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# Epidemiology of dyslipidaemia in professional drivers: results of RACER-ABPM (Risk of Adverse Cardiovascular Events among professional dRivers in Poland — Ambulatory Blood Pressure Monitoring) study

Bartosz Krzowski[1], Anna E. Płatek[1, 2], Filip M. Szymański[1], Anna Ryś[1], Karolina Semczuk-Kaczmarek[1], Karolina Adamkiewicz[3], Marcin Kotkowski[4], Krzysztof J. Filipiak[1]

[1]1st Department of Cardiology, Medical University of Warsaw, Warsaw, Poland

[2]Department of General and Experimental Pathology with Centre for Preclinical Research and Technology (CEPT), Medical University of Warsaw, Warsaw, Poland

[3]Department of Orthopaedics and Traumatology, Medical University of Warsaw, Warsaw, Poland

[4]Department of Neuroradiology, Institute of Psychiatry and Neurology, Warsaw, Poland

## Abstract

**Background:** Professional drivers are a group exposed to many cardiovascular risk factors. Non-systematic working hours, prolonged stress, low physical activity, along with irregular, and in most cases, unhealthy meals are common aspects of the normal working schedule of most of the professional drivers. These translate into high risk of cardiovascular disease (CVD).

**Aim:** The aim of the current analysis was to establish the prevalence of dyslipidaemia in a group of continuous professional drivers.

**Methods:** The RACER (Risk of Adverse Cardiovascular Events among professional dRivers in Poland — Ambulatory Blood Pressure Monitoring) study is a prospective study focused on assessing cardiovascular risk factors in professional drivers. Patients included in the study were screened for classical and non-classical cardiovascular risk factors and had an ambulatory blood pressure monitoring (ABPM) performed. Out of the whole RACER study population, 144 drivers were included into the RACER-ABPM study.

**Results:** Out of this group 135 (95.7%) were male, and the mean age was 50.2 ± 9.3 years, and mean body mass index was 32.3 ± 3.0 kg/m$^2$. A family history of CVD was noted in 21.3% of patients, 28.1% were current smokers, and 2.9% had diabetes mellitus. Out of those patients, 72.2% had low-density lipoprotein cholesterol (LDL-C) level > 115 mg/dL, 85.5% had LDL-C > 100 mg/dL, and 96.7% had LDL-C > 70 mg/dL. High-density lipoprotein cholesterol < 40 mg/dL in men and < 45 mg/dL in women was present in 84.4% of cases. Triglycerides > 150 mg/dL were found in 28.9% of cases.

**Conclusions:** In conclusion, dyslipidaemia is highly prevalent in professional drivers. Obesity is one of the major contributors to the cardiovascular risk, and dyslipidaemia along with other risk factors highly prevalent in this subgroup accounts for poorer prognosis.

**Key words:** dyslipidaemia, professional drivers, shift work, obesity

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**Address for correspondence:**
Anna E. Płatek, MD, PhD, 1st Department of Cardiology, Medical University of Warsaw, ul. Banacha 1a, 02–097 Warszawa, Poland, e-mail: a.platek@wp.pl
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## INTRODUCTION

Cardiovascular disease (CVD) is still the most common cause of death worldwide [1]. The economic cost of CVD in the European Union (EU) is estimated to be around €192 billion annually [2]. The economic cost and morbidity due to CVD are attributable to several risk factors. One of the most important, modifiable risk factors is dyslipidaemia. It is especially important in patients with elevated baseline CVD risk, i.e. due to genetic or occupational factors. Several studies proved professional drivers to be at higher mortality and morbidity risk compared to the general population [3]. Irregular working hours, prolonged stress, low physical activity, and unhealthy nutritional habits are just a few cardiovascular (CV) risk factors that this occupational group deals with [4]. These factors combined lead to the development of various CVD and high rates of premature death in professional drivers [5]. Little is known about the exact prevalence of dyslipidaemia in professional drivers in the EU. The aim of this study was to establish the prevalence of dyslipidaemia in a group of unselected professional drivers.

## METHODS

The current study was a subsequent analysis of the RACER (Risk of Adverse Cardiovascular Events among professional dRivers in Poland — development of specific cardiovascular preventive programme) study, which was a prospective study focused on the assessment of the CV risk profile of professional drivers of Central Europe. The full protocol of the RACER study has been described previously [6, 7]. The whole RACER programme was a nationwide project focused on collecting data on the prevalence of CV risk factors in an unselected group of professional drivers. The programme was focused on the screening of the drivers of public transport, buses, trucks, and taxis.

