“Harmony of Caring and Healing Inquiry for Holistic Nursing Practice; Enhancing Quality of Care”

Semarang, 20 – 21 August 2015

Published by
Jurusan Keperawatan
Fakultas Kedokteran Universitas Diponegoro
Website: www.jnk.keperawatan.undip.ac.id
Email: jnkundip@gmail.com
PROCEEDING 3rd JAVA INTERNATIONAL NURSING CONFERENCE 2015
“HARMONY OF CARING AND HEALING INQUIRY FOR HOLISTIC NURSING PRACTICE; ENHANCING QUALITY OF CARE”

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PUBLISHED BY JURUSAN KEPERAWATAN. FAKULTAS KEDOKTERAN
UNIVERSITAS DIPONEGORO
JL. PROF SUDHARTO, SH
TEMBALENG, SEMARANG

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Proceeding 3rd Java International Nursing Conference 2015
“Harmony of Caring and Healing Inquiry for Holistic Nursing Practice: Enhancing Quality of Care”

Semarang: Jurusan Keperawatan, Fakultas Kedokteran, Universitas Diponegoro, 2015
1 exemplar. 618 pages, 8.27 x 11.69 inch
THE EFFECT OF MOSQUITO COIL ON PEAK EXPIRATORY FLOW RATE (PEFR) IN SELECTED PUBLIC ELEMENTARY SCHOOL IN SOUTH SULAWESI

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ABSTRACT

Background: Children who were exposed by mosquito coil’s smoke can cause respiratory and cardiovascular diseases. It will cause irritation, inflammation and increased of bronchial reactivity and may decrease the ability of mucociliary clearance thus it potentially causes wheezing, exacerbation of asthma, respiratory tract infections, chronic obstructive pulmonary disease and acute exacerbations of chronic obstructive pulmonary disease. It can reduce the Peak Expiratory Flow Rate (PEFR).

Purpose: This study aims to describe the peak expiratory flow rate of students who were exposed by mosquito coil’s smoke based on age, sex, use of mosquito coils in one night, nutritional status and duration of exposure.

Method: This study used Quantitative Descriptive Study method to 138 students (grade 1-6 of elementary school in aged of 6-13 years old) who were exposed by mosquito coil’s smoke as sample using Stratified Random Sampling technique in SDN Mallaulu 238, Puncak Indah Village, East Luwu District, South Sulawesi. This study was conducted from August 2014 to February 2015. Data were collected using a Peak Flow Meter, step weight scale, microphone, and observation sheet. Analysis of data used univariate and cross tabulation.

Results: The results showed that 138 students (100%) were exposed by mosquito coils for ≥ 5 years and the use of mosquito coils per night. 126 students (91.3%) had low PEFR, 12 students (8.7%) had less PEFR. Mosquito coil’s smoke exposed by gender was female majority by 73 students (52.9%); aged was 9.1 to 13 years old by 82 students (59.4%); and nutritional status was normal by 77 students (55.8%).

Conclusion: Students who were exposed by mosquito coil’s smoke ≥ 5 years and use of mosquito coils in one night illustrated Peak Expiratory Flow Rate (PEFR) lower in female students and more common in grades 3-6 of elementary school students. Nursing implication improves the health education about the dangers of using mosquito coils and the importance of implementation in pulmonary examination program to elementary school students for early detection of PEF as an effort to decrease the prevalence of respiratory infections and reduce the risk of pulmonary abnormalities at the age of adulthood later.

Keywords: Peak Expiratory Flow Rate, Mosquito Coils
BACKGROUND

Air pollution is a leading cause of death in the worldwide, with households air pollution accounted about 3.5-4 million death each years and dominated by women and children who live in the lower economic class or in poverty because of frequent exposure to households air pollution (Stephen et al., 2014). Acute Respiratory Infections (ARI) is a disease that often occurs in children hood. The incidence in toddler age group (under five years old) was estimated to 0.29 episodes per child per year in developing countries and 0.05 episodes per child per year in developed countries. It shows that there are 156 million of new episodes per year in the world in which 151 million episodes (96.7%) occur in developing countries. Most cases occur in India (43 million), China (21 million) and Pakistan (10 million) and Bangladesh, Indonesia, Nigeria respectively 6 million episodes. From all cases occurring in the community, 7-13% was severe cases and required hospitalization. Episode of cold of toddlers in Indonesia was estimated to 2-3 times per year (Rudan et al., 2008).

