Abstract

Introduction: Traffic related on-road air pollution is a major contributor to outdoor air pollution in developing countries. Passenger transport micro-environments (TME) are at higher risk. As an occupation group, three-wheeled taxi drivers are constantly exposed, leading to adverse health consequences in heavy traffic congested areas in Sri Lanka.

Objectives: To describe the occupation related exposure to on-road air pollution (relative to other passenger TMEs and at individual level), prevalence and risk of adverse health conditions, and behavioural attitudes towards mitigation among three-wheeled taxi drivers in heavy traffic congested areas in the district of Colombo

Methods: The study comprised four components.

A descriptive cross-sectional study was conducted in 96 vehicles each representing three TMEs (three-wheeled taxi, non-AC bus, AC car). Ambient and in-vehicular particulate matter (PM) concentrations were measured using real time monitors, while being driven under the same conditions.

A descriptive cross-sectional study was conducted among three-wheeled taxi drivers to quantify the amount and diurnal variation of occupation related personal exposure to on-road air pollutants (n=84) and to determine the prevalence of occupation related adverse health conditions using a multitude of tools to establish their presence (n=385). PM exposure variations were assessed in relation to different environmental conditions using regression analysis to find out covariates.

A comparative cross-sectional study was conducted in a group of three-wheeled taxi drivers (high exposure) and two matched control groups of skilled labourers from heavy (moderate exposure) and less (low exposure) traffic congested areas (n=180). The adjusted prevalence risk (aPR) was estimated for high exposure group using Cox regression analysis.

A qualitative study with focus group discussions (n=9) and key informant interviews (n=12) was conducted among three-wheeled taxi drivers to explore their behavioural attitudes on mitigating on-road air pollution and adverse health effects.

Results: The average PM_{10} and $PM_{2.5}$ concentrations were 456.3 μg/m^3 (SD=47.2) and 386.2 μg/m^3 (SD=26.7) within three-wheeled taxis, 292.1 μg/m^3 (SD=36.3) and 239 μg/m^3 (SD=20) within buses and 63.5 μg/m^3 (SD=7) and 59.2 μg/m^3 (SD=6) within AC cars, respectively. As a fraction of total PM_{10}, fine particles were six-fold higher than coarse particles within three-wheeled taxis. Compared to its ambient air, vehicular PM concentrations were three times higher within three-wheeled taxis; two times higher within buses; and two times lower within cars ($p<0.001$).

The average PM exposure of three-wheeled taxi driver on sunny days was 316.5 μg/m^3 (SD=244.9). When all other factors were kept constant, the increase in PM_{10} exposure and $PM_{2.5}$ were 30 μg/m^3 (SE=10) and 25 μg/m^3 (SE=10) for increase in temperature >28 ^{0}C and 38 μg/m^3 (SE=9) and 37 μg/m^3 (SE=9) for increase in relative humidity >79%; 239 μg/m^3 (SE=8) and 237 μg/m^3 (SE=8) for driving during peak hours; and 119 μg/m^3 (SD=10) and 104 μg/m^3 (SE=10) for being in motion, respectively. Raining would reduce PM_{10} exposure by 221 μg/m^3 (SE=20) and $PM_{2.5}$ by 208 μg/m^3 (SE=20). During most of the weeks, NO_2 and SO_2 exposure levels were 25.5 μg/m3 (SD=13.4) and 14 μg/m^3 (SD=7.8).

Most prevalent health conditions were runny nose/sneezing/nasal congestion (38.2%; 95% CI: 33.3, 43.2), dry cough (16.1%; 95% CI: 12.6, 20.2), phlegm (19.4%; 95% CI: 15.6, 23.8), restrictive (14.8%; 95% CI: 11.4, 18.7) and obstructive (24.1%; 95% CI: 19.9, 28.7) type lung impairment; eye irritation/lacrimation/eye redness (20.5%; 95% CI: 16.6, 24.9), atopic dermatitis/eczema (5.7%; 95% CI: 3.8, 8.8), diabetes (39.2; 95% CI: 34.3, 44.3) and hypertension (41.5%; 95% CI: 36.6, 46.7).

Compared to moderate and low exposure, the aPR of dry cough was 4.8 (95% CI: 1.1, 22.1) and 9.7 (95% CI: 1.2, 76.5). The aPR of runny nose/sneezing/nasal congestion was 2.23 (95% CI: 1.01, 5.3); of production of phlegm was 5.8 (95% CI: 1.2, 26.3); of obstructive lung impairment was 6.1 (95% CI: 1.3, 27.2); and of hypertension was 2.8 (95% CI: 1.01, 7.9) compared to low exposure group. Further, mean FEV1 of 2.7 l (SD=0.4), FVC of 3.3 l (SD=0.4) and $FEF_{25-75\%}$ of 3.1 (SD=0.2) were significantly lower in the high exposure group ($p<0.01$).

Behavioural attitudes of three wheeled taxi drivers on mitigation of on-road air pollution and adverse health effects were dependent on their knowledge, socio-demographic characteristics and legislative factors related to behaviour. Despite having varying

opinions, three wheeled taxi drivers were not pro-active in minimizing the exposure to on-road air pollution or adverse health effects. However, they believed that they would have to face the consequences, unless they change their behaviour.

Conclusions and recommendations: Compared to other TMEs, drivers of three-wheeled taxis were most vulnerable to exposure to on-road air pollution. This occupation related exposure imparted substantial risk for respiratory and non-respiratory adverse conditions among them. Behavioural attitudes on mitigation were multi-faceted. To minimize the hazards, as well as to mitigate air pollution, educating and supporting them financially and by inducing a behavioural change are recommended to safeguard their health.

Keywords: on-road air pollution, three-wheel taxi drivers, occupational related adverse health conditions, mitigation attitudes