



# Dyslipidaemia, carbohydrate metabolism disorders and arterial hypertension detected in academic employees during examinations in occupational medicine

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## Abstract

**Introduction.** Many people have CVD risk factors without realising it and it is important to recognise the risk factors as soon as possible. Periodic examinations are a mandatory form of control for all employees in Poland. They provide an excellent opportunity to screen for the most common civilization diseases in the population.

**Objective.** The aim of this study is to evaluate the prevalence of dyslipidaemia, hyperglycaemia and hypertension among academics in a Polish university, and to compare the results between postdoctoral fellows and other academics.

**Material and method.** The study group were postdoctoral fellows (HAB; N=135, 53 females) and other academics (NHAB; N=286, 179 females) over the age of 40 who reported for a periodic occupational medical check-up. Fasting blood samples were drawn, serum glucose, lipids and blood pressure (BP) were measured.

**Results.** The mean age was 56.7 (SD 9.8) in HAB and 49.8 (SD 8.1) in NHAB. Mean systolic BP and glycaemia were significantly higher in male HAB group than male NHAB (135.8 vs 130.9 mmHg and 6.0 vs 5.6 mmol/l, respectively). The relationship in females was non-significant. The age-adjusted odds ratios (OR [95% CI]) of having elevated low density lipoprotein cholesterol, total cholesterol, glucose and blood pressure in male HAB vs male NHAB were 0.61 [0.32, 1.16], 0.64 [0.33, 1.23], 1.52 [0.80, 2.88] and 2.11 [0.88, 5.23], and in female HAB vs female NHAB – 0.59 [0.31, 1.12], 0.64 [0.32, 1.26], 0.87 [0.40, 1.79] and 1.86 [0.70, 4.68], respectively.

**Conclusions.** Adequately planned occupational medicine examinations provide an opportunity to diagnose dyslipidaemia, hyperglycaemia, or high BP in all groups of employees, including highly educated academics.

## Key words

hypertension, dyslipidaemia, early detection, prophylactic examinations, hyperglycaemia

## INTRODUCTION

One of the paradigms in occupational medicine is that better health awareness and a resultant reduction in the risk of developing chronic diseases of civilization goes in parallel with a higher level of education. From this point of view, academics employed at a university are expected to be especially conscious of health hazards and are therefore rarely the subject of specific research. This study is one of the first to present the basic health parameters in this group of patients.

It assesses the homogeneity of this group by comparing the parameters of employees with a postdoctoral fellowship title (who should be the most health-aware according to the above-mentioned paradigm) with other academics with a university degree, i.e. teaching assistants, researchers and lecturers.

In the general population, cardiovascular disease (CVD) causes over 4 million deaths in Europe each year [1]. Dyslipidaemia, diabetes and hypertension are all major controllable factors responsible for these deaths [2]. Reducing the prevalence of these risk factors is the main reason for the decline in CVD-related mortality [2]. Treatment of dyslipidaemia can reduce the risk of heart disease by as much as 30% over a 5-year period [3]. It is therefore essential

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to detect these disorders as soon as possible in order to initiate treatment.

A large epidemiological study in Poland revealed that over 60% of adults have hypercholesterolaemia, and 60% of them are unaware of the condition. A further 20% are aware, but are not treated, while only 10.9% are being effectively treated [4]. The highest prevalence was observed in the age group 40–59. The prevalence of diabetes in Poland is also high at 6.97% (diagnosed and undiagnosed cases) [5], with over a quarter of the patients with diabetes being unaware that they have the disease [6]. Similarly, the prevalence of arterial hypertension is also high at 42.7%, with an awareness level of 59.3% [7]. Only 23% of cases are adequately controlled. The prevalence has also increased by 12% over 10 years.

The above data indicate an urgent need to increase the detection rates of CVD risk factors in order to apply effective treatment and prevention methods. One way of achieving this could be through regular employee obligatory check-ups in institutions. In Poland over 5 million such visits are registered every year [8], offering an excellent opportunity to screen for CVD risk factors.

## OBJECTIVE

The aim of the study was to evaluate the prevalence of hypertension, hyperglycaemia and dyslipidaemia in a Polish university by analysing the differences in CVD risk factors between postdoctoral fellows (pol. *doktor habilitowany*, i.e. doctors after habilitation) and employees with MSc or a PhD title. An attempt was made to assess whether obtaining a postdoctoral fellowship is a protective factor in a university setting.

