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Original Article

Hematocrit levels as cardiovascular risk among taxi drivers in Bangkok, Thailand

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Abstract: In Thailand, taxi drivers employed in the informal sector often experience hazardous working conditions. Previous studies revealed that elevated Hematocrit (HCT) is a predictor of cardiovascular disease (CVD) risk. This study assessed factors associated with HCT in taxi drivers to predict their occupational CVD risk factors. A cross-sectional study was conducted on 298 male taxi drivers who joined a health check-up campaign in Bangkok, Thailand. HCT and body mass index were retrieved from participant health check-up files. Self-administered questionnaires assessed demographics, driving mileage, working hours, and lifestyle. Statistical associations were analyzed using stepwise linear regression. Our results showed that obesity (p=0.007), daily alcohol drinking (p=0.003), and current or past smoking (p=0.016) were associated with higher HCT levels. While working hours were not directly associated with HCT levels in the current study, the effect on overworking is statistically arguable because most participants worked substantially longer hours. Our findings suggest that taxi drivers' CVD risk may be increased by their unhealthy work styles. Initiatives to improve general working conditions for taxi drivers should take into account health promotion and CVD prevention. The policy of providing periodic health check-ups is important to make workers in the informal sector aware of their health status.

Key words: Cardiovascular disease, Hematocrit, Informal sector, Taxi driver, Thailand

Introduction

Cardiovascular disease (CVD) is a leading cause of death and disability in the developing world[1)]. CVD is a group of heart and blood vessel disorders including coronary heart disease and cerebrovascular disease[1)]. The major causes of CVD are related to lifestyle behaviors such as smoking, physical inactivity, unhealthy diet and excessive alcohol consumption[2–4)]. In Thailand, 54,375 deaths due to CVD were recorded in 2013 (84.1 deaths per 100,000), which was the second highest cause of death following cancer[5)].

Taxi drivers are at a high risk of developing CVDs[6, 7)]. Taxi drivers' lifestyles are generally unhealthy owing to high work demand and sedentary work[8, 9)]. CVD risk factors detected in professional drivers have included long driving time[10)], night shift[11)], air pollution[12, 13)], physical inactivity, smoking and mental stress[14)], and obesity[15)].

In Thailand, most taxi drivers are engaged in informal employment, which is often associated with hazardous working conditions[16)]. Informal employment is defined as "employees engaged in informal jobs where their employment relationships is, in law or in practice, not subject to national labour legislation, in some taxation, social protection or entitlement to certain benefits (advanced notice of dismissal, severance pay, paid annual or sick leave,

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etc.)"[17]. In 2011, the Thai government implemented a new act to extend the same social insurance schemes to workers in the informal sector that are available in the formal sector[18]. Some projects have been recently launched for the informal sector, for example, free health check-ups for farmers (called "farmer clinics")[19], but most workers in the informal sector, including taxi drivers, are still not sufficiently covered[20, 21]. Occupational health risks in the informal sector have not been adequately studied because of the difficulty approaching unorganized self-employed workers and the lack of a health monitoring and reporting system. Very few studies have evaluated the occupational health risks of Thai taxi drivers in small samples[22]. Further, to the best of our knowledge, no studies have investigated their CVD risks.

Previous epidemiological studies suggest elevated Hematocrit (HCT) is a predictor of CVD risks[23–26]. Most CVDs involve atherosclerosis, a condition in which plaque builds up in the artery, narrowing arterial diameter and restricting blood flow[27]. Elevated HCT is considered a significant factor in increased blood viscosity which worsens blood flow ability and consequently causes atherosclerosis[28]. The aim of this study, therefore, was to assess factors associated with HCT levels among taxi drivers in Thailand to help predict their occupational CVD risk factors. Understanding CVD risk factors will assist in health promotion and prevention of CVDs in taxi drivers.

