Nutrition and Food Sciences Research Vol 2, No 2, Apr-Jun 2015, pages: 23-28

Original Article

Vitamin D Status of Tehran Taxi Drivers: How Efficient Is the Occupational Exposure to Sun? A Case-control Study

Maliheh Zahedi-Rad, Bahareh Nikooyeh, Ali Kalayi, Nastaran Shariatzadeh, Tirang R. Neyestani*

Laboratory of Nutrition Research, National Nutrition and Food Technology Research Institute, Faculty of Nutrition Sciences and Food Technology, Shahid Beheshti University of Medical Sciences, Tehran, Iran

Received: January 2015 **Accepted:** March 2015

ABSTRACT

Background and Objectives: Day-shift taxi drivers have a long duration of direct sun exposure. However, the efficiency of this occupational exposure in vitamin D synthesis has not been addressed yet. The aim of this study was to assess the vitamin D status of taxi drivers in Tehran, and examine vitamin D status association with some anthropometric and circulating biomarkers.

Materials and Methods: In a case control study, 53 taxi drivers and 80 apparently healthy subjects from other occupations were enrolled. Questionnaires for demographic data, supplement use, and duration of sun exposure were completed. Weight, height and waist circumference were measured. Blood samples were taken from all participants for complete blood cell count, fasting blood glucose (FBG), lipid profile, and 25-hydroxycholecalciferol (25 (OH)D) measurements.

Results: Taxi drivers, as compared to the controls, had significantly higher body mass index (BMI), waist circumference (WC), serum triglycerides (TG), and 25(OH)D concentrations. Moreover, 56.6% of the drivers had more than 2 hours of sun exposure during a day.

Conclusions: Despite having higher circulating concentrations of 25(OH)D, the taxi drivers had higher cardiometabolic risk factors. These findings indicate a need for nutritional education for taxi drivers.

Keywords: Vitamin D, Driving, Sun exposure

Introduction

Taxi drivers are at risk of many occupational disorders including chronic fatigue, low back pain (1), lung cancers (2), cardiovascular disease (CVD) (3), obesity, diabetes (4), and other disorders (5). Taxi drivers may have long durations of direct sun exposure; this may pose them to a higher risk of skin cancer, on the one hand, and cause higher skin synthesis of vitamin D, on the other.

Vitamin D, a secosterol hormone whose synthesis in the skin is triggered by direct ultra-violet beam (UVB) exposure, has numerous calcemic and non-calcemic functions in the body. The effect of vitamin D on bone and muscle health has been known for long. However, the protective effects of vitamin D against many human disorders such as diabetes, CVD, certain types of malignancies, and auto-immune diseases including rheumatoid arthritis (RA), type 1 diabetes (T1D), multiple sclerosis (MS) and allergies have also been reported. The ameliorating effects of vitamin D supplementation on hyperglycemia, dyslipidemia and oxidative stress, as well as systemic and endothelial inflammation have recently been unveiled (6-9).

Taxi drivers have a rather long duration of solar UVB exposure. However, the efficiency of this exposure in endogenous vitamin D synthesis in this sub-group has not been addressed yet. We hypothesized that, despite a rather high prevalence vitamin D deficiency in Iran (10), this sub-group may have exceptionally desirable vitamin D status. If it is

***Address for correspondence:** Tirang R. Neyestani, Prof, Laboratory of Nutrition Research, National Nutrition and Food Technology Research Institute, Faculty of Nutrition Sciences and Food Technology, Shahid Beheshti University of Medical Sciences, Tehran, Iran. E-mail address: t.neyestani@nnftri.ac.ir

[Downloaded from nfsr.sbmu.ac.ir on 2026-11-14]

true, one may expect that this affect different health aspects of this population. The aim of this study was, firstly, to assess vitamin D status of a sample of taxi drivers working in Tehran, and secondly to examine the association of vitamin D status with some selected anthropometric and circulating biomarkers including blood glucose and lipid profile.

