The risk factors for and prevalence of coronary artery disease in heavy vehicle drivers

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ABSTRACT

الأهداف: لمعرفة مدى تكرار عوامل الخطر، وانتشار مرض الشريان التاجي بين سائقي المركبات الثقيلة من سكان سيفاز.

الطريقة: أجريت هذه الدراسة العرضية خلال الفترة ما بين نوفمبر 2004م وحتى سبتمبر 2006م. شملت إجمالي عدد 400 فرد، 200 سائق مركبة ثقيلة، و200 فرداً مثلوا مجموعة التحكم. أجري الاستبيان واحتوى على المحددات السكانية، الاجتماعية، مدخلات كتلة الجسم BMI، وعوامل الخطر للإصابة بمرض الشريان التاجي CHD. كما تم إجراء فحوصات للدم مثل فحص مستويات الدهون، القياسات النفسية، ومستوى سكر الدم عند الصيام، إضافتاً إلى إجراء تخطيط كهرباء EEG القلب لجميع الأفراد. كما أجري تخطيط القلب الكهربائي EEG أثناء التمرين وتخطيط الأوعية عند الحاجة.

النتائج: كان متوسط وزن السائق، كتلة الدهون في الجسم، الدهون الثلاثية، البروتين منخفض الكثافة، ومدخلات كتلة الجسم أعلى من مجموعة التحكم عند مستوى ملحوظ من الناحية الإحصائية، وكان متوسط مستوى البروتين عالي الكثافة الذي يعد عامل مانع للإصابة بمرض الشريان التاجي، أقل من مجموعة التحكم وعند مستوى ملحوظ من الناحية الإحصائية ($p<0.05$). في مجموعة السائقين تم تقييم 9 من 109 فحص لتمرين لتخطيط كهرباء القلب EEG (8.3%)، ومجموعة التحكم 3 من 61 (4.9%) كنتيجة غير طبيعية. في (4.97%) من السائقين. تم تقييم فحص التمرين كنتيجة إيجابية، بينما بلغت نسبة الانتشار (1.68%) في مجموعة التحكم ($p<0.05$). كانت نتيجة إجمالي نسبة (3.33%) من المشاركين لفحص تخطيط كهرباء القلب EEG عند التمرين موجبة.

خاتمة: يسمح الفحص الدوري الصحي لسائقي المركبات الثقيلة من تشخيص مرض الشريان التاجي عند مرحلة مبكرة وتقديم العلاج الأولي عند الضرورة. وقد تساهم التوعية الصحية لهذه المجموعة كجزء من التخفيف والحد من بعض عوامل مرض الشريان التاجي.

Objectives: To investigate the frequencies of risk factors and the prevalence of coronary heart disease (CAD) in heavy vehicle drivers.

Methods: This cross-sectional type study was conducted between November 2004 and September 2006 in heavy vehicle male drivers registered with the Sivas Professional Drivers Association, Sivas, Turkey. From 400 individuals, 200 heavy vehicle male drivers, and 200 control subjects, 90% were reached for the sample. A questionnaire including sociodemographic specifications, body mass index (BMI), and risk factors for CHD was performed and some blood and physiologic parameters such as lipid profiles, fasting glucose level, resting ECG, were checked in all individuals; if required exercise ECG and angiography was performed.

Results: The drivers' weight, body fat mass, triglycerides, very low-density lipoprotein, and BMI means were higher than the control group at a statistically significant level, and their mean high-density lipoprotein level, which is a protective factor for CAD, was lower than the control group at a statistically significant level. In the drivers' group, 9 of the 109 exercise ECGs (8.3%), and in the control group 3 of 61 (4.9%) were evaluated as abnormal. In 5% of the drivers, the exercise test was evaluated as positive and this prevalence was 1.7% in the control group (p=0.081). A total of 3.3% of the participants had a positive exercise ECG.

Conclusions: Periodic health check-ups for heavy vehicle drivers would allow for the diagnosis of heart disease at an early stage and the initiation of necessary treatment. Health education for this group could also have a part in the decrease and elimination of some risk factors for CAD.