## MATERIALS AND METHOD

The study was conducted in 2018 on all employees of one of the universities in Łódź, central Poland, who reported for obligatory medical check-ups based on referrals from the employer. Two groups of subjects were considered: postdoctoral fellows with habilitation (HAB) and others with any university degree (NHAB). All eligible employees were assessed, but the age cut-off of  $\geq 40$  years was introduced in order to obtain comparable groups of subjects (otherwise, the HAB group would not have a representative number of subjects aged  $< 40$ , because achieving habilitation below 40 year of age is infrequent). In addition to the standard procedures required by employee's check-ups, fasting blood samples were drawn and analysed in a certified laboratory. Arterial blood pressure, lipidogram, and glucose were measured as health outcomes for the study. LDL concentration was calculated with the Friedewald formula. Reference ranges were established according to current Polish guidelines [9].

The initial number of participants was 850; however, after excluding subjects under the age of 40, the final number of participants was 421 (55.1% female). For further analysis, male and female participants were discussed separately, due to different normative ranges of the health outcomes and different incidence of CVD risk factors in both genders. Subsequently, both groups were divided into academic workers without habilitation (MSc or PhD only, NHAB) and habilitated postdoctoral fellows (HAB).

Data analysis was performed with the use of Statistica (version 13) and R (version 3.5) software. For crude characterisation of the study population, mean values of the health outcomes in the habilitated (HAB) group and the non-habilitated (NHAB) group were calculated and compared by the t-test ( $P < 0.05$  was used as an approximate indicator of difference, strict statistical criteria of normality and equality of variances were not met). Frequencies of non-normative outcomes in both groups (HAB/NHAB) were compared by the Chi-squared test, or Fisher's exact test (for HDL in female group). Crude and age-adjusted odds ratios (OR) with 95% confidence intervals [95% CI] for nonnormative outcome (coded as '1') against outcome in the normative range (taken as reference, coded as "0"), in HAB relative to NHAB group, were obtained from logistic regression with subject group as the main explanatory variable (with NHAB group taken as reference, and coded as '0'), and age (in years) included as additional explanatory variable.

The study protocol was approved by the local Bioethical Committee at the Nofer Institute of Occupational Medicine in Łódź (Decision No. 04/2015 of 18 February 2015).

## RESULTS

The study group consisted of academics aged  $> 40$  years, 189 males (mean age – 54.4, SD 10.4) and 232 females (mean age – 49.5, SD 7.3). The NHAB group was younger (mean age – 49.88, SD 8.1) and included 286 subjects – 107 males (mean age – 51, SD 9.2) and 179 females (mean age – 49., SD 7.3). The HAB group (mean age – 56.7, SD 9.8) included 135 subjects – 82 males (mean age – 8.9, SD 10.2) and 53 females (mean age – 53.3, SD 8.2). Table 1 presents the mean values with SD of all the parameters in both groups in males and females. Among males, the glucose levels and systolic blood pressure were noticeably higher in the more advanced academic career level (HAB group). Among females, the glucose level was not noticeably changed, but there was some increase in systolic blood pressure in the HAB group.

The number of subjects with nonnormative values of total cholesterol (TC), LDL, HDL, glucose and blood pressure are shown in Tables 2 and 3 for males and females, respectively. While there are noticeable changes in frequencies and crude odds ratios for non-normative values, in the HAB relative to NHAB group. These were mostly attributed to age difference between the groups, because confidence intervals for age-adjusted ORs all embrace the value of 1.

## DISCUSSION

Postdoctoral fellows are academics who have a PhD title and have completed the habilitation process and are fully independent researchers. This is formal proof of a higher degree of education and an advanced career in research. Doctors after habilitation often also have the title 'professor' and often occupy a high post, such as chair of a department.

**Hypertension.** Systolic arterial blood pressure was significantly higher in the male HAB group than in the male NHAB group (the relationship in females being similar, but non-significant). In the male and female HAB group, the number of participants with abnormal blood pressure, as well

**Table 1.** Values of total cholesterol, low density lipoprotein, high density lipoprotein, glucose and blood pressure systolic (BP.s) and diastolic (BP.d) expressed as mean with SD and P-values for comparison of the means in NHAB (lower grade) and HAB (higher grade) academic group, separately in males and females

	Male			Female		
	NHAB (107)	HAB (82)	P	NHAB (179)	HAB (53)	P
TC (mmol/l)	5.39 (1)	5.21 (1.2)	0.248	5.49 (1.1)	5.48 (1.1)	0.987
LDL (mmol/l)	3.34 (0.9)	3.17 (1)	0.219	3.27 (1)	3.17 (1)	0.498
HDL (mmol/l)	1.40 (0.3)	1.39 (0.4)	0.918	1.70 (0.4)	1.82 (0.4)	0.098
Glucose (mmol/l)	5.59 (1)	6.02 (1.5)	0.022	5.26 (0.6)	5.25 (0.8)	0.944
BP.s (mmHg)	130.9 (14.5)	135.8 (13.9)	0.020	123.7 (14.8)	127.3 (15.3)	0.118
BP.d (mmHg)	80.9 (9.1)	82.8 (7.6)	0.116	77.2 (9.0)	78.4 (10.1)	0.394

BP.d – blood pressure diastoli; BP.s – blood pressure systoli; HDL – high density lipoprotein; HAB – postdoctoral fellows (pol. *doktor habilitowany*, i.e. doctors after habilitation); LDL – low density lipoprotein; NHAB – academics with MSc or a PhD; TC – total cholesterol.

