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QUALITY STATUS OF AMBIENTAL AIR IN THE CONNECTION TO MEDICAL VISITS OF SCHOOL CHILDREN AND YOUTH

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ABSTRACT
Introductory: *Ambiental air in town of Kakanj, stressed by polutants of mostly industrial origin, has become a major reason for increased use of medical care by school children and youth.* ***The goal:*** *The goal of this work is to examine corelation between ambiental concentrations of sulphurdioxid (SO_2), suspended particles and nitrogenoxides (NOx), and of number of visits by schoo l children and youth to medical care instituitions.* ***Method:*** *In period from January to December 2003., in the area of Kakanj and Brnjic, the investigation was carried on the monthly average of visits to medical care institutions and concentrations of sulphurdioxide, suspended particles and nitrogenoxides in the area of "Dom Kulture" Kakanj.****The results:*** *The investigation has shown that there is a linear increase of visits to medical care institutions in relation to linear increase of concetration of sulphurdioxide, suspended particles and nitrogenoxides (O<R<+1).*
Conclusions: *The school children and the youth in town of Kakanj visit medical instituitions considerably more frequently in comparison to the same age group in village of Brnjic, in corelation to monthly average values of concentration of sulphurdioxide, suspended particles and nitrogenoxides in air.*
Keywords: Air pollution; medical visits; school children; Kakanj

1. INTRODUCTION
Environment of Kakanj Town, with its significant industrial air pollution sources, as a result of technological process in power generation facilities, coal excavation, cement production, etc. with poor dispersion of harmful substances, presents risk for incidence of air pollution related disease and increased use of health care services by Kakanj population. [1] Before 1992, emission to atmosphere from facilities located in Kakanj municipality area was 15% of sulphurdioxide and 25% of suspended particles of total emission in Bosnia and Herzegovina. [1] Biggeri at al. in their survey carried out in 2001, focused their attention to air pollution early effects on health in correlation with daily mortality and/or admission to health facilities. [2] Atikson, Anderson, Starchan at al. epidemiology studies show positive short-term correlation between health and actual level of environmental air pollution. [3] Literature sources showed significant relation between increased sulphurdioxide, nitrogen oxides

and suspended particles concentration and frequency to health care facilities visit due to deterioration of already existing asthma. [3] Metzger at al. point out correlation between increased environmental air pollutant concentration and increased number of health care facility visits due to deterioration of already existing cardiac-vascular conditions. [4] Correlation between number of health care facilities visits and increased air pollutant concentration was also confirmed in Fusko at al. papers. [5] Similar results were also found by large Italian meta-analysis of air pollution short-term effects on mortality and frequency of admission to health care facilities, carried out by Bigger, Bellini at al. over the period 1996-2002 in 15 large Italian cities. [6]
Children are particularly vulnerable group of population and air pollution presents significant risk for damaging their health. Number of visits by the said population groups to health facilities in Hong Kong is in statistically significant correlation with air pollutant concentration. [7] Multiple regression analysis by Farhat at al. showed statistically significant correlation between air particles concentration and number of visits to health care facilities due to sharp increase of lower airways symptoms with children age 3 – 15, and particularly with children bellow 2 years old. [8,9]. Corresponding findings were shown by APHEA 2 (10), research study of short-term effects of air particles in eight European cities and it confirmed positive statistical correlation between number of admissions to health care facilities due to respiratory diseases and particle concentration level in the air, particularly for children age 0 -14. [10] More recent studies [11,12] show correlation between short-term exposure to increased concentration to suspended particles and sulphurdioxide in the air and deteriorated respiratory functions, deteriorated respiratory organs irritation symptoms, increased consumption of drugs for treating breathing organs diseases and increased number of admission to health care facilities. Health workers can contribute to reduced air pollution by waste material communicating to general public information on harmful impacts of pollutants on children and adults health. [13,14]

2. GOAL

The objective of this paper was to establish sulphurdioxide, suspended particles and nitrogen oxides air pollution impacts on number of visits to health care institution by children and youth.