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Diseases of the heart and circulation (cardiovascular and cerebrovascular) are for most adults the biggest risks to life. They account for at least 15 million deaths, or around 30% of the annual total, every year. Worldwide, there are more deaths from coronary heart disease (CAD [7.2 million]) than stroke (4.6 million).[1] The INTERHEART study found that the 2 most important risk factors are cigarette smoking and an abnormal ratio of blood lipids (Apolipoprotein B/Apolipoprotein A-1), which together predicted two-thirds of the global risk of heart attack. Additional risk factors are high blood pressure, diabetes, abdominal obesity, stress, a lack of daily consumption of fruits and vegetables, and a lack of daily exercise.[2] Most of them can be modified, treated or controlled; some cannot. The more risk factors a person has, the higher the chances that he or she will develop heart disease. The best way to prevent a heart attack is to reduce heart disease risk factors.[3] Professional driving is a well-known risk factor for CAD in specific population groups.[4] Truck drivers are at increased risk for the development of first myocardial infarction.[5] A high occurrence of diastolic hypertensive reactions to exercise among professional drivers was reported by Ugljesic et al.[6] Maximal total occupational stress index score were achieved in a group of professional truck drivers compared to inter-city bus drivers, suburban bus drivers, city bus drivers, official car drivers, and professional taxi drivers. The highest values of serum glucose, total cholesterol, LDL cholesterol, and triacylglycerols, and the lowest values of serum HDL cholesterol were found in professional truck drivers.[7] Many investigators reported that professional drivers are under the risk factors of hypertension and CAD.[8,9] Professional drivers need to be extremely careful in their occupation due to the accident possibility in any traffic conditions. That occupational stress may affect their personal physiologic and psychological conditions and cardiac health. The professional drivers undergo a medical examination at first applications for their license, and then periodically every 5 years at ages of 45 to 60 years, and every 3 years after the age of 60 in Turkey. In our country, there has been no study focusing on coronary diseases and risk factors in professional drivers. This encouraged us to conduct this study aiming to investigate the frequencies of risk factors and the prevalence of CHD in heavy vehicle drivers in the Sivas city of Turkey.

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Methods. This cross-sectional type study was conducted between November 2004 and September 2006. The number of registered heavy vehicle drivers to Sivas Professional Driver Association is 1200 (492 bus and 708 truck drivers). A total of 200 male persons (82 bus and 118 truck drivers) were randomly selected from the heavy vehicle driver population (p=0.08, q=0.92, N=1200, p=0.01, d=0.045). A total of 200 male non-driver persons of the same ages, with similar socioeconomic levels were used as a control group. Registry of Health Houses of the Territory of Cumhuriyet University was used to identify the control group. They were contacted via phone calls and after a brief explanation of the study they were invited to participate into the study. A total of 181 heavy vehicle drivers were included in the study (75 bus and 106 truck drivers). Drivers with full-time, permanent employment were included into the study. Recently hired drivers were also included. The drivers were reached via Sivas Professional Driver Association registry, and were asked for their participation and gave their informed consent. Drivers in a firm were reached by going to their firms and given information about the study. Twenty-three drivers that were working for their own profit were contacted by telephone, and their participation into the study was provided. All employed drivers in the region were eligible for the study. The ones that were unwilling to participate and did not come to their appointments on 2 occasions were excluded from the study. No data for these 19 non-participants is available. No other exclusion criteria were accepted other than these. Working as a driver before, unemployment, being students and retired persons were regarded as exclusion criteria from the control group. No professional driver was present in the control group. Two cases that were realized to be professional driver, and 11 cases that did not attend their appointment were excluded from the control group. Also, 8 cases refused to participate in the second step of the study and were excluded (totally 179 persons). The current study was approved by Cumhuriyet University Ethic Committee and participant's confidentiality was guaranteed and the cases were told to feel free to withdraw from the study without any consequences whatsoever. This study was planned as 2 steps and on non-work days. The first step was conducted in the Department of Public Health, Faculty of Medicine Building (outside of hospital) Cumhuriyet University. We visited the drivers after getting an appointment by phone, and had a brief conversation with the study participants about the aim and scope of the study. Drivers were asked for not eating anything after 20.00 PM the day before the visit in order to get fasting blood samples.

