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Respiratory symptoms and associated factors among motorcycle taxi driver in Ubungo municipality, Dar Es salaam, Tanzania

Abstract

Background: Motorcycle taxis have arisen as a key feature of rural and urban transport services. It is among occupation in which workers are highly exposed to ambient air pollutants and probably make them to be susceptible in developing respiratory diseases.

Objective: To determine prevalence of respiratory symptoms and the associated factors among motorcycle taxi drivers in Ubungo municipality.

Materials and methods: The study design was descriptive cross sectional study conducted from March to July 2018. Multistage sampling technique was used to obtain sample of 200 motorcycle taxi drivers and 100 office attendants. A modified British medical research council questionnaire and personal sampling pump (SKC Sidekick pump) were used for data collection. Data were analyzed by using Statistical Package for Social Science software22versions.

Results: Motorcycle taxi drivers had personal exposure to geometric mean dust concentration 1.60 mg/m^3 (SD=2.12) while office attendants had 0.071 mg/m^3 (SD=1.26) for eight hours, which was less than TLV according to the ACGIH. The prevalence of respiratory symptoms were reported to be higher among motorcycle taxi drivers compared to office attendants for all symptoms and the differences were statistically significant at P-value <0.001, where morning cough (55.5% vs. 27%); cough last for three months yearly (26% vs 2%); phlegm (53.2% vs 15%), phlegm last for three months yearly (23% vs.0%) wheezing (29% vs 2%) and shortness of breath (47.7% vs. 16%). Work duration was the factor significantly associated with cough, cough last for three months, phlegm and shortness of breath among motorcycle taxi drivers.

Conclusion: Prevalence of the respiratory health symptoms was higher among motorcycle taxi drivers than the control. Working as motorcycle taxi driver for four years and above is a risk factorfor developing respiratory health problems.

Keywords: motorcycle taxi drivers, respiratory symptoms, lung function, Tanzania

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Abbreviations: ACGIH, american conference of governmental industrial hygienists, BMI, body mass index, MUHAS, muhimbili university of health and allied science; PPE, personal protective Equipment, PVC, polyvinyl chloride; SKC, side kick casella; SD, standard deviation; TLV, threshold limit values

Introduction

Motorcycles provide a convenient and inexpensive transport substitute to automobiles in developing world. They are more navigable than automobiles and cheap in term of fuel consumption. Motorcycles now compete with public transport modes in developing countries as residents require greater mobility to access jobs and services.[1] The use of motorcycles has increased greatly in Africa in recent years. Motorcycles are often used as taxis, with riders charging a fare to carry passengers or goods. In rural areas and periurban, motorcycle taxis play a crucial role in connecting people to services and farms to markets, and in many countries motorcycles are the most commonly found vehicle on rural roads. Motorcycle transport is facing the risk of being injured in a crash and exposure to the dust. Recently motorcycle taxi drivers have increased in Tanzania, majority of people with no formal employment are involved in this business and now they can run their own lives without depending to other people or involving to illegal businesses.[1,2]

Studies in Nigeria showed motorcycle tax drivers to suffer higher prevalence of respiratory symptoms such as cough reported by 71%, sputum production 67%.[3–9] In Tanzania what is reported is the increase of motorcycle accidents and injuries among motorcycle taxi drivers. Motorcycle taxi drivers are among of risk group of workers exposed to dust, where they used to drive motorcycle constantly for more than eight hours in dusty environment without using any devices for protection. This situation make them to be more susceptible in developing respiratory problems.[3,4]

Study reported that people who commuting by motorcycle were highly exposed to air pollutants than all other modes of transport because the work requires taking passengers to and from different destinations within and even to the peripheries of the city for commercial gains. This type of duty may take them from a less busy to a more congested and industrialized parts of the city.[5] The motorcycle taxi drivers during the course of their duties inhaled these harmful particles, dust, black smoke, mist and volatile organic compounds especially when passing through highly air-polluted corridors such as traffic hold-ups, checkpoints and industrialized areas of the city.