Cardiovascular risk factors assessed in the study include the prevalence of classical and non-classical CV risk factors. The RACER programme was initiated in order to draw attention to the health situation of professional drivers in Poland and throughout Europe. The study protocol was approved by the Regional Bioethics Committee. The study was conducted in accordance with the Declaration of Helsinki. The participation of the drivers in the study was voluntary. To a present subanalysis called RACER-ABPM, consecutive patients randomly selected from the whole study population were included. They agreed to participate in the study and additionally had 24-h ambulatory blood pressure monitoring (ABPM) performed to confirm the diagnosis of arterial hypertension and assess of the daily variability of the blood pressure (BP) values. The inclusion criteria for both studies were: informed written consent to participate in the study, age ≥ 18 years, and current employment as a bus driver in a city transportation system or on international routes. The main exclusion criteria of the study were: a lack of informed consent to participate in the study, a concomitant disease with survival prognosis below six months, or receiving medication with a potential of causing depression. Enrolled patients were not selected by the level of education, socio-economic status, lifestyle habits (not related to the profession), or any other socio-demographic parameters. None of the patients received lipid-lowering agents.

Cardiovascular risk factors were defined as in the previous studies for hypertension, diabetes, metabolic syndrome, heart failure, and myocardial infarction [8]. Diagnosis of non-classical CV risk factors was made based on questionnaires, which were described previously in detail [6, 7]. Questionnaires were scored by researchers, assuring the anonymity of patient data. They included evaluation of sexual dysfunction using the International Index of Erectile Function (IIEF) [9], depression using Beck Depression Inventory II (BDI-II) [10], and daytime sleepiness by the Epworth Sleepiness Scale (ESS) [11]. All participants were also asked if they find their work stressful and for their work schedule: regular working hours or shift work. All patients had their CV risk assessed using SCORE tables, verified for the national population [12, 13].

All patients included in the RACER-ABPM had ABPM performed to evaluate mean BP values during 24 h, on a non-working day, preceded by a night's sleep. The examination was performed in accordance with the rules of the European Society of Hypertension using the BR-102 plus (Schiller AG, Baar, Switzerland) [14]. Normal values were considered as less than 130/80 mmHg for 24-h average, less than 135/85 mmHg for awake average, and less than 120/70 mmHg asleep average. If at least one of these values was exceeded, the patient was considered hypertensive in the ABPM measurement.

The biochemical parameters were assessed in blood samples taken during the examination. Plasma cholesterol and triglyceride levels were assessed enzymatically, while plasma high-density lipoprotein cholesterol (HDL-C) concentration was assessed immunoenzymatically. Low-density lipoprotein (LDL) concentration was calculated using Friedewald formula. Hypercholesterolaemia was diagnosed with LDL plasma levels of ≥ 115 mg/dL (3.0 mmol/L), and total cholesterol of ≥ 190 mg/dL (5.0 mmol/L). Atherogenic dyslipidaemia was defined as a coexistence of increased triglycerides levels ≥ 150 mg/dL (1.7 mmol/L), low HDL concentration < 40 mg/dL (1.0 mmol/L) in men and < 45 mmol/dL (1.2 mmol/L) in women, and abnormal LDL particles — small dense LDL-C. Hypertriglyceridaemia was characterised by triglyceride elevation > 150 mg/dL (1.7 mmol/L), with normal LDL-C levels. Cut-off values for normal LDL levels were established according to the European Society of Cardiology guidelines [15] as < 70 mg/dL (< 1.8 mmol/L) for patients at very high CVD risk, < 100 mg/dL (< 2.6 mmol/L) for patients at high-risk, and < 115 mg/dL (< 3.0 mmol/L) for patients at low to moderate risk.

### *Statistical analysis*

Data were tested for normality using the Kolmogorov-Smirnov test. Continuous data are presented as mean and 95% confidence intervals (CI), with statistical comparisons performed with the Mann-Whitney test or Student's t-test. For categorical variables, a comparison was made using either the $\chi^2$ or Fisher exact tests. A p value of less than 0.05 was considered statistically significant. Statistical analyses were performed using SPSS (SPSS version 21, Inc., Chicago, IL).

## RESULTS

The RACER-ABPM analysis involved a total of 141 patients. As was previously described [7], the group consisted of 135 (95.7%) men at the mean age of 50.2 ± 9.3 years, and mean body mass index (BMI) of 32.3 ± 3.0 kg/m$^2$. Fifty-five (39.0%) patients had obesity and 70 (49.6%) patients were overweight. The CV risk factors were highly prevalent in this population. Diabetes mellitus was diagnosed in four (2.9%) patients. The family history of CVD was noted in 21.3% of patients, and 28.1% were current smokers. As the non-classical CVD risk factors, depression was found in nine (6.4%) cases, 27 (19.1%) drivers were at high risk for sleep-disordered breathing, and 42 (31.1% men) were diagnosed with erectile dysfunction.