Air pollution can cause a variety of diseases and disorders of body functions including respiratory problems (Ministry of Health, 2008). One source of indoor pollutants is smoke coils that can repel mosquitoes, but it is also a threat for health, especially to the respiratory system. Indonesia as a tropical area is a potential endemic area of some infectious diseases which any time can become a threat to public health. Geographic effect can lead an increase in cases and deaths of URTI (Upper Respiratory Tract Infection) patients, such as environmental pollution caused by smoke from forest fires, exhaust gases originating from transportation and air pollution inside home because of kitchen steam, smoking and mosquito coil’s smoke endangering health, especially on URTI disease (Noer & Mutiatikum, 2009).

Tang et al, (2010) revealed that mosquito coils and lung cancer in Taiwan between 2002 and 2004 showed that the risk of lung cancer among smokers who were exposed by mosquito coil’s smoke was 14 times higher than non-smokers without mosquito coil’s smoke exposure. Among 33 provinces in Indonesia, there are five provinces with high incidence and prevalence of respiratory disorders particularly Pneumonia for all age groups. South Sulawesi was ranked on fifth (4.8%) after Nusa Tenggara Timur (10.3%), Papua (8.2%), Central Sulawesi (6.1%) and West Sulawesi (5.7%) (Riset Kesehatan Dasar, 2013). The spread of respiratory diseases in the city of Makassar as the capital of South Sulawesi was even fairly attacking children and adults. Number of URTI patients in Makassar was ranked in top 10 diseases and in 2012 there were 130,939 (19.64%) patients. While the main cause of the highest mortality of all ages were caused by asthma as many as 745 patients (health profile of Makassar, 2012).

URTI was a main cause of patient to visit community health centers (40% -60%) and hospitals (15% -30%) (Guidelines for Disease Control of ARI, 2012). Based on data obtained from the URTI program in Community Health Center of Malili, East Luvu District in South Sulawesi in 2014, URTI was in the top 10 diseases and was in the first rank by 5334 patients in 2013. It was still in the first rank in 2014 by 6275 patients with the average number of cases reached 500
patients per month. The highest number of cases found in Puncak Indah Village (Community Health Center of Malili, 2013).

From the results of a survey from house to house of URTI patients particularly in Puncak Indah Village, program managers of URTI in community health center of Malili concluded that one of causes in URTI case was the use of mosquito coil continuously throughout the night in the room. This was supported by a previous study conducted by Liu et al (2003) that lit one of mosquito coil produced Particulate Matter (PM) \(_2,5\) that equals to 75-137 cigarettes. PM\(_2,5\) is very small particles (pollutant) in the air with diameter 2.5 micrometers or smaller, that cause respiratory and cardiovascular diseases. Acute exposure of PM\(_2,5\) will cause irritation, inflammation and increased bronchial reactivity and may decrease the ability of mucociliary clearance thus it potentially causes wheezing, exacerbation of asthma, respiratory tract infections, chronic obstructive pulmonary disease (COPD) and acute exacerbations of chronic obstructive pulmonary disease COPD (Bruce et al, 2000 in Arifa, 2010). For early detection of the disorder, it is necessary an examination of Peak Expiratory Flow Rate (PEFR) using a Peak Flow Meter. PEF is the maximum flow produced during expiration and done with maximum strength after full inspiration (Musmar & Minawi, 2010). People can normally exhale about 80% of vital capacity in a second, but on the contrary if the result is less than 80% means airway obstruction occurred (Price & Wilson, 2012).

**Peak Flow Meter or Peak Expiratory Flow Rate (PEFR)** is a tool to perform pulmonary function tests. Peak flow meter measurement was performed three times and the highest value in the measurement can be used to describe the function of lung ventilation. This tool can find out as early as possible the decline in lung function and airways narrowing or obstruction (Ariestianti et al, 2013).

**OBJECTIVE**

This study aims to describe the peak expiratory flow rate of students who were exposed by mosquito coil’s smoke based on age, sex, use of mosquito coils in one night, nutritional status and duration of exposure.