A questionnaire was completed in face to face interviews with the individuals who were asked about their lifestyle and other personal characteristics that are risk factors for CAD. After individuals who were taken into the study were given 10 minutes to rest, their blood pressure, height and waist circumference measurements were taken. An aneroid sphygmomanometer was used for measuring blood pressure on the right arm in the sitting position. We used a larger cuff size for obese persons. Blood pressure was measured 2 times with 5 minutes intervals, and calculated mean of blood pressure for all participants. The individuals' height and gender were entered into the Tanita TBF-551 Body Fat Monitor, and their weight in kilograms was measured and body fat percentage was calculated for males. A 5 ml sample of blood was taken from the brachial vein for measurement of cholesterol, high density lipoprotein (HDL), low density lipoprotein (LDL), very low density lipoprotein (VLDL) and triglycerides, placed in a sterile vacuum tube and sent to the biochemistry laboratory before 900 a.m. every day. The participants were fasting when the blood samples were taken. We did not give permission to drink anything and smoke cigarettes to participants in the morning period prior to given the ECG and blood samples. An electrocardiography (ECG) was taken of the study participants using the Cardioline Delta 3 Plus Digital ECG machine. In the second stage of the study, a patient file was created for every participant, that included the questionnaire, examination and measurement data, and an appointment was made for the patient at Cumhuriyet University Medical Faculty Teaching Hospital (CUMFTH) Cardiology Outpatient Clinic. The cardiologist at the clinic evaluated the questionnaire and ECG for CAD and arrhythmias and, when indicated, gave the participants an exercise ECG with the Tepa Stress Win 3.0.5 system instrument.

Measures outcome variables. "The family history" defined as positive if an individual's father or grandfather had a heart attack before age 55, or sister, mother or grandmother had one before age 65.[10] "Regular physical activity"; a pattern of physical activity was regular if activities were performed outside work: 1) most days of the week, preferably daily; 2) 5 or more days of the week if moderate-intensity activities (in bouts of at least 10 minutes for a total of at least 30 minutes per day); or 3. 3 or more days of the week if vigorous-intensity activities (for at least 20-60 minutes per session).[11] "Balanced diet"; a balanced diet was defined as having a diet containing carbohydrate, protein, fat, vitamins, mineral salts and fiber. It should contain these things in the correct proportions 3 times with 5 basic food groups (meat and poultry, vegetables and fruits, dairy products, grains, sugar and oils) in their daily meal. "High blood pressure" in an adult was defined as a systolic pressure of 140 mm Hg or higher, and/or a diastolic pressure of 90 mmHg or higher.[12] "Body Mass Index (BMI)" was calculated as weight in kilograms divided by height in meters squared. For adults, overweight was defined as BMI >25 kg/m^2, and obesity was defined as >30.0 kg/m^2.[13] The exercise ECG was then evaluated according to the guidelines.[14] A thirty-seconds continuous rhythm strip was read by a cardiologist to assess arrhythmias. When indicated angiography was recommended. The cardiologist was blinded to the profession of the participants. The cholesterol, HDL, LDL, VLDL and triglyceride levels were measured in the Biochemistry Laboratory at CUMFTH with the Synchron Lx20 instrument. The Synchron HDL kit was used with the homogeneous calorimetric method to measure the serum HDL level, the Synchron Triglycerides kit was used with the Enzymatic-GPO-Trinder method to measure the serum triglyceride level, the Synchron Glucose kit was used with the UV-Hexokinase method to measure the serum fasting glucose level, and the Synchron cholesterol kit was used with the Enzymatic method to measure the serum cholesterol level. The VLDL and LDL levels were calculated. These values that were measured were classified as low, normal, or high, according to the reference values recommended in the kits. We used the diagnostic criteria for epidemiological studies on diabetes and other categories of hyperglycemia, as recommended by the Expert Committee on the Diagnosis and Classification of Diabetes Mellitus.[15] According to the fasting glucose level, individuals with fasting venous plasma glucose concentrations of 100 mg/dl were classified as normal. If the fasting venous plasma glucose concentrations were >126 mg/dl were classified as diabetic. The subjects with fasting glucose levels 100-126 mg/dl were defined as having impaired glucose tolerance (IGT), or impaired fasting glucose (IFG).

The data were entered into the computer using the SPSS program version 9.0 (SPSS Inc., Illinois, USA). Student's t test and Chi square test and multiple logistic regression analysis were used in the statistical evaluation.