A study in Brazil reported that motorcycle taxi drivers working in an urban environment with heavy air pollution experience airway symptoms, inflammation and decreased mucociliar clearance.[6] Study done in Indonesia reported high prevalence of respiratory symptoms

and lung impairment among online motorcycle taxis drivers,[7] also studies done in Nigeria reported that motorcycle taxis drivers have significantly lower mean vital capacity than non-commercial motorcyclists. This situation tend to predispose them to lung function impairment.[8] Study done in Congo reported on high prevalence of respiratory symptoms and pattern of lung function among motorcycle taxi drivers who are constantly exposed to emissions to be higher than bus driver.[3] In Tanzania most of motorcycle taxi drivers are working in more than 8 hours and majority of them are not using any PPE (mask) to protect them from dust and other particulate. Being exposed to dust and other particulates may probably make motorcycle taxi drivers to develop respiratory health effects however the condition can be aggravated by previously respiratory illness, age, obesity and smoking. Little is known relating to the prevalence of the respiratory symptoms among motorcycle taxi drivers in Tanzania. The aim of this study was to determine the prevalence of respiratory symptoms and the associated factors among motorcycle taxi drivers. Knowing the prevalence and associated factors will help to develop recommendations relevant for interventions of this group of workers.

Materials and methods

Descriptive cross sectional study was conducted for five months from March to July 2018, whereas consented 200 male motorcycle taxi drivers and 100 male office attendants were studied as exposure and control group respectively. Eligibility for participation was being motorcycle taxi drivers for exposed and office attendants for control, but both working for one year and above, aged 18 and above working in Ubungo Municipal Council. A multistage sampling technique was used to select participants from study area, at first stage simple randomly selection by lottery method was done to select 10 wards out of 14 wards in Ubungo municipal. At second stage simple randomly selection was done to obtain 2 registered waiting stations in each ward, where 20 waiting stations were included in the study. And the last stage was simple randomly selection in each selected waiting station where a registered and consented motorcycle taxi driver and office attendants who were eligible and worked for one year and above were selected. The Modified British medical research council questionnaire was used in the study which include questions on respiratory symptoms (cough, wheezing, phlegm, shortness of breath etc.), smoking, occupational exposure (duration of the job, working days and hours per week). The questionnaire was translated in Swahili language by using back translation for validating, the tool was pretested before data collection and the corrections were made accordingly to those questions which needed clarification or better way of asking.

Measurement

Anthropometric Measures

Anthropometric parameters such as weight (Kg) and height (m) were measured. The Body Mass Index (BMI) was obtained by the ratio: weight (Kg)/(height (m))^2. Body mass index (BMI) was calculated and classified according to WHO guidelines for BMI.A BMI of <18.5 was regarded as underweight, 18.5 - 24.9 normal, 25 - 29.9 overweight and ≥30 obese.

Dust exposure measurement

Total dust exposure was established by using a personal sampling pump (Side Kick Casella) which operated at flow rate of 2.0L/minute with PVC filter which was weighted before sampling. The field information such as date, pump number, filter number, time and flow rate were recorded in the sampling sheet. The pump was attached on a belt around each of the motorcycle taxi driver's waist. The sampling train consisting of tubing, pump, and the filter cassette holder was attached onto the collar in such that the intake was in the breathing zone. The pump switched on to start sampling and collection of the dust for eight hours. The time was noted in the sampling sheet when the pump starts, and when the pump switched off. After sampling, sampling train was disconnected from the participant's collar and the personal sampling pump was removed from the belt. The cassette sealed with plugs on both ends for transportation. The sample was transported to MUHAS multipurpose laboratory where the gravimetric analysis of filter was done by using micro balance (Mettle Toledo xp 205, capacity of 0.01mg-220g), the difference of filters prior and after use in weight is the weight of the total dust trapped on the filter during sampling. The mass concentration was calculated as weight of sample divide by volume of total dust sampled as shown below

Total volume of total dust = Flow rate× Sampling time

Sampling time = Tf – Ti

$$C = \frac{(Wf\text{-}Wi) \times 10^3}{VT} \text{ (mg/m3)}$$

Whereas

C = mass concentration of total dust (mg/m3)

Wf = final weight of filter, g

Wi = initial weight of filter, g

VT = total volume of air sampled, M^3

Tf = final time after sampling

TI = initial sampling time.