Subjects and Methods

Recruitment of participants

We conducted a cross-sectional study of taxi drivers in Bangkok, Thailand. The target population was taxi drivers who participated in the health check-up campaign "Health status of workers in the informal sector in Bangkok" between March 25th and March 27th, 2015, held in the parking lot of Don Muang Airport, Bangkok. This was one of a series of campaigns designed by the National Health Security Office in 2014–2015 that provided free health check-ups to employees holding informal jobs. The campaign was advertised in the parking area of the airport using loudspeakers, notice boards and banners. The participant exclusion criteria of this study were as follows: (a) female drivers, (b) taxi drivers with less than one year work experience, (c) taxi drivers who work less than 40 hours per week, and (d) taxi drivers who are unable to read. Participation was voluntary. Informed consent was obtained before the study was administered. The study was approved by the Ethical Review Committee for Human Research, Mahidol University (Protocol No. 29/2558).

Outcome

The outcome of this study was HCT level (%) retrieved from the health check-up file as a predictor of CVD risk[23–26]. Venous blood samples were collected by professional medical technologist from 9 am to 4 pm. HCT levels were measured by the Flow Cytometry method using semiconductor laser (XE-2100D, Sysmex, Kobe, Japan).

Dependent variables

A self-administered questionnaire was developed in consultation with a panel of experts after a pretest was conducted among taxi drivers (n=25). The questionnaire included age, marital status, education, working experience, daily mileage, daily working hours, monthly rest days, daily sleeping hours, daily alcohol drinking, regular exercise, smoking, and history of lifestyle-related diseases (hypertension, hyperlipidemia, or diabetes). Weekly working hours was calculated from daily working hours and monthly rest days. Standing height and weight were measured by trained nurses. Standing height was recorded to the nearest 1 cm without shoes. Weight was measured in 1 kg increments using a digital weighting scale on participants wearing ordinary clothes. Body mass index (BMI) was calculated as weight (kg) divided by height (m^2). Participants were classified obese if their BMI value equaled 25 kg/m^2 or greater.

Statistical analysis

First, we calculated descriptive statistics for categorical variables as proportions of the total sample and for continuous variables as mean±SD with minimum and maximum values. Second, continuous variables were classified into two levels for analysis according to median, because the outcome and dependent variables were not distributed normally by the Kolmogorov-Smirnov test. Third, Mann-Whitney and Kruskal-Wallis tests were used to explore the factors associated with HCT levels. Fourth, stepwise linear regression techniques were used to analyze the associations between the relevant independent factors and HCT level. Statistical analysis was performed using the SPSS version 17.0 (SPSS Inc., Chicago, IL, USA). A two-tailed p value of 0.05 was considered significant.

Results

A total of 330 taxi drivers were approached, of whom 309 participated in the study (93.6%). After applying the

Table 1. General characteristics of study participants

Characteristics	n=298
Age (yr), mean±SD (Min–Max)	49.0±9.4 (27–79)
Marital status, %	
Married	78.0
Single/Divorced/Widowed	22.0
Education, %	
None/Primary school	38.3
Secondary school	19.7
High school or above	42.1
Working experience (yr), mean±SD (Min–Max)	10.7±8.6 (1–54)
Driving mileage (km), mean±SD (Min–Max)	316.5±83.3 (50–700)
Working hours (h/w), mean±SD (Min–Max)	77.5±18.0 (40–130)
Sleeping hours (h/d), mean±SD (Min–Max)	6.8±1.5 (3–13)
Obesity, %	53.9
Daily alcohol drinking, %	19.8
Smoking, %	
Current smoker/Past smoker	52.4
Non-smoker	47.6
Regular exercise, %	26.2
History of lifestyle-related diseases, %	27.2

SD: Standard Deviation; Min: Minimum; Max: Maximum

exclusion criteria, 298 participants were analyzed. Table 1 shows the general characteristics of the study participants. The average age of the participants is 49.0±9.4 years old, with a mean of 10.7±8.6 years experience working as a taxi driver. Participants drive 316.5±83.3 km per day, work 77.5±18.0 per week, and sleep 6.8±1.5 hours per day on average. The majority of participants classify as obese (53.9%), and 27.2% have a history of hypertension, hyperlipidemia, or diabetes. Regarding their lifestyle, 19.8% of the participants drink alcohol daily, 52.4% are current or past smokers, and 73.8% do not exercise.

