Research Journal of

Environmental Toxicology

ISSN 1819-3420

Academic Journals Inc.

www.academicjournals.com

OPEN ACCESS Research Journal of Environmental Toxicology

ISSN 1819-3420
DOI: 10.3923/rjet.2017.35.39

CrossMark

Research Article
Risks Factor of Particulate Matter (PM_{10}) and Acute Respiratory Infection in Community at Urban Area

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Abstract

Background and Objective: Diseases Acute Respiratory Infections (ARI) is a disease caused by particulate matter (PM_{10}) and housing conditions are bad/poor in urban. This study objectives to determine the relationship between the levels of particulate matter (PM_{10}) of home air quality and the incidence of the acute respiratory infection in the community living in the working area of Dahlia Health Center, Makassar city. **Methodology:** The study type used the case control study design and the samples were chosen using the Purposive Stratified Random Sampling technique. The total samples comprised 195 respondents. The data about the physical condition of the houses were collected using the measurement (case 65 and control 130 or 1:2), while other variables were collected through observation and interviews using questionnaires. **Results:** The study results obtained using the chi square test indicated that the variables which had a significant relationship with the Incidence of the acute respiratory infection of the respondents living in the study area of Dahlia Health Center were PM_{10} in the houses ($p<0.000$), BMI ($p<0.020$), ventilation ($p<0.031$), while the variables which did not have a relationship were the temperature ($p>0.216$), humidity ($p>0.360$) and smoking in house ($p>0.712$). It is calculated that odd's ratio with 95% confidence interval using logistic regression model were PM_{10} and acute respiratory infection (OR: 29.177, 95% CI: 3.172-268.341, $p<0.003$, age OR: 0.127, 95% CI: 0.015-1.096, $p>0.061$. **Conclusion:** Particulate matter (PM_{10}) in the home meet the requirements of health and change the behavior of blocking the vents to increase the flow of fresh air from outside into the house.

Key words: Risk factor, acute respiratory infection, PM_{10}, odds ratio, CI

Received: October 16, 2016 Accepted: November 17, 2016 Published: December 15, 2016

Citation: Anwar Daud, Anwar Mallongi, B. Agus Bintara, Mustafa and Maming, 2017. Risks factor of particulate matter (PM_{10}) and acute respiratory infection in community at urban area. Res. J. Environ. Toxicol., 11: 35-39.

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Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

The worldwide urban population, now over 3.5 billion is projected to rise to 6.5 billion[1] by 2050. Particulate Matter (PM) air pollution in urban areas is a major public health concern. Burning solid fuels indoors for heating, light and cooking and burning liquid fuels outdoors to power vehicle engines, results in a complex mix of gases and Particulate Matter (PM). The most convincing evidence for adverse health effects exists for PM. In Europe, 80% of the population live in areas, where PM levels exceed World Health Organization (WHO) air quality guidelines and the life expectancy of Europeans is decreased, on average, by almost 9 months due to PM. Worldwide, it is estimated that the fraction of outdoor PM below 2.5 μm in diameter (PM2.5) accounted for 3.1 million deaths[2] in 2010. These effects manifest as cardiorespiratory diseases (myocardial infarctions, stroke, COPD and lung cancer) exacerbations of asthma[3,4] and cystic fibrosis[5] and respiratory infections in children[4]. In resource poor settings, approximately 3 billion people depend on burning solid fuels (coal or biomass fuels, wood, animal dung and crop wastes) for heating and cooking. The PM generated from indoor solid fuel combustion exposes individuals who spend long periods of time near stoves (predominantly women and young children) to 100-fold levels in excess of those considered acceptable. As a direct result, indoor air pollution is responsible for 2.7% of the global burden of disease[6,7] and contributes to 2 million deaths per year, exceeding the annual mortality attributed to malaria[8]. About 85% of future global population growth is predicted to occur in cities in the developing world[1] and in the absence of major policy shifts towards cleaner environments, the majority of children in the 1st half of this century are likely to grow up exposed to unsafe air both at home and outdoors. This study will focus on one component of the adverse effects of PM_{10}-acute respiratory infection and will consider both the effects of fossil fuel and biomass-derived PM[8].

MATERIALS AND METHODS

From April-July, 2016, a case control study was conducted at the Dahlia Health Center Makassar city. The study was approved by the institutional ethics committee and written informed consent for participation was obtained from all the patients and controls.