Results. The mean age of the study participants was 40.32±8.58 years. There was no significant difference between the study and control groups for mean age. The blood pressures for the drivers showed that the mean systolic was 124.23±17.14 mm Hg, and the mean diastolic of 80.47±10.83 mmHg, and for the control group were 123.64±14.27 (mean systolic) and 79.30±10.02 mmHg (mean diastolic). The means for some of the study participants' measurements for coronary artery risk factors are given in **Table 1**. The drivers' weight, body fat mass, triglycerides, VLDL, BMI means were higher than the control group at a statistically significant level (p=0.001), and their mean

Table 1 - The means for some of the study participants' measurements for coronary artery risk factors.

Variables	Driver Mean ± SD	Control Mean ± SD
Age, years	41.37 ± 7.05	39.32 ± 9.73
Systolic blood pressure, mm Hg	124.23 ± 17.14	123.64 ± 14.27
Diastolic blood pressure, mm Hg	80.47 ± 10.83	79.30± 10.02
Body mass index, kg/m^2	27.96 ± 3.85*	26.54 ± 4.02
Waist circumference, cm	96.85 ± 15.07	95.72 ± 14.70
Body fat percentage	27.86 ± 8.01*	23.88 ± 6.91
Fasting blood glucose, mg/dl	89.37 ± 14.88	91.53 ± 18.08
Triglyceride, mg/dl	184.3 ± 115.44*	154.97 ± 98.36
Cholesterol, mg/dl	185.85 ± 38.64	185.62 ± 41.79
HDL, mg/dl	32.82 ± 7.59*	35.47 ± 10.69
LDL, mg/dl	116.16 ± 34.15	118.67 ± 38.31
VLDL, mg/dl	36.86 ± 23.09*	31.44 ± 20.00

HDL - high-density lipoprotein, LDL - low-density lipoprotein, VLDL - very low-density lipoprotein, *p<0.05

Table 2 - The distribution of some of the risk factors for the study and control groups.

Variables	Drivers n	(%)	Control n	(%)
Blood pressure, (χ^2=4.24, p=0.039)				
Hypertensive	38	(21)	23	(12.8)
Normotensive	143	(79)	156	(87.2)
Cigarette status, (χ^2=3.63, p=0.057)				
Current Smokers	114	(63)	95	(53.1)
Not current smokers	67	(27.6)	84	(41.3)
Regularly physical activity, (χ^2=3.43, p=0.064)				
Yes	25	(13.8)	38	(21.8)
No	156	(86.2)	141	(78.8)
Body mass index, (χ^2=9.33, p=0.009)				
Normal	41	(22.7)	60	(33.5)
Overweight	87	(48)	88	(49.2)
Obese	53	(29.3)	31	(17.3)
Fasting blood glucose, (χ^2=0.95, p=0.622)				
Normal	156	(86.2)	148	(82.7)
IGT or IFG	21	(11.6)	27	(15.1)
Diabetes	4	(2.2)	4	(2.2)
Balanced Diet, (χ^2=0.45, p=0.504)				
Yes	105	(58.0)	111	(62.0)
No	76	(42.0)	68	(38.0)
Family history of CVD (χ^2=5.67, p=0.017)				
Yes	35	(19.3)	54	(30.2)
No	146	(80.7)	125	(69.8)
Alcohol consumption, (χ^2= 0.10, p=0.750)				
No	147	(81.2)	143	(79.9)
Yes	34	(1.7)	36	(3.9)

IGT - impaired glucose tolerance, IFG - impaired fasting glucose, CVD - cardio vascular disease

Table 3 - Multiple logistic regression analysis for hypertension as a dependent variable.

Variables	Wald value	*P*-value	Odds ratio	95% CI for OR Lower	Upper
Age					
22-35 years	5.58	0.02	6.00	1.36	26.58
35+ years	20.53	0.00	29.94	6.88	130.28
Occupation					
Non-driver	0.6822	0.41	0.78	0.43	1.41
Body mass index					
Normal	0.4807	0.49	1.31	0.61	2.82
Obese	8.34	0.00	3.40	1.48	7.80
Physical Activity					
Regular	0.70	0.40	0.73	0.35	1.5
Alcohol consumption					
Regular	0.03	0.86	1.08	0.45	2.59

A model with 5 independent variables (age, occupation, BMI, physical activity, alcohol consumption) found to be statistically significant was able to accurately predict 95.6% of normotensive and 26.5% of hypertensive individuals to fit the model of Hosmer-Lemeshow.