The exposure level (concentration) was compared with threshold limit value for total dust by the ACGIH which is 10mg/m^3.

Data analysis

The collected data were cleaned, coded, entered, and analyzed by using Statistical Package for Social Sciences (SPSS). Continuous variables were described by mean and standards deviation (mean; SD) and categorical variables were described by proportion (%). Chi-square test, Fisher exact test and Independent t- test were used for comparison of categorical and numerical variables respectively. Statistical significance was defined as a 2-sided P value less than 0.05.Binary logistic regression analysis was done to determine the potential determinants of respiratory symptoms, while controlling for potential confounders of respiratory symptoms.

Results

Demographic and social characteristics of the study population

The mean age of motorcycle taxi drivers and office attendants were 30.32(SD 5.83) and 27.59 (SD 5.64) respectively. Majority of motorcycle taxi drivers and office attendants had normal BMI with the mean of 23.94(SD 3.06) and 22.75(SD 2.44) respectively. Majority of motorcycle taxi drivers and office attendants had primary education level 65.5 % and 61% respectively. The participants married were 61.5% motorcycle taxi drivers and 59% office attendants. About 61% of commercial motorcyclists had more than four years in working while for office attendants were 50%. It was revealed that most motorcycle

taxi drivers and office attendants reported working for more than eight hours in a day were 97.5% and 100%)were respectively. Also, the current study showed that 19% of both motorcycle taxi drivers and office attendants were smokers (Table 1).

Table 1 Demographic and social characteristics of the study population (n=300)

Characteristics	motorcyclist n=200	Office attendants n= 100	Total n=300
Age(years) Mean (SD)	30.32(5.83)	27.59(5.64)	29.41(5.9)
Weight(kg) Mean (SD)	60.05(9.99)	59.68(9.03)	63.92(10.12)
Height(cm) Mean (SD)	165.94(6.67)	161.71(7.47)	164.53(7.22)
BMI(kg/m^2) Mean (SD)	23.94(3.06)	22.75(2.44)	23.55(2.92)
Education level n (%)			
None	1(0.005)	0	1(0.33)
Primary school	139(69.5)	61(61)	200(66.67)
Secondary school	60(30.5)	39(39)	99(33)
Marital status n (%)			
Single	56(28)	31(31)	87(29)
Married	123(61.5)	59(59)	182(60.67)
Cohabitate	21(10.5)	10(10)	31(10.33)
Working years n (%)			
1-4years	78(39)	50(50)	128(42.67)
> 4years	122(61)	50(50)	172(57.33)
Number of working day per week n (%)			
5 days	2(1)		2(0.67)
6 days	54(27)	100(100)	154(51.33)
7 days	144(72)		144(48)
Number of working hours per day n (%)			
≤8 hours	5(2.5)	100(100)	105(35)
≥8 hours	195(97.5)		195(65)
Smoking status n (%)			
Yes	38(19)	19(19)	
No	162(81)	81(81)	

% Percentages, Abbreviations: SD, Standard Deviation, BMI, Body mass index

Prevalence of respiratory health symptoms among motorcycle taxi drivers and office attendants

The prevalence of respiratory health symptoms was reported to be higher among motorcycle taxi drivers compared to office attendants for all symptoms and the differences were statistically significant at p-value <0.001. Prevalence of respiratory symptoms for motorcycle taxi drivers and office attendants were expressed in respectively manner as follow: morning cough 111 (55.5%) and 27 (27%); cough last for three months 52(26%) and 2(2%); phlegm 106(53.2%) 15(15%) and phlegm last for three months 46(23%) and 0(0%) wheezing 58(29%) and 2(2%);shortness of breath 94(47.7%) and 16(16%) (Table 2).

Total dust exposure level

A total of 35 total dust samples were collected, the result showed that, motorcycle taxi drivers had exposed to geometric mean 1.60 mg/m^3 (SD=2.12) while office attendants had exposed to geometric mean 0.071 mg/m^3 (SD=1.26) of total dust for eight hours which were below the threshold limit value (10mg/m^3)according to the ACGIH.