Table 2 presents the association of HCT level with general characteristic variables. The average overall HCT level is 44.4±3.5%. Driving mileage and working hours are not significantly associated with HCT levels. Obesity ($p<0.001$), daily alcohol drinking ($p=0.009$), current or past smoking ($p=0.041$), and lack of exercise ($p=0.046$) are associated with higher HCT. A participant age of 48 years and over is associated with lower HCT, compared with participants aged less than 48 years ($p=0.005$).

Table 3 indicates the results of the stepwise linear regression analyses for correlates of HCT levels. After adjusting confounders, higher HCT levels are associated with obesity ($p=0.007$), daily alcohol drinking ($p=0.003$), and current or past smoking ($p=0.016$).

Table 2. The association of average Hematocrit level with general characteristic variables (Mann-Whitney and Kruskal-Wallis tests)

Characteristics	HCT Mean (%)	(SD)	*p* value
Overall	44.4	(3.5)	
Age (yr)			
<48	45.1	(3.5)	0.005
≥48	43.9	(3.3)	
Marital status			
Married	44.4	(3.3)	0.42
Single/Divorced/Widowed	44.9	(3.9)	
Education			
None/Primary school	44.3	(3.7)	0.61
Secondary school	45.0	(2.9)	
High school or above	44.5	(3.5)	
Working experience (yr)			
<8	44.4	(3.6)	0.69
≥8	44.3	(3.3)	
Driving mileage (km)			
<300	44.6	(3.3)	0.81
≥300	44.3	(3.4)	
Working hours (hr/w)			
<78	44.5	(3.1)	0.79
≥78	44.6	(3.6)	
Sleeping hours (hr/d)			
<6.5	44.5	(3.2)	0.87
≥6.5	44.4	(3.4)	
Obesity			
Yes	45.1	(3.4)	<0.001
No	43.6	(3.5)	
Daily alcohol drinking			
Yes	45.4	(3.5)	0.009
No	44.2	(3.4)	
Smoking			
Current smoker/Past smoker	44.7	(3.7)	0.041
Non-smoker	44.1	(3.3)	
Lack of exercise			
Yes	44.6	(3.5)	0.046
No	43.9	(3.3)	
History of lifestyle-related diseases			
Yes	44.1	(3.5)	0.38
No	44.5	(3.3)	

SD: Standard Deviation

Table 3. Stepwise linear regression analyses for correlates of Hematocrit levels

Characteristics	Beta	(95%CI)	*p* value
Phase 1*			
Daily alcohol drinking	1.77	(0.63–2.90)	0.002
Phase 2†			
Obesity	1.24	(0.32–2.15)	0.008
Daily alcohol drinking	2.03	(0.89–3.16)	0.001
Phase 3‡			
Obesity	1.25	(0.35–2.16)	0.007
Daily alcohol drinking	1.77	(0.63–2.91)	0.003
Current and past smoking	1.12	(0.22–2.02)	0.016

CI: Confidence Interval
*$R^2=0.05$, Adjusted $R^2=0.04$
†$R^2=0.08$, Adjusted $R^2=0.07$
‡$R^2=0.11$, Adjusted $R^2=0.10$

Discussion

This study examined factors associated with HCT levels among taxi drivers to predict their occupational CVD risk factors. We found that most taxi drivers worked relatively long hours and that higher HCT was associated with obesity, daily alcohol drinking and current or past smoking. While working hours were not directly associated with HCT levels, taxi drivers' unhealthy working styles may increase their CVD risk.