3. METHODS

The survey was carried out during the period January-December 2003 on the sample of 7,143 school-age children and youth between 7-18 years old, who, in territorial and administrative terms, belong to Kakanj School-Age Children and Youth Dispensary and on the sample of 1,000 school-age children and youth, who in territorial and administrative terms, belogn to Brnjic Village Filed Clinic, which is 9 kilometers air line away from Kakanj. Within the said samples, average monthly number of visits to Kakanj School-Age Children and Youth Dispensary/Brnjic Village Filed Clinic was monitored. In the same period, average monthly concentration of sulphurdioxide (SO_2), suspended particles and nitrogen oxides (NO_x) in the air in Kakanj were monitored, calculated based on average daily concentration of this pollutants measured at the measuring station at "Dom Kulture" Kakanj site. Sulphurdioxide concentration was measured by ultraviolet fluorescence method, by APSA 360 analyzer (Japanese manufacturer HORIBA). Nitrogen oxides concentration was measured by hemi-luminiscence method by APSA 360 analyzer of the same manufacturer. Suspended particles concentration was measured using beta rays ionizing emission method by EBERLINE FH2 I-R analyzer of German manufacturer EBERLINE. The results were statistically processed, correlation coefficients, statistical variation significance, relative risk, statistical probability and reliability coefficient established.

4. RESULTS

4.1. Corelation between monthly average concentrations of polutants and average number of first visits to medical care institution

Table 1. Corelation between monthly average concetrations of polutants in air and average number of first visits to medical care institution by school children and youth

Investigated pollutants in air	*Visits to medical care institutions*	*Correlation*
Monthly average of concentration of sulphurdioxide	*Monthly average of first visits to medical care institution per 1000 inhabitans of the age grup*	*0,538*
Monthly average of concentrations of suspended particles	*Monthly average of first visits to medical care institution per 1000 inhabitans of the age grup*	*0,244*
Monthly average of concentrations of nitrogenoxides	*Monthly average of first visits to medical care institution per 1000 inhabitans of the age grup*	*0,639(*)*

Legend: *correlation is significant at the 0.05 level

Table 2. Number of visits to medical care institution and number of healthy school children and youth, in the area of town of Kakanj and village of Brnjice shown in eigth evaluated months in 2003.

Municipality	Age group: From the age of 7 to the age of 18	
	The year of investigation: 2003.	
	The monthly average of visits to medical care institutions	
Kakanj town	a	b
	1172	5971
Brnjic village	c	d
	133	867

Legend: a = the exposed ill in Kakanj **c = the unexposed ill in Brnjic**
b = the exposed healthy in Kakanj **d = the unexposed healthy in Brnjic**

Significant statistical variation was found in number of first visit to health care facility between the two surveyed groups ($p<0,05$). Relative risk of increased need for visit to health care facility by respondents in Kakanj in 2003 amounted 1,2377; with 95% statistical probability and with statistical variation which can be expressed as: $1,0443<RR<1,4574$, and correlation coefficient between the two phenomena of OR=1,2795.

Correlation was established between increased air pollutants concentration and number of visits to health care facility by these two groups, since there is OR>1

5. DISCUSSION

It was found that during 2003 school-age children and youth of Kakanj Town visited health care facilities significantly more compared to the respondents of the same age from Brnjic Village area, which also belongs to Kakanj Municipality, but it is 9 km air line away from the town and it is not located in the direction of dominant winds in this area, which is important for air pollution by waste from industrial and power facilities.[1]

Statistical correlation between air pollution level and number of visits to health care facilities by population of this age was confirmed, but this statistical correlation is significant only for concentration of nitrogen oxides ($p<0.005$). Results obtained in this survey are in line with the findings of other authors Bigger, Fusco, Wong, Ostro, Farhat, etc. [2,5,7,8,9] This survey established degree of real correlation between average number of visits to health care facilities by school-age children and youth with average concentration of nitrogen oxides ($r=0.693$) and sulphurdioxide ($r=0.538$), which is in line with other authors' findings [11,12,13] Significant level of correlation between number of visits to health care institution by this age cohort with average nitrogen oxide and sulphyrdioxide concentrations was also confirmed in the surveys done by Berktas at al. on sulphurdioxide impact on frequency of health care facility visits due to deteriorated asthma symptoms [11], surveys on suspended particles impact on children and youth visits to health care facilities

carried out by Schwartz at al. [12], as well as by Jazbec and Trasanda at al. on correlation between nitrogen oxide concentration in the air and children and youth visits to health care facilities.
The presented survey established statistically significant correlation on the level of loose correlation between number school-age and youth visits to health care facilities and average concentration of suspended particles (r=0.244) in the air in Kakanj during the surveyed period. Similar survey results were obtained also by Ostro [8], Farhat [9], Atikson [10], Berktas [11], Shwartz [12] at al.
Research on short-term health consequences of increased concentration of nitrogen oxides in the air show their impact on increased number of visits by children and youth to Asthma Guidance Centers. This pollutant reduction policy could significantly contribute to reduced number of visits to health care facilities and mortality, to which health workers can significantly contribute by communicating to general public information on harmful impact of pollutants on children and adult health [13,14].