Table 4 - Prevalence of hypertension in drivers according to years during the occupation.

Variables	Normotensive n	(%)	Hypertensive n	(%)	Total n	(%)
Years						
0-10	35	(87.8)	6	(12.2)	41	(100)
11-20	66	(84.6)	12	(15.4)	78	(100)
21+	42	(77.7)	20	(32.3)	62	(100)

χ^2=7.22, p=0.027

HDL level (p=0.007), which is a protective factor for CAD, was lower than the control group at a statistically significant level. The distribution of some of the risk factors for the study and control groups is shown in **Table 2**. In the evaluation of the drivers for coronary artery risk factors it was determined that 48.0% were mildly obese, and 29.3% were obese, compared to 49.2% (mildly obese) and 17.3% (obese), for the control group (p<0.009). According to the results of blood pressure readings the prevalence of the diagnosis of hypertension in the drivers was 21.0%, and in the control group was 12.8%. Risk assessment of some variables (BMI, physical activity and alcohol consumption) for hypertension was given in **Table 3**. In the logistic regression analysis that consisted only the drivers, the years in profession was taken as dependent variable and BMI, physical activity, alcohol consumption were added to the model. The analysis revealed 6.96 fold increased risk of hypertension in drivers that had worked for 20 or more years compared to the ones that worked for less than 10 years. The prevalence of drivers with a history of diabetes was 3.0%, and of the control group was 4.7% (p=0.385). The majority of both the drivers (86.2%) and the control group (78.8%) did not exercise regularly. A balanced diet was eaten by 58.0% of the drivers, and 62.0% of the control group. The prevalence of drivers with a history of heart disease in a first degree relative was 19.3%, and in the control group was 30.2% . The prevalence of cigarette smoking in the drivers was 63.0%, and in the control group was 53.1%. The majority of both the drivers (81.2%) and the control groups (79.9%) no consumed alcohol. The majority of the drivers (64.1%) considered their work to be stressful, as well as the control group (64.8%) (p=0.887).

The mean year of working in profession was 16.45±8.76 in the drivers' group (**Table 4**). The hypertension frequency in the drivers that worked for 21 years or more were found to reach 32.3%. In the drivers' group 9 of the 109 exercise ECG s (8.3%), and in the control group 3 of 61 (4.9%) were evaluated as abnormal. In 4.97% of the drivers the exercise test was evaluated as positive, and this prevalence was 1.68% in the control group (p=0.081). A total of 3.33% of the participants had a positive exercise ECG. Three cases from the study and 2 from the control group had coronary angiograms. One from each group had coronary revascularization.