Factors associated with respiratory health symptoms among motorcycle taxi drivers

Predictors of respiratory health symptoms

Binary logistic regression showed that work duration was the most predictor of respiratory symptoms after adjusting for all important confounders such as smoking, BMI, and previous respiratory diseases, whereas cough (OR = 1.66, 95%CI (1.04 - 2.65)), cough last for three months (OR = 3.6, 95% CI (1.7-8.0)), phlegm (OR = 2.8, 95%CI (1.5-5.0)) and shortness of breath (OR = 2.0, 95%CI (1.1-3.7)), (Table 3).

Table 2 Prevalence of respiratory health symptoms among motorcycle taxi drivers and office attendants' group

Respiratory health symptoms	Commercial motorcyclists	Office attendants	X2	P-value
Morning Cough				
Yes	111(55.5)	27(27)	20.667	0.001
No	89(44.5)	73(73)		
Cough last for three months yearly				
Yes	52(26)	2(2)*	24.416	0.001
No	148(74)	98(98)		
Phlegm production				
Yes	106(53)	15(15)	38.438	0.001
No	94(47)	85(85)		
Phlegm last for three months yearly				
Yes	46(23)	0(0)	41.358	0.001
No	154(77)	100(100)		
Wheezing			28.711	0.001
Yes	58(29)	2(2) *		
No	142(71)	98(98)		
Shortness of breath				
Yes	94(47)	16(16)	28.473	0.001
No	106(53)	84(84)		
Chest pain				
Yes	41(20.5)	13(13)	2.058	0.151
No	159(79.5)	87(87)		

Chi-square test, *fisher exact test, p<0.05, values in parentheses are percentages

Table 3 Predictors for respiratory health symptoms among motorcycle taxi drivers

Variables	OR (95% CI)	P-value
Morning cough		
Working duration (ref: 1 to 4 years)		
More than 4 years	1.66 (1.04 - 2.65)	0.04*
Previous disease (ref: No)		
Yes	1.98 (0.32 - 12.49)	0.47
BMI (ref: < 18.5 Underweight)		
18.5 – 24.9 (Normal weight)	0.27 (0.04 - 1.77)	0.17
25 – 29.9 (Overweight)	0.68 (0.15-3.13)	0.622
≥30 (Obesity)	0.56 (0.12 - 2.75)	0.48
Smoking status (ref: No)		
Yes	0.97 (0.54 - 1.76)	0.93
Dust concentration	1.156(0.845-1.581)	0.364

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Table Continued...

Variables	OR (95% CI)	P-value
Cough last for three months		
Working duration (ref: 1 to 4 years)		
More than 4 years	3.682(1.694 -8.001)	0.001*
Previous disease (ref: No)		
Yes	2.880 (0.402-20.632)	0.292
BMI (ref: < 18.5)		
18.5 – 24.9 (Normal weight)	1.785 (0.089-35.875)	0.705
25 – 29.9 (Overweight)	1.614 (0.259-10.070)	0.608
≥30 (Obesity)	2.288(0.339-15.452)	0.396
Smoking status (ref: No)		
Yes	0.994(0.429-2.302)	0.989
Dust concentration	1.152(0.773-1.810)	0.540
Phlegm		
Working duration (ref: 1 to 4 years)		
More than 4 years	2.767(1.522-5.029)	0.001*
Previous disease (ref: No)		
Yes	1.192(0.566-2.511)	0.505
BMI (ref: < 18.5)		
18.5 – 24.9 (Normal weight)	6.951(0.350-138.035)	0.204
25 – 29.9 (Overweight)	1.797(0.300-10761)	0.521
≥30 (Obesity)	2.784(0.442-17.551)	0.276
Smoking status (ref: No)		
Yes	1.192(0.566-2.511)	0.643
Dust concentration	1.277(0.777-2.098)	0.335
Wheezing		
Working duration (ref: 1 to 4 years)		
More than 4 years	1.089(0.576-2.059)	0.792
Previous disease (ref: No)		
Yes	1.673(0.268-10.456)	0.582
BMI (ref: < 18.5)		
18.5 – 24.9 (Normal weight)	1.043(0.054-20.072)	0.978
25 – 29.9 (Overweight)	1.331(0.232-7.641)	0.749
≥30 (Obesity)	1.113(0.184-6744)	0.907
Smoking status (ref: No)		
Yes	1.011(0459-2.224)	0.971
Dust concentration	1.452(0.737-2.098)	0.281

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Table Continued...