**METHODS**

This study used Quantitative Descriptive Study method with 138 students (grade 1-6 of elementary school in aged of 6-13 years old) who were exposed by mosquito coil’s smoke as sample using Stratified Random Sampling technique in SDN Mallalu 238, Puncak Indah Village, East Luvu District, South Sulawesi. This study was conducted from August 2014 to February 2015. Samples were taken using stratified random sampling technique with exclusion criteria were the students and or family members experiencing respiratory disorders at the time when this study being conducted (eg, respiratory infections, asthma, bronchitis, cough, runny nose).

Data were collected by using Peak Flow Meter tool, step weight scales, microtoise, and observation sheet. Peak Expiratory Flow (PEF) measurement on students who were exposed by mosquito coil’s smoke used a peak flow meter in liters/minute, with the method that was the students inhale deeply and then exhale
as strong as possible. The result would be seen in the low category if PEFR <300 L/min, less if PEFR 301-500 L/min, and normal if PEFR > 601 L/min. Results of measuring the use of mosquito coils per night was coil (coil, spiral, pieces) and exposed duration by mosquito coils based on the number of years since the children were exposed until this study being conducted.

Management of data in this study used computer with cross tabulation and frequency distribution of students including the distribution of class, sex, age, nutritional status, use of mosquito coils in one night, duration of exposure, and PEFR.

RESULTS

The results showed in Table 1, that the respondents were exposed by mosquito coils based on the characteristics of the respondents that the highest in grade 3 by 29 students (21.0%). Female students were majority exposed by 73 students (52.9%) while based on age was 9.1 to 13 years old by 82 students (59.4%). According to the characteristics of the nutritional status of the respondents, the number of students who were exposed by mosquito coils was the most in normal category by 77 students (55.8%).

Based on the characteristics and duration of using of mosquito coils per night, 138 students (100%) using mosquito coils 1 (one) per night over 5 years consumption. While low category of PEFR of students who were exposed by mosquito coils was 126 of 138 students (91.3%) and less category of PEFR was 12 students (8.7%).

Table 1

<table>
<thead>
<tr>
<th>Characteristics of Participants</th>
<th>f</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Class</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Class 1</td>
<td>22</td>
<td>15.9</td>
</tr>
<tr>
<td>Class 2</td>
<td>16</td>
<td>11.6</td>
</tr>
<tr>
<td>Class 3</td>
<td>29</td>
<td>21.0</td>
</tr>
<tr>
<td>Class 4</td>
<td>23</td>
<td>16.7</td>
</tr>
<tr>
<td>Class 5</td>
<td>27</td>
<td>19.6</td>
</tr>
<tr>
<td>Class 6</td>
<td>21</td>
<td>15.2</td>
</tr>
<tr>
<td><strong>Sex</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>65</td>
<td>47.1</td>
</tr>
<tr>
<td>Female</td>
<td>73</td>
<td>52.9</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.0 - 9.0 years</td>
<td>56</td>
<td>40.6</td>
</tr>
<tr>
<td>9.1-13.0 years</td>
<td>82</td>
<td>59.4</td>
</tr>
<tr>
<td><strong>Nutritional Status</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Very Thin</td>
<td>20</td>
<td>14.5</td>
</tr>
<tr>
<td>Thin</td>
<td>34</td>
<td>24.6</td>
</tr>
<tr>
<td>Normal</td>
<td>77</td>
<td>55.8</td>
</tr>
<tr>
<td>Fat</td>
<td>7</td>
<td>5.1</td>
</tr>
</tbody>
</table>
Table 2 shows the sex characteristics of the respondents with PEF. It illustrates that a low PEF was majority in female by 70 respondents (95.9%) from 126 respondents with low PEF. Whereas in Table 3 shows that the age characteristics of the respondent with PEF illustrates that a low PEF was dominated by the aged of 9.1 years - 13 years as many as 70 students (65.4%). Table 4 illustrates that the low value of PEF was the highest in the normal nutritional status by 68 students (88.3%) from the 126 students with low PEF.