Discussion. Approximately 50 years ago it was stated that there is an increased risk for myocardial infarction in professional drivers, and it has been emphasized in later studies that this risk is particularly high for bus drivers.[8,16,17] Even though the underlying factors are not completely understood, it has been shown that various chemical and psychosocial factors in the work environment are the cause for this higher risk.[16,18,19] There are several main risk factors for the development of CAD and some studies have supported the fact that, as a result of these factors, bus drivers have a high risk for the development of CAD.[20] Ischemic heart disease has been found to be the highest in drivers with these characteristics: middle aged male, between 50-59 years old, cigarette smoker, obese, and with family members who died between 40-64 years of age.[21] In a study conducted in Stockholm it was reported that, similar to truck drivers, taxi and bus drivers also have an elevated risk for myocardial infarction (MI). According to this study, although cigarette smoking, habitual alcohol drinking, physical inactivity in free time, obesity, diabetes, hypertension and socioeconomic situation were found to be causative factors for increased risk in truck drivers, they were not factors in taxi and bus drivers.[22] In a study by Bigert et al[23] during different periods the MI risk increases in truck, taxi and bus drivers. Risk factors for CAD have been examined in multiple studies, and hypertension has been found to be one of these factors. Wang and Lin[24] found a 56.0% prevalence of hypertension in bus drivers, and 30.6% in the control group. In a study by Zivkovic et al[25] a 36.5% prevalence for hypertension was reported in bus drivers. Greiner et al[26] determined that 25.1% of intercity transit drivers had hypertension. The prevalence of hypertension in the drivers in our study was 21.0%, and in the control group was 12.8%. In a study conducted by Holme et al[27] in Norway it was determined that, compared to other occupations, bus drivers have more sedentary lifestyles, higher blood pressure and blood lipid levels. Wang and Lin[24] also found that 9.6% of bus drivers have obesity, 34.0% hypercholesterolemia, and 69.4% hypertriglyceridemia. In our study the prevalence of drivers with obesity was 29.3%, with hypercholesterolemia was 30.9% and with hypertriglyceridemia was 48.6%. The prevalence of obesity in our study was higher than the prevalence found in Wang and Lin's study. In addition according to the evaluation of the body fat index results the prevalence of obesity was 53.5%. In addition in Wang and Lin's study[24] the prevalence of obesity in the drivers was found to be higher than the control group. This finding is consistent with our study. Although the prevalence of hypercholesterolemia determined in our study was consistent with Wang and Lin's study[24] the prevalence of hypertriglyceridemia was found to be lower. The prevalence of cigarette smoking in Thailand among males has been reported to be 78%, and 70% in Indonesia.[28,29] In the middle 1980s it was estimated that the majority of men in China, approximately 300 million individuals, were cigarette smokers.[28,30] Nelson et al[31]reported current smoking prevalence was 33.5% for short haul truck drivers, 45.8% for long haul truck drivers, and 30% for the general population. Chen et al[32] reported smoking prevalence was 42.0% for taxi drivers. The prevalence of cigarette smoking in the drivers in our study in particular was found to be quite high. In our study, the drivers' weight, body fat mass, triglycerides, VLDL, and BMI means were higher than the control group at a statistically significant level, and their mean HDL level, which is a protective factor for CAD, was lower than the control group at a statistically significant level. The prevalence of CAD has been reported in various studies. In a study conducted in India, the CAD prevalence has been reported to be 9.5%.[33] In Janus et al's study,[29] an urban region in India, the prevalence was determined to be 13.9%. In a study conducted in the US in 20-74 year old males, a CAD prevalence of 7% was found.[34]

The years in proficiency is shown to affect the frequency of CAD and the risk factors. The study by Ragland et al[35] that investigated hypertension prevalence among drivers, and the study of Belkic et al[36] clearly demonstrated importance of years in the occupation, and issues of selection with respect to professional drivers and hypertension. The standard cardiac risk factors fail to fully explain the increased CVD risk among drivers. In our study, the logistic regression analysis revealed that age was the only factor that had effect on hypertension. The number of drivers in our study with a positive exercise ECG test was higher than the control group, but the difference was not found to be statistically significant. We think that this elevation is due to the higher number of risk factors mentioned previously in the group of drivers. In addition the prevalence that we found is also lower in comparison to other studies. In a study, Onat et al[37] reported the rate of having cardiac disease as 4.4% in 40-49 years age group, and 21.6% in the 60-69 years age group in Turkey. Ugljesic et al[38] were reported the high occurrence of diastolic hypertensive reactions to exercise among professional drivers. They discussed these reactions might be associated with risk of ischemic heart disease and hypertension. They also recommend more sensitive methods might be indicated in selected cases in such investigations. Our study group is not representative of the age breakdown of the general population. Coronary artery disease' prevalence increases with age. For this reason when evaluating the prevalence, the age factor needs to be taken into consideration. In this study the mean age of the drivers are 2 years higher than the control group and although it is not statistically significant, may have an impact on the results. The frequency of CAD was evaluated via questionnaire, resting ECG, and treadmill stress tests. Resting and stress test may be normal despite severe coronary stenosis detected in coronary angiography. This may be a limitation for our study. In these studies retrospective investigation may cause bias. Also data of non-participants of the study and the control groups are lacking, being a limitation in this study.

In conclusion periodic health check-ups for heavy vehicle drivers would allow for the diagnosis of heart disease at an early stage and the initiation of necessary treatment. Health education for this group could also have a part in the decrease and elimination of some risk factors for CAD.

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