349/2002 modificată de Ordonanța 5/2008: Art. 3, alin.(1)
9. http://www.dreptonline.ro/legislatie/legea_prevenirii_tutunului.php
10. Tárnoki AD, Tárnoki DL, M. J. Travers MJ, et al. Tobacco smoke is a major source of indoor air pollution in Hungary's bars, restaurants and transportation venues. *Clin Experim Med J* 2009; 3, 1: 131-138.
11. Tárnoki AD, Tárnoki DL, Hyland A, et al. Measurement of indoor smoke pollution in public places in Hungary, Orvosi Hetilap, Budapest, 2010.
12. Tárnoki AD, Tárnoki DL, Travers MJ, et al. Compliance still a problem with no smoking law. *BMJ Tob Control*, 2010; 19: 520-522.
13. Hyland A, Travers MJ, Dresler C, Higbee C, Cummings KM. A 32-country comparison of tobacco smoke derived particle levels in indoor public places – *BMJ Tob Control* 2008; 17: 159-165.

NEWS

MATHEMATICAL MODEL EXPLAINS BACTERIA- HOST INTERACTIONS IN LYME DISEASE

The Lyme disease is a borreliosis characterized in early stage, by a rash on the skin named erythema migrans, caused by the interactions between bacteria and the host immune response. In this early stage the antibiotic treatment is most effective. The cutaneous rash has three separate morphologies: homogenous erythemas, central clearing rash with a peripheral ring erythematosus and characteristic central erythemas with a bull's-eye appearance. When the aspect of rush it's not characteristic, the diagnosis is difficult. Using a mathematical model that explains bacteria- host immune response interactions, researchers Vig and Wolgemuth show that the morphology of rash and the time during spreading are linked with the rates of bacterial replication and macrophage clearing. Also, this model revealed that the antibiotic treatment clears spirochetes from the dermis in the first week for all type of erythemas, but evolution of rush morphology is not an indicator of the efficacy of the therapy.The researchers suggest that the mathematical model could be able to explains bacteria- host interactions in other bacterial infection and could be used to develop guided treatment for Lyme disease (Vig DK, Wolgemuth CW. Spatiotemporal evolution of erythema migrans, the hallmark rash of lyme disease. *Biophys J*. 2014; 106(3):763-8).

Cătălina Luncă