Materials and methods

Taxi drivers were invited to participate in the study following coordination with the Tehran Taxi Driving Organization (TTDO). They were informed via both TTDO and live radio announcements. Those willing to participate in the study were referred to the Laboratory of Nutrition Research at the National Nutrition and Food Technology Research Institute (NNFTRI). The inclusion criteria were being a taxi driver, aged 20-69 years, and having no clinical disease including endocrine (thyroid, diabetes), kidney (renal failure) and malignancies. we calculated that a sample of 60 subjects in each group would have 80% power to detect a change in means of 25(OH)D of 0.5 SD (assuming an effect size of 0.5)(6). Of 65 drivers referred to the laboratory, 53 had the inclusion criteria. The control group comprised of 80 apparently healthy people from other occupations who were invited to participate in the project by flyers and general advertisements. They were mainly bank, companies and institutions employees. Questionnaire of demographic data, supplement use, and duration of direct sun exposure was completed for all participants. Weight was measured to the nearest of 0.1 kg using a digital scale (Seca 840) with light clothing, height was measured using wall-mounted stature meter with the precision of 0.1 cm, and waist circumference was measured by a flexible meter to the nearest of 0.1 cm. Body mass index (BMI) was calculated using the formula BMI= weight (kg)/height2(m). In addition, information on duration of sun exposure was also gathered. participants were asked to recall the number of minutes/hour that they have spent in daylight (6). After 12-hour fasting, 10 mL of venous blood was taken from all participants. The blood was then divided into two tubes, with or without anticoagulant ethylene diamine tetra-acetate (EDTA). The anti-coagulated samples were used for complete blood cell count (CBC) test whereas sera were recovered from the clot samples after keeping the blood samples for 30-45 minutes at room temperature (RT) followed by centrifugation at 1000 g for 30 minutes at RT. Fasting serum glucose (FSG) was measured using enzymatic method, and serum total cholesterol (TC), triglycerides (TG), and high-density lipoprotein cholesterol (HDL-C) were determined using commercial kits (all from Pars-Azmoon, Tehran, Iran) with the aid of an auto-analyzer (Selectra E, the Netherlands). Low-density lipoprotein cholesterol (LDL-C) was calculated using Friedwald formula (11).

Serum 25(OH)D was measured using high-performance liquid chromatography (HPLC), as described earlier (12). In this study, vitamin D status was predefined based on serum 25(OH)D concentrations as deficiency <27.5 nmol/L, insufficiency>27.5 nmol/L but <50 nmol/L, and sufficiency>50 nmol/L (The unit can be converted into ng/mL by dividing 25(OH)D concentration by 2.5). All participants received a written lab report of their tests and, if requested, nutritional counseling for free.

Statistical analyses: Data are expressed as mean±standard deviation (SD). Normality of data distribution was checked using Shapiro-Wilks's W test. Between-group comparison of the values was performed by Student t-test. Correlations between the variables were evaluated by Pearson (r). Differences in proportions were evaluated using Chi-Square test. All statistical analyses were done by the SPSS software (ver. 16; SPSS Inc, Chicago, IL). P<0.05 was considered significant.

Results

Table 1 demonstrates the demographic and anthropometric features of the participants. There were no significant differences in age (drivers 43.3±8.4 years and controls 40.1±10.3 years, p=0.065) and sex distribution (88.7% males and 11.3% females in the taxi drivers and 92.5% males and 7.5% females in the controls, p=0.541).

[Downloaded from nfsr.sbmu.ac.ir on 2026-11-14]

Table 1. Demographic and anthropometric characteristics of the case and control groups

Characteristic	Cases (n=53)	Controls (n=80)	P value
Sex (n (%))			0.541
Male	47(88.7)	74(92.5)	
Female	6(11.3)	6(7.5)	
Age (year)	43.3±8.4	40.1±10.3	0.065
Height (cm)	172.6±8.5	171.7±8.7	0.575
Weight (kg)	87.8±19.0	81.2±15.1	0.029*
BMI(kg/m2)	29.2±4.7	27.4±3.9	0.018*
Waist circumference (cm)	101.9±13.0	96.8±10.1	0.015*

Abbreviations: BMI, Body Mass Index
***** Denotes the significance of differences between the 2 groups (chi-square or *t*.test).

However, the taxi drivers had significantly higher BMI and waist circumference than the controls (Table 1).

Biochemical measures, vitamin D status, and duration of sun exposure of the cases and controls are presented in Table 2.

Serum TG was the only component of lipid profile, which was significantly different between the two groups, with higher concentrations in the taxi drivers (192.0±149.9 vs. 149.0±77.6 mg/dL, p=0.033). Despite higher BMI, the taxi drivers had significantly higher circulating 25(OH)D concentrations than the controls (almost 1.5 times). Some 56.6% of the taxi drivers had more than 2 hours of sun exposure during a day. The occurrence of poor vitamin D status was significantly higher among the controls than in the taxi drivers (Table 3).