Variables	OR (95% CI)	P-value
Shortness of breath		
Working duration (ref: 1 to 4 years)		
More than 4 years	2.031(1.122-3.678)	0.019*
Previous disease (ref: No)		
Yes	0.973(0.148-6.407)	0.977
BMI (ref: < 18.5)		
18.5 – 24.9 (Normal weight)	5.822(0.298-113.744)	0.245
25 – 29.9 (Overweight)	2.326(0.398-13.580)	0.348
≥30 (Obesity)	2.024(0.330-12.420)	0.446
Smoking status (ref: No)		
Yes	1.923(0.907-4.081)	0.088
Dust concentration	1.173(0.797-1.726)	0.419

*Logistic regression, odds ratio, 95% Confidence interval, p<0.05

Discussion

This study was the cross-sectional study aimed to assess respiratory symptoms and associated factors among motorcycle taxi driver, whereas office attendants were used as control. The study finding showed high prevalence of respiratory health symptoms among motorcycle taxi drivers than office attendants and the difference were statistically significant. Morning coughs (55.5% vs. 27%); cough last for three months (26% vs 2%); phlegm production (53.2%vs 15). These findings were similar to the study done in Nigeria among motorcyclist and controls[9] where the prevalence of cough (71% vs. 21%) and sputum (67% vs. 20%) was higher among the motorcycle taxi drivers than controls. Differences in the prevalence of respiratory symptoms noted among motorcyclists and the office attendants, can be explained based on their occupation, the motorcycle taxi drivers are exposed daily to traffic road air pollutants for more than 8 hours, compared with control subjects who are more often work in indoor environment for 8 hours per day. Since these individuals in both groups were not subjected to the same level and duration of exposure to air pollutants, this fact can justify the differences noted in prevalence of respiratory health symptoms. Also the finding were consistent with study done in Brazil[6] which showed more reported respiratory symptoms from motorcyclists although in the mentioned study did not involve control.

Study revealed that the motorcycle taxi drivers working for more than 4 years had 1.66, 3.68, 2.77 and 2.03 times the odds of developing morning cough, cough last for three months, phlegm and shortness of breath respectively compared to those motorcycle taxi drivers worked for 1-4 years after adjusting all important confounders BMI, smoking, previous diseases). Our findings are similar to the studies done in Congo and Nigeria[3,4,9] where they found that transit workers with more years on the job had higher risk of respiratory problems compare to those with few years in working, this could be due to the cumulative effect of air pollutants which weaken the respiratory system and make motorcyclist with many years on work to be more vulnerable with their respiratory system. This is the first study to assess personal total dust exposure and respiratory health effects among motorcycle taxi drivers in Tanzania, using the Modified British medical research questionnaire. Despite of the strength, the study has some limitations; First, a cross-sectional design that could not establish the causal relationship between the exposed groups and the occurrence of respiratory effects. Even though the non-exposure group strengthens the outcomes relationship. Second, it has been conducted in men only because the work of motorcycle taxi drivers is mainly done by men in Ubungo Municipal and in Tanzanian setting. The low dust exposure below ACGIH limit value may be attributed by the collection mechanism which did not consider the ability and sensitivity to capture the dust while on movement.[10–20]

Conclusion and recommendations

Prevalence of the respiratory health symptoms was higher among motorcycle taxi drivers than the control. Working as Commercial motorcyclist for four years and more is a risk factor for developing respiratory health problems. Dust concentration should be analyzed of the components/constituents in relationship with motorcycling activity. In addition given time further study with more rigorous study design such as cohort or randomized control trial to be employed.