Table 2
Cross Tabulation Based on Sex Characteristics of Respondents with Peak Expiratory Flow Rate (PEFR) of Students who Exposed by Mosquito Coil

<table>
<thead>
<tr>
<th>Sex Characteristics</th>
<th>PEF Category</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low</td>
<td>Less</td>
</tr>
<tr>
<td></td>
<td>n</td>
<td>%</td>
</tr>
<tr>
<td>Male</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>126</td>
<td>91.3</td>
</tr>
</tbody>
</table>

Table 3
Cross Tabulation Based on Age Characteristics of respondents With Peak Expiratory Flow Rate (PEFR) of Students Who Exposed by Mosquito Coil

<table>
<thead>
<tr>
<th>Age Characteristics</th>
<th>PEF Category</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low</td>
<td>Less</td>
</tr>
<tr>
<td></td>
<td>n</td>
<td>%</td>
</tr>
<tr>
<td>6.0-9.0 years</td>
<td>56</td>
<td>100</td>
</tr>
<tr>
<td>9.1-13.0 years</td>
<td>70</td>
<td>85.4</td>
</tr>
<tr>
<td>Total</td>
<td>126</td>
<td>91.3</td>
</tr>
</tbody>
</table>
Table 4
Cross Tabulation Based on Nutritional Status Characteristics of Respondents with Peak Expiratory Flow Rate (PEFR) of Students who Exposed by Mosquito Coil

<table>
<thead>
<tr>
<th>Nutritional Status Characteristics</th>
<th>PEFR Category</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low n</td>
<td>%</td>
</tr>
<tr>
<td>Very Thin</td>
<td>20</td>
<td>100</td>
</tr>
<tr>
<td>Thin</td>
<td>34</td>
<td>100</td>
</tr>
<tr>
<td>Normal</td>
<td>77</td>
<td>100</td>
</tr>
<tr>
<td>Fat</td>
<td>7</td>
<td>100</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>126</strong></td>
<td><strong>91.3</strong></td>
</tr>
</tbody>
</table>

DISCUSSION

Students who were exposed by mosquito coils was dominated by female with lower PEFR than male students, this study showed that the lung capacity of male was higher than female. This was in line with the theory put forward by Pearce (2010) that the lung capacity of male was higher (4-5 liters) than female (3-4 liters). This capacity will be reduced when the airway is exposed continuously by pollutants that will cause respiratory tract irritation and thickening. If this continues for a long time the narrowed airway epithelium would lead to a lack of air entering the lungs. According to James Peterson, 2006 in (Quincene, 2014) from the American College of Sports Medicine that regular aerobic exercise increased the strength and function of the respiratory muscles and the diaphragm muscle where strong external intercostal muscles would increase the capacity of a person's vital to expand the chest cavity during inhalation (Price and Wilson, 2012). In general, men is more active than women as a study conducted by Professor William Sheel from the University of British Columbia which showed that respiratory metabolism during exercise is higher in men than in healthy women.

According to Goldsmith and Friberg, 1977 in Mukono (2008) that particles in and outside the room would cause disturbances in the human body. In general, the effects of these particles to the individual and society were acute and chronic disease, hidden diseases that can shorten the life of the individual (cancer), disturb the physiological function of the lungs, nerves and oxygen transport by hemoglobin. When humans inhale to breathe, then the air containing oxygen, nitrogen, carbon monoxide and other gases will also be inhaled into the lungs and reach the alveoli. HbCO levels (Hemoglobin Carbon monoxide) will increase when air containing pollutants are carried into the respiratory tract, so that the oxygen levels will be reduced because the Co molecules that catch most of the hemoglobin. Reduced oxygen levels in the blood will cause dizziness, discomfort in the eyes, ringing in the ears, nausea, vomiting, narrowing, shortness of breath, muscle weakness, fainting and even death.

Previous study conducted by Coman, Davis and Cornwell, 1991 in Mokono (2008) stated that in general, the effects of mosquito coil’s smoke (pollutants)
would cause respiratory irritation to the respiratory tract. Cilia movement would be slower, even stopped due to loss of cilia and cells lining mucus membranes so it could not clean the respiratory tract. If respiratory tract irritation occurred, there would be also an increased in mucus production that cause airways narrowing. Nadakavukaren, 1986 in Mukono (2008) also revealed that if the cilia could no longer active, inhaled particulates will be more carried into the lungs that impaired macrophage function and lead to edema of membrane mucous narrowing the respiratory tract. If the respiratory tract has narrowed the air flow will also be lower and cause PEFR decreased.