Table 2. Biochemical measures, vitamin D status and duration of sun exposure of the case and control groups

Characteristic	Cases (n=53)	Controls (n=80)	P value
FBS (mg/dL)	80.0±12.5	83.6±9.1	0.055
TG (mg/dL)	192.0±149.9	149.0±77.6	0.033*
Tchol (mg/dL)	176.4±37.1	167.6±34.3	0.163
LDL (mg/dL)	92.6±30.7	91.67±29.3	0.850
HDL (mg/dL)	47.4±9.9	46.3±11.1	0.551
Hb (mg/dL)	15.4±1.5	15.1±1.3	0.145
Hct (%)	46.2±4.2	44.7±3.7	0.034*
25OHD (nmol/L)	55.7±24.0	37.5±16.6	<0.001*
Sun exposure (n(%))			
No	3 (5.7)	11 (13.8)	<0.001*
10min-1hr	10 (18.9)	46 (57.5)	
1-2hr	10 (18.9)	11 (13.8)	
More than 2hr	30 (56.6)	12 (15.0)	

Abbreviations: FBS, Fasting Blood Sugar; TG, Triglyceride; Tchol, Total Cholesterol; LDL, Low Density Lipoprotein; HDL, High Density Lipoprotein; Hb, Hemoglobin; Hct, Hematocrit
***** Denotes the significance of differences between the 2 groups (chi-square or *t*.test).

Table 3. Comparison of vitamin D status between taxi drivers and controls

Characteristic 25OHD n (%)	Cases (n=53)	Controls (n=80)	P value
Deficient (25 (OH) D < 27.5 nmol/L)	7 (13.2)	27 (33.8)	<0.001*
Insufficient (27.5 - 50 nmol/L)	13 (24.5)	37 (46.2)	
Sufficient (25 (OH)D > 50 nmol/L)	33 (62.3)	16 (20.0)	

*Denotes the significance of differences in the distribution of vitamin D categories between the 2 groups (chi-square test)

[Downloaded from nfsr.sbmu.ac.ir on 2026-11-14]

Discussion

In this study, weight, BMI and waist circumference were significantly higher in the taxi drivers than the control group. Based on the BMI results, 89.6% of the taxi drivers were overweight or obese. Other studies showed that levels of BMI were higher in drivers than non-drivers, and there was higher prevalence of obesity in the former group (13-18).

Waist circumference, a widely used index for fat distribution, is indicative of visceral fat which is believed to be more harmful than general obesity. In this study waist circumference of drivers was significantly higher than controls. Other studies showed that in 50% of the male taxi drivers, waist circumference was higher than the normal rate (19). Saberi studied Iranian bus and truck drivers and showed 68.3% prevalence of waist circumference greater than 102 cm in this population (19-21).

Higher BMI, LDL-C, blood glucose, age and hypertension have been shown to be strong risk factors of low GFR and renal failure in Tehran taxi drivers (22). We did not measure hypertension of our subjects.

This study showed higher BMI, triglyceride, total cholesterol, and LDL-C levels in drivers than in the controls. Though the differences for some variables were not statistically significant, this can be an alert since many studies showed them as the risk factors of metabolic syndrome (MeS) and cardiovascular disease (CVD) (17-18, 23). The reasons for these findings could be many including sedentary life style and unhealthy eating patterns of taxi drivers both of which can result in weight gain and consequent metabolic changes.

Early diagnosis, lifestyle change and having healthy dietary patterns are easy and cheap preventive methods. Other studies have also shown that sedentary lifestyle, bad eating habits, and high sugar and simple carbohydrate intake are leading causes of high triglyceride in drivers (18, 24). On the other hand, high serum cholesterol level in this group may be the leading cause of coronary artery disease (3).

Studies in Iran and other countries have revealed that job stress, long time driving and unhealthy habits are important risk factors in hypertension, diabetes, and coronary heart disease of drivers (5, 16, 25). Hattori characterized the working environment of taxi drivers as continuous tension in driving: lack of exercise, exposure to various harmful environments, changes in lifestyle, and irregular eating habits caused by irregular work schedule. These factors, especially irregular eating habits and lack of exercise, can cause obesity and diabetes mellitus, which are risk factors of other chronic diseases (26). We did not measure stress in the participant taxi drivers. Another important factor is long driving time and sedentary lifestyle. Taxi drivers' long working time may contribute in higher blood pressure and in risk of cardiovascular disease (17-18, 27).