Previously diagnosed hypertension was present in 39 (27.9%) patients. Assessment of the ABPM values showed that the mean 24-h BP values were 130.3 ± 14.3 mmHg and 80.9 ± 9.9 mmHg for systolic and diastolic BP, respectively. Based on these results 104 (73.8%) patients were diagnosed with arterial hypertension.

The mean lipid levels in the population were as follows: 191.3 ± 38.2 mg/dL for total cholesterol, 32.3 ± 7.1 mg/dL for HDL-C, 132.6 ± 36.8 mg/dL for LDL-C, and 132.0 ± 65.6 mg/dL for triglycerides. The mean non-HDL-C level was 159.0 ± 36.7 mg/dL. After dividing patients according to lipid disorders, we found hypercholesterolaemia in 71 (50.4%) patients. Thirty-six (26.2%) patients had atherogenic dyslipidaemia, and 14 (9.9%) patients suffered from hypertriglyceridaemia. Out of those patients, 72.2% had LDL-C level > 115 mg/dL, 85.5% had LDL-C > 100 mg/dL, and 96.7% had LDL-C > 70 mg/dL. HDL-C < 40 mg/dL in men and < 45 mg/dL in women was present in 84.4% of cases. Triglycerides > 150 mg/dL were found in 28.9% of cases (Fig. 1).

When we divided patients according to their CV risk assessed according to the SCORE classification, it showed that 15 (10.6%) patients were at low CV risk, 80 (56.7%) patients were at moderate risk, 31 (22.0%) were at high risk, and 15 (10.6%) were at very high CV risk. Current goal for LDL-C concentration for patients at very high CVD risk (< 70 mg/dL) was met in none of cases, for patients at high risk (< 100 mg/dL) in 11.8% of cases, and for patients at low to moderate risk (< 115 mg/dL) in 31.7% of cases. Overall,

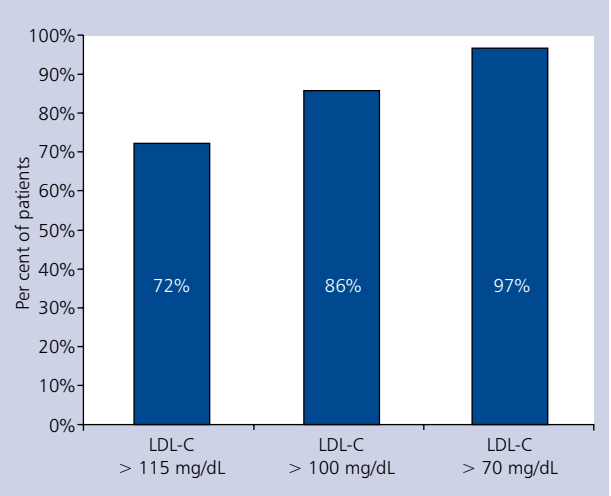


Figure 1. Concentrations of low-density lipoprotein cholesterol (LDL-C) in professional drivers

only 34 (24.1%) patients reached the target LDL-C levels. Subsequent analysis of patients who did and did not reach the target LDL-C levels showed that patients with lower LDL-C had significantly more favourable concentrations of lipid fractions. No other differences were noted between the groups. Detailed analysis is showed in Table 1.

## DISCUSSION

Many factors negatively impact professional drivers' cholesterol level and general CV risk profile. The prevalence of classical CV risk factors has been examined in small groups of drivers of a selected type, for example, tram drivers, taxi drivers, or bus drivers [16]. Very few studies took into account the occurrence of dyslipidaemia, and none of the previous studies looked at all types of drivers.

One of the largest studies investigated risk factors for ischaemic heart disease in Sweden in 1993. 440 professional bus and truck drivers were compared with a control group of 1000 subjects. It did not show differences in total cholesterol, HDL-C, and triglycerides. However, the drivers appeared to have significantly higher BMI [17]. On the other hand, outcomes of the study conducted in Serbia showed that 79% of the drivers suffered from dyslipidaemia. Concentrations of serum lipids were the lowest in taxi drivers and the highest in bus drivers. Additionally, the authors connected LDL level with occupational stress index (OSI), proving that the higher the OSI, the higher the LDL level [18]. Other studies were also conducted in non-European countries. Regional differences were found. 35.7% of bus drivers in Brazil were found to have hypercholesterolaemia and 77% to be at least overweight [19]. The study focused on long-haul truck drivers in the United States, including 1670 drivers, and showed that over two-thirds of the respondents were obese and 17% drivers