Cases: All the subjects who came for medical check-up in the Dahlia Health center Makassar city from April-July, 2016 were screened for suit ability for inclusion in the study. The diagnosis and classification of the Acute Respiratory Infection (ARI) and its severity was made according to Health Ministry. Inclusion criteria for cases were (a) diagnosis of ARI according to the treating physician, (b) symptoms and (c) use of medications for ARI.

For <8 years of age, spirometry was not possible therefore diagnosis of ARI was based on the presence of clinical symptoms as given in Health Ministry guidelines. However, for stringent criteria of selecting ARI under this age group, cases were recruited that were presence of two or more of the following symptoms: (a) current presence of wheeze in any child with a history of more than 2 episode of documented wheeze or use of bronchodilator in the preceding 12 months, (b) on any regular medication for ARI, such as corticosteroids, b-2 agonist, methyl xanthines, leukotriene modifiers and cromones and (c) presenting with symptoms of ARI along with positive family history of ARI.

Controls: Controls were persons attending control is that those who do not suffer from ARI from the same locality/community with other ailments. The inclusion criteria for controls were: (a) No past or present diagnosis of ARI and other pulmonary diseases, (b) No history of wheezing, short-ness of breath and other symptoms of allergic diseases, such as nasal and skin symptoms, (c) No use of medications for ARI and (d) Absence of first-degree relatives with a history of ARI.

Statistical analysis: Data was entered in Microsoft Excel and analyzed using statistical software SPSS version 20.0 (Chicago, IL, USA). Mean and Standard Deviation (SD) were calculated for continuous variables and proportions were calculated for categorical variables. For assessing the association of risk factors with acute respiratory infection and severity, chi-square test was used with 2 degree of freedom for categorical variables and student's t test for continuous variables. It is calculated odd's odds ratio with 95% confidence interval using Logistic Regression model. Variables that were entered in the logistic regression model to find association with acute respiratory infection and its severity were those which on univariate analysis were found to be associated with acute respiratory infection with $p<0.05$. Using a 2-tailed distribution,of $p<0.05$ was considered statistically significant. For analyzing associated factors with the severity of acute respiratory infection, a "Case only" study was performed.

We recruited cases and controls between the age group of 8 and 60 years. For the uniformity of data, grouped recruited population in 2 groups (1) age 15 years and (2) age >15 years. Both the groups were age and sex matched.

Analysis was done to find out any association for anthropometry (Body weight and height, place of residential (urban and sub urban).

Measurement of PM_{10}: Data collected in the study are primary data and secondary data. Primary data on concentrations of PM_{10} were conducted by measuring the PM using 831 four channel handheld particle counters or aerosol mass monitor and the data on the sources of exposure to PM_{10} is known based on direct interviews using questionnaires, while secondary data or supporting data obtained from institutions concerned, such as district and villages offices, health centers and the city health department. Analyzing of descriptive data, aims to describe the characteristics of the population and presented in the form of a frequency distribution. Bivariate analyzing, to see the relationship between the independent variable on the dependent variable using the chi-square test, t-test and logistic regression of using SPSS-IMB computer application program. Presentation of data in tables and accompanied by narration.

RESULTS

Included in the study were 130 controls and 65 cases of acute respiratory infection. For the difference between cases and controls from continuous data can be seen in Table 1.

Table 1 and 2 shown that there are no differences in the characteristics of variables between cases and controls using t-test. The variables tested were age, body weight, body height, body mass index and particulate matter.

Table 3 shown that the variables most at risk after logistic regression test is variable particulate matter (PM_{10}) with OR: 29.177, 95% CI: 3.172-268.341, p<0.003, use of mosquito OR: 1.938, 95% CI: 0.945-3.975, p-value 0.071, while the variable age and humidity is a factor supporting the respective values OR: 0.127, 95% CI: 0.015-1096, p>0.061 and OR: 1.067, 95% CI: 0.279-4.084, p-value 0.925 respectively.

