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# Occupational Exposure on Gasoline Station Workers Not Affect the Nasal Mucociliary Clearance Time and Pulmonary Function Test

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**Background:** Gasoline station workers are directly exposed to benzene, toluene, ethylbenzene, xylene (BTEX) which may worsen their nasal mucociliary clearance (NMCC) time and pulmonary function test (PFT). This study aimed to know the profile of NMCC and PFT on gasoline station workers compared to control group. **Method:** Age and sex matched case control design study was conducted on 34 subjects of gasoline station workers and 34 non gasoline station workers. The NMCC time was assessed with saccharine tablet which inserted with a Tilley forceps. The time from saccharine placement until subject reporting the first sensation of a sweet taste was measured to the nearest minute. The PFT consist of vital capacity (VC), forced vital capacity (FCV), forced expiratory volume in 1 second (FEV1) and the ratio of FEV1/FCV were measured using digital spirometer. Data were analyzed with *Pearson Chi-Square tests*. **Results:** The mean NMCC time for gasoline station workers was  $1386.5 \pm 552.9$  seconds and control group was  $1191.7 \pm 468.3$  seconds, but not significantly different ( $P = 0.406$ ). The VC result of exposed group was  $3061.8 \pm 699.3$  ml, FCV =  $3070.7 \pm 855.9$  ml, FEV1 =  $2832.1 \pm 574.1$  ml and FEV1/FCV =  $112.9 \pm 133.9\%$ , whereas the VC result of non exposed group was  $3284.7 \pm 964.4$  ml, FCV =  $3361.5 \pm 2926.8$  ml, FEV1 =  $2926.8 \pm 719.3$  ml and FEV1/FCV =  $88.2 \pm 6.7\%$ . The PFT results were also not significantly different between the groups ( $P > 0.01$ ). **Conclusion:** Occupational exposure by gasoline vapour may affected the NMCC time and PFT but not different from the common population.

**Keywords:** Fuel Vapour, NMCC Time, PFT, Gasoline Station Workers.

## 1. INTRODUCTION

Exposure to irritant gases and chemical compounds may cause hyperreactivity of mucous membranes that causing inflammation of mucosal respiratory tract.<sup>1</sup> Exposure to benzene, toluene, ethylbenzene, xylene (BTEX) continuously make the nasal mucous loss cilia and necrosis of the nasal mucous epithelial cells that function on nasal mucociliary clearance (NMCC) and pulmonary function test (PFT).<sup>2</sup>

Physiologically, nose serves as the first line of defense in the inspired air. The dust particles, bacteria, viruses and carried particles are caught in the mucous lining of the nasopharynx and oropharynx direction. The functions performed by the cilia and mucus simultaneously known as nasal mucociliary clearance (NMCC).<sup>3,4</sup> The mucociliary system can be effective if the mucus and cilia function adequately.<sup>5</sup> Nasal mucociliary system is influenced by various factors, including physiological factors, diseases and the environment. The influence of the fuel vapour will affect the environment of the nose.<sup>6,7</sup>

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In developed countries, refueling vehicles consumers would serve themselves, in contrast to gasoline stations in Indonesia where the consumer is always served by the gasoline station attendant. As the gasoline station attendants serve for a long hours of work, the officer will be exposed to the volatile substances contained in the fuel.<sup>8</sup> However, no personnel used personal protective equipment (PPE), in this case the mask during working hours therefore the level of risk exposure to the vapour fuel gasoline station workers in Indonesia would be higher. There is no policy for mandatory use of masks. Therefore, it is important to test NMCC and PFT to determine the effects of exposure of fuel vapour.

## 2. METHOD

An age and sex matched case control design study was conducted on 34 subjects of gasoline station workers as the case group and 34 subjects of non gasoline station workers as the control group. Research had been conducted on four gasoline stations in Semarang City. The NMCC time was assessed with

the saccharine test, where a saccharine tablet was inserted under direct vision with a pair of Tilley nasal dressing forceps into the medial aspect of the inferior turbinate of one nasal cavity. The time from saccharine placement until the subject, who sat forward quietly with the head bent forward, reporting the first sensation of a sweet taste was measured to the nearest minute. The PFT consists of vital capacity (VC), forced vital capacity (FCV), forced expiratory volume in 1 second (FEV1) and the ratio of FEV1/FCV. Data were analyzed with the *Pearson Chi-Square tests*.

Research has received approval from the ethical committee of Medical Faculty of Diponegoro and Kariadi Hospital Cental Java No. 506/EC/FK-RSDK/2016.

### 3. RESULTS

Proportionally, there were 62% males and 38% females, with age and sex matched in case and control groups. The *median* age in gasoline station workers were lower than non gasoline station workers as the control group, but all of the respondents were under 40 years old ( $\leq 2080$  weeks). The *mean*  $\pm$  SD age in weeks showed no different between the groups (*Pearson Chi-Square*,  $P > 0.01$ ).

The *median*, *minimum* and *maximum* values of NMCC time in gasoline station workers were higher than non gasoline station workers. The *mean*  $\pm$  SD NMCC time for gasoline station workers was higher than non gasoline station workers but not significantly different ( $P = 0.406$ ).

The VC result of exposed group was not significantly lower than the control ( $P = 0.548$ ), as well as the FCV ( $P = 0.439$ ), and the FEV1 ( $P = 0.475$ ). The ratio of FEV1/FCV of exposed group was not significantly higher than the control ( $P = 0.435$ ).