Liu et al (2003) said that the mosquito coil was equivalent to 75-135 cigarettes and generate PM$_2.5$. When breathing, PM$_2.5$ would be carried into respiratory tract causing irritation, inflammation and increased bronchial reactivity that reduced the ability of airway clearance mukosiliar and hiperresponsivitas, causing airway obstruction, increased of airway resistance and decreased of PEFR (Arifa, 2010). Exposure by pollutants has not had a significant impact at first because the body may be able to repair this damage, but changes in the lung tissue started when it continuously repeated. Normal cells lining the lungs will be damaged and it can affect the quality of individual life.

The same study by Tang et al (2010), stated that consequences as a result from frequent exposed by PM$_2.5$ could lead to airways remodeling, causing respiratory problems with the result that PEFR decreased, it was consistent with the results of this study that 9.1-13 years old experienced lower PEFR than the age of 6-9 years. The same theory is disclosed by Liu et al., (2003) that when mosquito coils lit, it would produce PM$_2.5$ from the incomplete combustion. When a person inhaled the air, PM$_2.5$ would also be inhaled to reach the bottom of the respiratory tract (alveoli). Therefore, the use of mosquito coils in a long time caused the exposure of pollutants by the chronic smoke, which caused abnormalities in the airway.

This study also showed that students exposed by mosquito coils had started to be exposed since childhood with an average of more than 5 years. Mosquito coil’s smoke exposure in a long time will affect children’s respiratory tract where diameter in childhood airway is smaller and easier narrowed due to mucus membrane edema and increased of secret production (Wong et al., 2009). The process of lung development in childhood is extremely valuable and as much as possible kept away from air pollution. Exposure to air pollution on childhood will affect the maximum capacity of the lungs to be achieved in adulthood (WHO, 2011; WHO, 2014)

Based on the nutritional status of children, the results of this study indicate that the peak expiratory flow of students who were exposed by mosquito coils with a normal nutritional status were not much different from the thin nutritional status. This was consistent with previous studies conducted by Muchlis, Said, and Madiyono (2005) entitled Pulmonary Function Tests on Street Children in Central Jakarta indicated that there were no difference of Peak Expiratory Flow Rate on street children with well-nourished and malnutrition status. Another factor caused the difference in peak expiratory flow rates could be caused by children physical
activities, for example frequent exercise can make a person's lung capacity greater.

Students use mosquito coils ≥ 5 years had lower PEFR and this was in line with a study conducted by Chen et al, 2008 in Arifa (2010) entitled the difference of PEFR percentages in women were exposed and not exposed by mosquito coil's smoke in Bengkoang, Sukoharjo, stated that a person would be decided being exposed by mosquito coils when used 3 coils per week for 5 years that decreased lung function. This was consistent with epidemiological studies conducted in Southern California since 1993 to determine the effects of air pollution on the development of lung function by around 1759 children at the age of 10 years old that passed measurements of lung function and repeated again at the age of 18 years old. The result showed that the influence of air pollution that causes lung function became worse according Gauderman 2004 in (Muchlis, Said, & Madiyono 2005).

Besides, according to study by Rahayu (2009), entitled Differences PEF due to air pollution in the Tirtonadi and Proliman Balapan terminal in Surakarta, stated that people who were exposed by air pollution would affect a change in respiratory tract such as mucous gland hyperplasia, mucosal thickening, respiratory muscle spasm and excessive mucus production, causing disturbances in lung function and decreasing PEF.

CONCLUSION

Students who were exposed by mosquito coil's smoke ≥ 5 years and use of mosquito coils in one night illustrated Peak Expiratory Flow Rate (PEFR) lower in female students and more common in grades 3-6 of elementary school students. Nursing implication improves the health education about the dangers of using mosquito coils and the importance of implementation in pulmonary examination program to elementary school students for early detection of PEF as an effort to decrease the prevalence of respiratory infections and reduce the risk of pulmonary abnormalities at the age of adulthood later.

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