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Conflicts of interest

Author declares that there are no conflicts of interest.

References

1. Bradbury A. *Tanzania motorcycle taxi rider training : assessment and development of appropriate training curriculum Final report Transaid May 2015*. 2015. p. 1–35.
2. Kauky CG, Kishimba RS, Urio LJ, et al. Prevalence of helmet use among motorcycle users in Dar Es Salaam, Tanzania. *Pan Afr Med J*. 2015;1(2):1.
3. Mbelambela EP, Hirota R, Eitoku M, et al. Occupation exposed to road-traffic emissions and respiratory health among Congolese transit workers, particularly bus conductors, in Kinshasa: a cross-sectional study. *Environ Health Prev Med*. 2017;22(1):11.

4. Messan F. Bronchospasm Diagnosis in Motorcycle Taxi Drivers Exposed to Automotive Pollutants in Porto-Novo. *Open J Respir Dis*. 2013;03(01):13–20.
5. Kingham S, Longley I, Salmond J. *Determination of personal exposure to traffic pollution while travelling by different modes November 2011*. 2011;104.
6. Brant TCS, Yoshida CT, Carvalho TDS, et al. Mucociliary clearance , airway inflammation and nasal symptoms in urban motorcyclists. *Clinics*.2014;867–870.
7. Damayanti T, Pradipta J, Susanto A. Respiratory Symptoms and Lung Function Among Online Motorcycle Taxi Drivers. *Chest*. 2019;156(4).
8. Ezeja GU, Onwudiwe CU, Nwodo OD, et al. Effects of Air Pollution on the Vital Capacity of Commercial Motorcyclists in Nigeria Population. *Asian J Med Heal*. 2020;18(1):1–7.
9. BO Adefuye, PO Adefuye, O Odusan. Respiratory Symptoms and Pattern of Lung Functions Among Commercial Motorcyclists in Sagamu, Nigeria. Annals of health research. 2015;1(2):1.
10. Ekpenyong CE, Ettebong EO, Akpan EE, et al. Urban city transportation mode and respiratory health effect of air pollution : a cross-sectional study among transit and non-transit workers in Nigeria. *BMJ Open*. 2012;2(5):e001253.
11. Ameh S, James A. Particulate pollution, house location, gravel road and associated respiratory health effects among the residents of Rehoboth metropolis, Namibia. *J Public Environ Heal*. 2016;3:224–33.
12. Botha M, Robertson CL. *Assessment of airborne road dust and potential silica exposure*. 2014;17.
13. Meo SA, Al-drees AM, Masri AA Al, et al. Effect of Duration of Exposure to Cement Dust on Respiratory Function of Non-Smoking Cement Mill Workers. *Int J Environ Res Public Health*. 2013;10(1):390–398.
14. World Health Organization. Ambient Air Pollution: A global assessment of exposure and burden of disease. *World Heal Organ*. 2016;1–131.
15. Abate KH. Exposure to occupational dust and changes in pulmonary function among cobblestone paving workers of Jimma. *Revista Ambiente & Água*. 2016;9(1):1–12.
16. Tsai DH, Wu YH, Chan CC. Comparisons of commuter's exposure to particulate matters while using different transportation modes. *Sci Total Environ*. 2008;405(1–3):71–77.
17. Pourhoseingholi MA, Vahedi M, Rahimzadeh M. Sample size calculation in medical studies. *Gastroenterol Hepatol Bed Bench*. 2013;6(1):14–17.
18. WHO. *Health effects of transport-related air pollution*. In: Michal Krzyzanowski BK-D et al. editors. 2005. p. 1–205.
19. Andersen ZJ, Hvidberg M, Jensen SS, et al. Chronic obstructive pulmonary disease and long-term exposure to traffic-related air pollution. *Am J Respir Crit Care Med*. 2011;183:455–461.
20. Stephen P, Mahalakshmy T, Manju R, et al. High prevalence of chronic respiratory symptoms among auto rickshaw drivers of Urban Puducherry, South India. *Indian J Occup Environ Med*. 2018;22:40–44.