DISCUSSION

Deficiencies ventilation provides air and should be sufficient to dilute the contaminants to levels below human perception and those considered detrimental for health. Ventilation may be inadequate due to insufficient air volume, high levels of recirculation, incorrect placement of ventilation points, deficient distribution that leaves certain areas without ventilation and a lack of maintenance or incorrect design of filtering systems[9]. In a study carried out in the United States analyzing 97 buildings, it was observed that deficient maintenance of air conditioning systems was associated with increased respiratory, eye and skin symptoms among the occupants[10]. In developing countries, biomass fuels are often used for cooking or heating homes, which usually coincides with deficient ventilation of the spaces where the combustion takes place. Several researchers have found a clear relationship between the different ventilation systems (natural, air conditioning or mixed) and IAC. The CO_2 levels are considered a good parameter for assessing indoor ventilation quality in enclosed settings like day-care centers or schools, levels above the threshold of 1000 ppm would imply poorly functioning ventilation systems[11].

The relationship between acute respiratory infections and Indoor Air Pollution (IAP) has been well established. The presence of humidity or IAP has been consistently no associated with the appearance of infections (OR: 1.50, 95% CI: 1.32-1.70) both in children and in adults[12]. Exposure to biomass smoke raises the risk for respiratory infections in children (OR: 3.53, 95% CI: 1.93-6.43). Dherani *et al.*[13], in a recent meta-analysis, observed an increase of 80% in the risk for pneumonia in children under the age of 5 related with IAP due to the use of solid combustibles (OR: 1.79, 95% CI: 1.26-2.21). Moreover, the risk is dependent of dosage and increases with high concentrations of contaminants[14]. A recent intervention study in Guatemala analyzed exposure in children who were under the age of 4 months and followed until the age of 18 months. In the home of one group, stoves

Table 1: Baseline characteristic of study population

	Case		Control		
Variables	Mean	Standard deviation	Mean	Standard deviation	t-test (p-value)
Age (years)	31.32	16.77	28.00	18.87	1.25 (0.21)
Weight (ink)	45.63	9.55	42.22	2.75	1.91 (0.06)
Height (inch)	151.60	19.05	145.61	19.98	2.00 (0.05)
BMI	19.16	3.05	19.05	4.23	0.20 (0.84)
PM_{10} (mg m^{-3})	27.95	15.48	24.14	11.22	1.96 (0.05)

Mean and standard deviation and t-test value significations 2-tailed, BMI: Body mass index, MP: Particulate matter

Table 2: Result chi-square analysis

	Cases		Controls		
Demographic characteristic	n	%	n	%	Values
Age groups					0.033
<15 years	24	25.8	69	74.2	
>15 years	41	40.2	61	59.8	
Sex					0.839
Male	31	32.6	64	67.4	
Female	34	34.0	66	66.0	
BMI					0.020
Normal	42	40.8	61	59.2	
Abnormal	23	25.0	69	75.0	
Density residential					0.323
Good	17	28.3	43	71.7	
Ugly	48	35.6	87	64.4	
Smoke behavior					0.712
No smoker	52	34.0	101	66.0	
Smoker	13	31.0	29	69.0	
Using insect repellent					0.109
Yes	43	30.1	100	69.9	
No	22	42.3	30	57.7	
Ventilation condition					0.031
Good	20	24.7	61	75.3	
Poor	45	39.5	69	60.5	
Level PM_{10}					0.000
Good	20	20.2	79	79.8	
Ugly	45	46.9	51	53.1	
Temperature					0.216
Good	22	40.0	33	60.0	
Ugly	43	30.7	97	69.3	
Humidity					0.360
Good	20	38.5	32	61.5	
Ugly	45	31.5	98	68.5	

Table 3: Logistic regression analyzing

Variable (coding)	OR	95% CI	p-value
Age	0.127	0.015-1.096	0.061
BMI	1.671	0.478-5.845	0.422
Density residential	1.059	0.487-2.304	0.884
Smoking	1.231	0.544-2.788	0.618
Using insect repellent	1.938	0.945-3.975	0.071
Ventilation	1.562	0.731-3.337	0.250
PM_{10}	29.177	3.172-268.341	0.003
Temperature	0.964	0.253-3.681	0.957
Humidity	1.067	0.279-4.084	0.925

with chimneys were installed, while the other group maintained the traditional way of cooking over an open fire. There was an observed significant reduction in the incidence of severe pneumonia in the intervention group[15]. The greatest reduction in incidence was seen in cases where there was no infection due to respiratory syncytial virus. This could indicate that IAP favor bacterial pneumonia[15].

CONCLUSION

Indoor air pollution are a risk factor for multiple acute respiratory infection diseases. Many sources are able to generate indoor contaminants and there is a direct association between PM_{10} levels and using insect repellent.

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