6. CONCLUSIONS

The presented survey established positive correlation and statistically significant correlation between level of air pollution, particularly by nitrogen oxides and number of visits to health care facilities by school-age children and youth in Kakanj Town and Brnjic Village.
Linear growth of number of visits to health care facility proportional to linear growth of sulphurdioxide, suspended particles and nitrogen oxides air concentration growth was established, which is statistically presented by: O<R<+1. There is statistical correlation between these two phenomena.
Number of visits to health care facilities shows the degree of real correlation with concentration of nitrogen oxides and sulfurdioxide in the area and the degree of loose correlation with concentration of suspended particles in the air.

7. REFERENCES

[1] Buza A.:Stanje zagađenosti zraka u opštini Kakanj.U:Prvi jugoslavenski kongres o očuvanju čistoće vazduha. Jedinstvena jugoslovenska strategija očuvanja čistoće vazduha. Zbornik referata. Knjiga I. Zenica, BiH, 14.-16. juni 1989:367-379.
[2] Biggeri A., Bellini P., Terracini B.: Italian MISA Group.Meta-analysis of the Italian studies on short-term effects of air pollution. Epidemiol Prev 2001; 25:1-71.
[3] Atikson RW., Anderson HR., Starchan DP., Bland JM., Bremnere SA., Ponce de Leon A.: Short-term assotiations between outdoor air pollution and visits to accident and emergency departments in London for respiratory complaints. Eur Respir J 1999; 13:257-265.
[4] Metzger KB., Tolbert PE., Klein M., Peel JL., Flanders WD., Todd K., et al.: Ambient air pollution and cardiovascular emergency department visits. Epidemiology 2004; 15:46-56.
[5] Fusco D., Forastiere F., Michelozzi P., Spadea T., Ostro B., Arca M., et al.: Air pollution and hospital admissions for respiratory conditions in Rome, Italy. Eur Respir J 2001; 17:1143-1150.
[6] Biggeri A., Bellini P., Terracini B.: Meta-analysis of the Italian studies on short-term effects of air pollution-MISA 1996-2002. Epidemiol Prev 2004; 28: 4-100.
[7] Wong GW., Ko FW., Lau TS., Li ST., Hui D., Pang SW., et al.: Temporal relationship between air pollution and hospital admissions for asthmatic children in Hong Kong. Clin Exp Allergy 2001; 31:565-569.
[8] Ostro BD., Eskeland GS., Sanchez JM., Fevzioglu T.: Air pollution and health effects: A study of medical visits among children in Santiago, Chile. Environ Health Perspect 1999;107:69-73.
[9] Farhat SC., Paulo RL., Shimoda TM., Conceicao GM., Lin CA., Braga AL., et al.: Effect of air pollution on pediatric respiratory emergency room visits and hospital admissions. Braz J Med Biol Res 2005; 38:227-235.
[10] Atkinson RW., Anderson HR., Sunyer J., Ayres J., Baccini M., Vonk JM., et al.: Acute effects of particulate air pollution on respiratory admissions: result from APHEA 2 project. Air Pollution and health: a European Approach. Am J Respir Crit Care Med 2001; 164:1860-1866.
[11] Berktas BM., Bircan A.: Effects of atmospheric sulphur diocside and particulate matter concentracions on emergency room admissions due asthma in Ankara.Tuberk Toraks 2003;51:231-238.
[12] Schwartz J., Slater D., Larson TV., Pierson WE., Koenig JQ.: Particulate air pollution and hospital emergency room visits for asthma in Seattle.Am Rev Respir Dis1993;147:826-831.
[13] Jazbec A., Simic D., Hrsac J., Peros-Golubcic T., Kujundzic D., Sega K., et al.: Short-term effects of ambient nitrogen oxides on number of emergency asthma cases in Zagreb, Croatia. Arh Hig Rada Toksikol 1999; 50:171-182.
[14] Trasande L., Thurston GD.: The role of air pollution in asthma and other pediatric morbidities. J Allergy Clin Immunol 2005; 115:689-699.