Accumulated fatigue due to overworking is hypothesized to progress atherosclerosis rapidly and contribute to CVD[29]. However, research on the health effects of overworking has been inconclusive because many studies did not control for potential confounders[38]. Our study found that taxi drivers work substantially longer hours than the national average in Thailand (77.5 vs 50.1 hours/week)[30]. While working hours were not directly associated with HCT levels in the current study, it is statistically arguable the effect on working hours because majority of the participants worked substantially longer hours and we classified into two levels according to median. In addition, working hours other than total workload may have influenced taxi drivers' overall lifestyles and consequent HCT levels. Interventions to improve general working conditions for taxi drivers should take into account health promotion and CVD prevention (e.g., acceptable wage systems, suitable resting periods, and providing welfare and resting facilities).

Obesity may exacerbate CVD risk in taxi drivers. In the current study, obesity was associated with high HCT levels, consistent with a previous study[31]. The prevalence of obesity in male taxi drivers in the current study (53.9%) was substantially higher than the adult male average in Thailand (29.1%)[32]. Elevated HCT levels, a predictor of CVD risk, may be attributed by obesity-related diseases such as sleep apnea syndrome (SAS)[33] and metabolic syndrome[34]. Furthermore, obesity is now widely known as a contributing factor of SAS through the narrowing effects of upper airway fat on the pharyngeal lumen, contributing to intermittent hypoxia during sleep[35]. Severe SAS, can cause secondary polycythemia with elevated HCT, increasing CVD risk[33]. Future research should focus on the prevalence of SAS in taxi drivers in Thailand. This may help to understand the causal structure of CVD. Periodic health check-ups are important to recognize the health status of taxi drivers. Interventions including weight control programs may be introduced as effective measures to prevent CVD in taxi drivers.

Excessive alcohol drinking contributes to a higher CVD risk in taxi drivers. Professional drivers often drink alcohol because they believe it relaxes them, alleviates fatigue and releases their inhibitions from mental stress[36]. We found that daily alcohol drinking was associated with higher HCT, which was consistent with a previous study[37]. Elevated HCT often results from low plasma volume caused by alcohol diuresis, because alcohol decreases the body's production of an anti-diuretic hormone that is used by the body to reabsorb water[38]. Previous epidemiological studies show that CVD risk in relation of alcohol consumption is U- or J-shaped[39, 40], meaning that reduced risk is associated with moderate drinking, and increased risk is associated with both abstention and heavy drinking. Heavy drinking over the course of long periods may affect the cardiovascular system, though the specific mechanisms remain uncertain[41]. Providing drinking behavior education may help prevent CVD in taxi drivers.

Smoking is one of the major factors of CVD. In the current study, current or past smokers had higher HCT levels than non-smokers, consistent with a previous study in Japan[42]. Numerous studies have demonstrated that smoking leads to atherosclerosis and consequent CVD[43−45]. The mechanisms whereby the toxic components of tobacco lead to atherosclerosis are largely uncertain, but smoking increases inflammation, thrombosis, and oxidation of low-density lipoprotein cholesterol[46]. Furthermore, smoking is a leading cause of death in professional drivers[47]. Effective interventions to support smoking cessation in taxi drivers are urgently needed.

This study has some limitations. First, the sample size was relatively small and the sample was collected in only one area. Consequently, the sample may not be representative of all taxi drivers in Thailand, and findings should be generalized with caution. Second, blood samples were collected during working hours. The time of measurement, such as before or after work, may affect HCT levels and consequently predicted CVD risk. Finally, bias could be introduced through self-report. Despite this limitation, previous studies have employed self-reporting as it is a practical and reliable sampling technique to assess drivers' working hours[48, 49].

In conclusion, taxi drivers' CVD risk may be elevated by their unhealthy work style contributing to factors including obesity, daily alcohol drinking, and current or past smoking. Interventions to improve general working conditions for taxi drivers should take into account health promotion and CVD prevention. The policy of providing periodic health check-ups to the informal sector is important to increase health status awareness.

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