Table 1. Comparison of patients according to the control of low-density lipoprotein (LDL) cholesterol concentration

| | Drivers with elevated LDL levels (n = 107) | Drivers with good LDL control (n = 34) | p |
|---|---|---|---|
| Age [years] | 50.0 ± 10.2 | 50.2 ± 8.8 | 0.96 |
| Male sex | 103 (94.1%) | 32 (90.9%) | 0.46 |
| Hypertension | 79 (73.5%) | 25 (77.3%) | 0.48 |
| Diabetes mellitus | 4 (3.9%) | 0 (0.0%) | 0.57 |
| Family history of CVD | 25 (23.5%) | 8 (22.7%) | 0.84 |
| Current smoking | 33 (30.9%) | 6 (18.2%) | 0.19 |
| Job strain | 89 (83.1%) | 29 (86.4%) | 0.51 |
| Normal BMI values | 16 (14.7%) | 2 (4.5%) | 0.19 |
| High risk of sleep disordered breathing | 27 (25.0%) | 6 (18.2%) | 0.37 |
| Depression | 5 (4.4%) | 4 (9.1%) | 0.36 |
| Erectile dysfunction | 30 (27.9%) | 12 (36.4%) | 0.31 |
| Mean systolic BP [mmHg] | 129.4 ± 12.4 | 131.8 ± 15.1 | 0.45 |
| Mean systolic BP [mmHg] | 80.9 ± 9.1 | 80.4 ± 10.6 | 0.64 |
| BMI [kg/m$^2$] | 29.1 ± 4.3 | 31.0 ± 5.5 | 0.12 |
| Total cholesterol [mg/dL] | 205.6 ± 30 | 146.8 ± 23.9 | < 0.0001 |
| HDL cholesterol [mg/dL] | 33.8 ± 6.5 | 27.4 ± 6.8 | < 0.0001 |
| LDL cholesterol [mg/dL] | 146.7 ± 28.8 | 89.1 ± 21.5 | < 0.0001 |
| Triglycerides [mg/dL] | 125.4 ± 49.1 | 152.1 ± 100 | 0.51 |
| Non-HDL cholesterol [mg/dL] | 171.8 ± 30.9 | 119.4 ± 22.4 | < 0.0001 |

Data are presented as mean ± standard deviation or number (percentage). BMI — body mass index; BP — blood pressure; CVD — cardiovascular disease; HDL — high-density lipoprotein; LDL — low-density lipoprotein

were morbidly obese with BMI > 40 kg/m$^2$. Only 22% were taking medicine for, or had been told they had, high cholesterol. Cholesterol levels weres not assessed in this study [20].

The previously mentioned studies show no consistency regarding cholesterol level and prevalence of dyslipidaemia in professional driers. Results depend on a geographic region, method, and analysed group. In studies conducted in the EU, dyslipidaemia was usually included in the other CVD risk factors and not analysed separately. Moreover, all of these studies were usually small.

The present study showed that in a non-selected group of European professional drivers lipid abnormalities and weight excess are highly prevalent. 72.2% of the studied population had LDL level > 115 mg/dL, and abnormally low levels of HDL-C were found in 84.4% of drivers. Criteria for overweight were met by 84% of drivers. Compared to the population data available for the same geographic region, the dyslipidaemia in the group of professional drivers is more prevalent than in the general population. The epidemiological study shows that 61% of the general population, aged 20–74 years, is affected by dyslipidaemia [21, 22]. Therefore, professional drivers can be identified as a group at particularly high CVD risk. Early diagnosis of dyslipidaemia and treatment are necessary to improve CV risk profile.

Dyslipidaemia is just a part of the puzzle of classical risk factors. Those consist of sedentary lifestyle and lack of physical activity, smoking habits, and unhealthy diet associated with frequent travelling, resulting in high prevalence of overweight and obesity, which are connected with high cholesterol and glucose levels, diabetes mellitus, hypertension, and metabolic syndrome [5]. Non-classical cardiovascular risk factors are also responsible for high CV risk among professional drivers. They are more likely to experience depression, psychological stress, or have low socioeconomic status [5, 6]. Additionally, drivers are exposed to air pollution and vehicle-related particles, which are related to systemic inflammatory responses [23]. The association between air pollution, PM10 exposure, and elevated serum triglycerides together with total cholesterol has been proven. What is more, air pollution levels directly correlate with triglyceride and total cholesterol levels. It is suggested that dyslipidaemia is a mediator between air pollution and CVD [24].

## CONCLUSIONS

In conclusion, professional drivers are at very high CV risk. One of the major risk factors present in this group is dyslipidaemia. Potential prevention and education strategies in this occupational group regarding lifestyle changes are crucial

and would result in improvement of the general health status in this group, as well as an improvement in the safety of the road traffic.

***Conflict of interest:*** *none declared*

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