**Table I. The profile differences of nasal mucociliary clearance time and pulmonary function test between occupational gasoline station workers and non gasoline station workers (N = 68).**

Variables	Groups		P*
	Gasoline station workers	Non gasoline station workers	
<b>Sexes</b>			
Male	21	21	1.0
Female	13	13	
<b>Ages (weeks)</b>			
Mean $\pm$ SD	1447.5 $\pm$ 494.3	1504.1 $\pm$ 472.5	0.477
Median	1253.7	1388.650	
(Min–Max)	1009.1–2785.6	1028.3–2737.3	
<b>NMCC time (second)</b>			
Mean $\pm$ SD	1386.5 $\pm$ 552.9	1191.7 $\pm$ 468.3	0.406
Median	1269.0	1127.0	
(Min–Max)	456.0–2727.0	367.0–2403.0	
<b>VC</b>			
Mean $\pm$ SD	3061.8 $\pm$ 699.3	3284.7 $\pm$ 964.4	0.548
(Min–Max)	2030–4460	2050–5350	
<b>FCV</b>			
Mean $\pm$ SD	3070.7 $\pm$ 855.9	3361.5 $\pm$ 965.9	0.439
(Min–Max)	415–4680	2090–5560	
<b>FEV1</b>			
Mean $\pm$ SD	2832.1 $\pm$ 574.1	2926.8 $\pm$ 719.3	0.475
(Min–Max)	1850–3920	1820–4390	
<b>FEV1/FCV</b>			
Mean $\pm$ SD	89.9 $\pm$ 7.0	88.2 $\pm$ 6.7	0.435
(Min–Max)	73.9–100	77.9–100	

Note: \*Pearson Chi-Square,  $P > 0.01$ , not significant.

The *minimum* and *maximum* value of VC in expose group was lower than the control, as well as FCV, FEV1 and FEV1/FCV. The PFT results were also not significantly different between the groups ( $P > 0.01$ ), as can be seen in Table I.

### 4. DISCUSSION

This study were done in four different places of gasoline station in different condition, but the measurement for the nasal mucociliary clearance (NMCC) time as well as pulmonary function test (PFT) were done in the air conditioned room with similar humidity and temperature. The previous *in vitro* study revealed that the nasal mucociliary transport optimally functioned on 28°–33 °C, while the *in vivo* study showed that on 10°–39 °C with 10%–70% humidity, the nasal mucociliary transport was still function normally.<sup>9</sup> Other previous study had found that NMCC significantly increased in the age up to 40 years old.<sup>10</sup> Therefore, to avoid bias from the influence of age, this study were done in the population below 40 years ( $\leq 2080$  weeks) to match the age and sex with the control group. In order to avoid bias, data on smoking habit history, allergic rhinitis, the use of nasal drops medication or inhaler, were collected and exclusion were done based on some criteria.

There were no significant differences of NMCC time between gasoline station workers and non gasoline station workers. It contrasted to the result of a study in Yogyakarta.<sup>11</sup> The mean NMCC time of that study for exposed group was 12.74  $\pm$  5.57 minutes and for the non-exposed group was 7.8  $\pm$  2.03 minutes. Our study found the NMCC time in gasoline station workers was 23.06  $\pm$  9.12 minutes and in non gasoline station workers was 19.51  $\pm$  7.48 minutes. Based on this result, it showed that there were differences in the mean of NMCC time, but the lowest was in the control group. It is necessary to make an evaluation for the measurement of saccharine test because of the subjectivity of subjects. Probably, there were different method on measurement environment, especially on the room’s temperature and humidity.

Other study had published that nasal muco-cilliary transport defect were proportional to the exposure.<sup>12</sup> Unfortunately, this study did not support that hypotesis. The workers who had the same day-working time, with almost identical concentration of exposure, found the different result of NMCC time. New and long expose workers had a similar NMCC time, thus the lengthening NMCC time occurred in early starting day-work.

According to these findings, it is important to initiate an early preventive intervention without any discrimination to their work-time period, for example by using safety mask to protect direct contact to irritant inhalant, such as benzene. Nasal wash procedure is also necessary for reducing inflammation mediators that were stimulated by such kind of chemical injury on upper respiratory tract.<sup>13</sup>

The respiratory tract is the first target for atmospheric pollutants. The hypothesis of inflammatory response and “one air one disease” theory explained that the upper respiratory tract inflammation may trigger the lower respiratory tract as well as lung. So, the exposure on gasoline station workers by the gasoline vapour which contain benzene, toluene, ethylbenzene, xylene (BTEX) may worsen the nasal mucociliary clearance (NMCC) time and pulmonary function test (PFT).

The previous *in vivo* study found the histo-pathological changes on lung parenchym on Pb exposure after 4, 8, 12 hours respectively.<sup>14</sup> There were a degeneration changes and a decrease in the number of epithelial and goblet cell in guinea pig’s trachea

that caused by gasoline station vapour. Otherwise, 90 days exposure may cause huge lymphocytes infiltration in lamina propria accompanied by eosinophilic expression as well as local vascular dilatation.<sup>15</sup> The microanatomic's changes are followed by functional disturbance.

The spirometry profile may figure the pulmonary function and proved the decreasing function that triggered by gasoline vapour. This study also found that there were physiological changes on VC, FCV, FEV1 and FEV1/FCV that cause by gasoline station vapour. All parameter of PFT in expose group was lower than control group, but not significant. The longer gasoline vapour exposure, there will be much pathologic destruction which affecting pulmonary function,<sup>16</sup> and this study proved that in expose group, there were a decrease pulmonary function, but it was still not different with the non expose group. It could happen because we can not make sure that all control group were totally free of air pollutant that may also affect their respiratory tract. However, the age of expose subjects less than 40 years old and still in a short to medium period of work (not more than 10 years on duty).

## 5. CONCLUSION

The occupational exposure by gasoline vapour may affect the NMCC time and PFT, but not significantly different from the common population, thus, further cohort studies are needed.

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