An important pronouncing aspect of this study was measuring vitamin D and sun exposure of both the cases and controls. Drivers had significantly higher vitamin D status compared to the controls, and more than 2 hours of sun exposure per day. Having high vitamin D is a good health index, and helps preventing many chronic diseases. Vitamin D deficiency is a risk factor of MeS (28), inflammatory markers and cardiovascular diseases (6, 8).

Educating taxi drivers and encouraging them to change their lifestyle, do more exercise, pay more attention to their dietary patterns, eat more fruit and vegetable, and correct carbohydrate to protein and fat ratios of the diet are easy strategies for long healthy life in this group. Periodic health checkups would allow drivers for diagnosing their disease in early stage. It is more cost benefit for the government and policy makers to pay welfare payment to taxi drivers.

Financial disclosure

The authors declared no financial interest.

Funding/Support

This research was financially supported by the National Nutrition and Food Technology Research Institute.

[Downloaded from nfsr.sbmu.ac.ir on 2026-11-14]

References

1. Lim SM, Chia SE. The prevalence of fatigue and associated health and safety risk factors among the taxi drivers in Singapore. Singapore Med J. 2015 Feb;56(2):92-7.
2. Borgia P, Forastiere F, Rapiti E, Rizzelli R, Magliola ME, Perucci CA, et al. Mortality among taxi drivers in Rome: a cohort study. Am J Ind Med. 1994; 25(4):507-17.
3. Chen JC, Chen YJ, Chang WP, Christiani DC. Long driving time is associated with haematological markers of increased cardiovascular risk in taxi drivers. Occup Environ Med. 2005 Dec;62(12):890-4.
4. Brice R. A taxi driver with type 2 diabetes. BMJ. 2009;338:b1369.
5. Yang Y, Fan XS, Tian CH, Zhang W, Li J, Li SQ. Health status, intention to seek health examination, and participation in health education among taxi drivers in jinan, china. Iran Red Crescent Med J. 2014 Apr;16(4):e13355.
6. Nikooyeh B, Neyestani TR, Farvid M, Alavi-Majd H, Houshiarrad A, Kalayi A, et al. Daily consumption of vitamin D- or vitamin D+ calcium-fortified yogurt drink improved glycemic control in patients with type 2 diabetes: a randomized clinical trial. Am J Clin Nutr. 2011; 93(4):764-71.
7. Nikooyeh B, Neyestani TR, Tayebinejad N, Alavi-Majd H, Shariatzadeh N, Kalayi A, et al. Daily intake of vitamin D- or calcium-vitamin D-fortified Persian yogurt drink (doogh) attenuates diabetes-induced oxidative stress: evidence for antioxidative properties of vitamin D. J Hum Nutr Diet. 2014 Jul 5;27 Suppl(2):276-83.
8. Shab-Bidar S, Neyestani TR, Djazayery A, Eshraghian MR, Houshiarrad A, Gharavi A, et al. Regular consumption of vitamin D-fortified yogurt drink (Doogh) improved endothelial biomarkers in subjects with type 2 diabetes: a randomized double-blind clinical trial. BMC Med. 2011;9:125.
9. Shab-Bidar S, Neyestani TR, Djazayery A, Eshraghian MR, Houshiarrad A, Kalayi A, et al. Improvement of vitamin D status resulted in amelioration of biomarkers of systemic inflammation in the subjects with type 2 diabetes. Diabetes Metab Res Rev. 2012 Jul;28(5):424-30.
10. Rahnavard Z, Eybpoosh S, Homami MR, Meybodi HA, Azemati B, Heshmat R, et al. Vitamin d deficiency in healthy male population: results of the Iranian multi-center osteoporosis study. Iran J Public Health. 2010;39(3):45-52.
11. Warnick GR, Knopp RH, Fitzpatrick V, Branson L. Estimating low-density lipoprotein cholesterol by the Friedewald equation is adequate for classifying patients on the basis of nationally recommended cutpoints. Clinical Chemistry. 1990;36(1):15-9.
12. Neyestani T, Gharavi A, Kalayi A. Determination of serum 25-hydroxy cholecalciferol using high-performance liquid chromatography: a reliable tool for assessment of vitamin D status. International journal for vitamin and nutrition research Internationale Zeitschrift für Vitamin-und Ernährungsforschung Journal international de vitaminologie et de nutrition. 2007;77(5):341.
13. Kurosaka K, Daida H, Muto T, Watanabe Y, Kawai S, Yamaguchi h. Characteristics of Coronary Heart Disease in Japanese Taxi Drivers as Determined by Coronary Angiographic Analyses. Industrial Health 2000;38:15-23.
14. Ueda T, Hashimoto M, Yasui I, Sunaga M, Higashida T, Hara I. A questionnaire study on health of taxi drivers--relations to work conditions and daily life. Sangyo Igaku 1989;31(3):162-75.
15. Yazdi Z, Sarreshtehdari M, Tayefi M. Metabolic Syndrome prevalence and its related factors in heavy vehicle drivers. Journal of Qom University of Medical Sciences and Health Services. 2011;5(4):68-72.
16. Navadeh S, Moazenzadeh M, Mirzazadeh A. Driving environment in Iran increases blood pressure even in healthy taxi drivers. JRMS. 2008;13(6):287-93.
17. Wang PD, Lin RS. Coronary heart disease risk factors in urban bus drivers. Public Health. 2001;115(4):261-4.
18. Ozdemir L, Turgut O, Aslan S, Tandogan I, Candan F, Nur N, et al. The risk factors for and prevalence of cronary artery disease in heavy vehicle drivers. Saudi Med J. 2009;30(2):272-8.
19. Hirata Rp, Sampaio LM, Filho FS, Braghiroli A, Balbi B, Romano S, et al. General Characteristics and Risk Factors of Cardiovascular Disease among Interstate Bus Drivers. The ScientificWorld Journal. 2012;2012:1-7.
20. Saberi HR, Moravveji AR, Fakharian E, Dehdashti AR. Prevalence of metabolic syndrome in bus and truck drivers in Kashan, Iran. Diabetology and Metabolic Syndrome. 2011;3(1):1-5.
21. Kumanyika SK, Obarzanek E, Stettler N. Populationbased prevention of obesity: the need for comprehensive promotion of healthful eating, physical activity, and energy balance: a scientific statement from American Heart Association Council on Epidemiology and Prevention, Interdisciplinary Committee for prevention (formerly the expert panel on population and prevention science). Circulation. 2008;118(4):428-64.
22. Mahdavi-Mazdeh M. Screening for Decreased Renal Function in Taxi Drivers in Tehran, Iran. 2010 32(1):62-8.
23. Shin SY, Lee CG, Song SH, Kim SH, Lee HS, Jung MS, et al. Cardiovascular Disease Risk of Bus Drivers in a City of Korea. Annals of Occupational and Environmental Medicine 2013, 25:34. 2013;25(34):1-9.

[Downloaded from nfsr.sbmu.ac.ir on 2026-11-14]

24. Djindjić N, Jovanović J, Djindjić B, Jovanović M, Pesić M, Jovanović J. Work stress related lipid disorders and arterial hypertension in professional drivers - a cross-sectional study. Vojnosanit Pregl. 2013; 70(6):561-8.

25. Imran M, Devi B. Study of Changes in Cardiovascular and Cerebrovascular Risk Factors Due to Stress Using Physiological and Biochemical Profiles in Professional Urban Bus Drivers. International Journal of Recent Trends in Science And Technology. 2013;6(2):98-103.

26. Hattori M, Azami Y. Searching for preventive measures of cardiovascular events in aged Japanese taxi drivers--the daily rhythm of cardiovascular risk factors during a night duty day. J Hum Ergol 2001;30(1-2):321-6.

27. Kobayashi F, Watanabe T, Watanabe M, Akamatsu Y, Tomita t, Nakane T, et al. Blood pressure and heart rate variability in taxi drivers on long duty schedules. J Occup Health. 2002;44:214-20.

28. Salekzamani S, Neyestani TR, Alavi-Majd H, Houshiarrad A, Kalayi A, Shariatzadeh N, et al. Is vitamin D status a determining factor for metabolic syndrome? A case-control study. Diabetes, metabolic syndrome and obesity: targets and therapy. 2011;4:205.

[Downloaded from nfsr.sbmu.ac.ir on 2026-11-14]