**Table 2.** Number and percentage of males with nonnormative glucose, lipid levels or blood pressure in both groups, with P-value for equality of proportion of non-normative value, and the crude and age-adjusted (Adj) odds ratios (OR) for falling within the nonnormative range of the given parameter for HAB vs NHAB group, with 95% Confidence Intervals (95% CI)

	NHAB (107)	HAB (82)	P	Crude OR [95% CI]	Adj OR [95% CI]
	N (%)	N (%)			
TC > 4,9 mmol/l	75 (70.1)	42 (51.2)	0.013	0.45 [0.25, 0.81]	0.64 [0.33, 1.23]
LDL > 3 mmol/l	70 (65.4)	37 (45.1)	0.008	0.43 [0.24, 0.78]	0.61 [0.32, 1.16]
HDL < 1 mmol/l	92 (86.0)	68 (82.9)	0.709	0.79 [0.36, 1.75]	0.90 [0.38, 2.15]
Glucose >5.6mmol/l	42 (39.3)	48 (58.5)	0.013	2.18 [1.21, 3.93]	1.52 [0.80, 2.88]
BP ≥140/90mmHg	11 (10.3)	17 (21.0)	0.066	2.32 [1.03, 5.41]	2.11 [0.88, 5.23]

BP – blood pressure; HDL – high density lipoprotein; HAB – postdoctoral fellows (pol. *doktor habilitowany*, i.e. doctors after habilitation); LDL – low density lipoprotein; NHAB – academics with MSc or a PhD; TC – total cholesterol.

**Table 3.** Number and percentage of females with nonnormative glucose, lipid levels or blood pressure in both groups, with P-value for equality of proportion of nonnormative values and the crude and age-adjusted (Adj) odds ratios (OR) for falling within the nonnormative range of the given parameter for HAB vs NHAB group, with 95% Confidence Intervals (95CI)

	NHAB (179)	HAB (53)	P	Crude OR [95% CI]	Adj OR [95% CI]
	N (%)	N (%)			
TC >4.9mmol/l	125 (69.8)	34 (64.2)	0.539	0.77 [0.40, 1.47]	0.64 [0.32, 1.26]
LDL >3mmol/l	107 (59.8)	27 (50.9)	0.324	0.7 [0.37, 1.29]	0.59 [0.31, 1.12]
HDL <1.2mmol/l	16 (8.9)	1 (1.9)	0.130	5.1 [0.02, 1.51]	3.74 [0.70, 69.23]
Glucose >5.6mmol/l	42 (23.5)	13 (24.5)	1	1.06 [0.51, 2.17]	0.87 [0.40, 1.79]
BP ≥140/90mmHg	14 (7.8)	9 (17.0)	0.089	2.11 [0.88, 5.23]	1.86 [0.70, 4.68]

BP – blood pressure; HDL – high density lipoprotein; HAB – postdoctoral fellows (pol. *doktor habilitowany*, i.e. doctors after habilitation); LDL – low density lipoprotein; NHAB – academics with MSc or a PhD; TC – total cholesterol.

as the age adjusted OR, were both more than twice as high as in the NHAB group. There may be several explanations for this difference. Firstly, the HAB group had a higher mean age and the WOBASZ study demonstrated that SBP rises with age until about the age of 70 [10]. Secondly, achieving the degree of a postdoctoral fellow may be in itself stressful due to the highly competitive environment and challenging work. Furthermore, postdoctoral fellows often occupy posts of high responsibility in their workplaces which may lead to higher work strain, a known risk factor of hypertension, especially among older employees [11]. The data from the very few studies conducted on work stress levels in academics is inconclusive, whereas research in other workers shows that older age has both benefits and drawbacks in terms of stress regulation (e.g. better emotional regulation, but higher strain) [12].

**Carbohydrate metabolism disorders.** The male HAB group had significantly higher blood glucose levels than NHAB, and

their glucose levels were more frequently outside the normal range (<5.6 mmol/l). No such relationship was observed in the females, perhaps again due to the smaller age gap. The risk of elevated glucose levels in the HAB group in males was also higher after age adjustment, whereas the age-adjusted OR in females was non-significant in HAB and NHAB.

The prevalence of impaired fasting glucose in both male groups was relatively high. Polish data on the precise age distribution of impaired fasting glucose (IFG) is lacking. In a metaanalysis of papers on IFG in Europe, the authors report a prevalence of IFG of 10.6% in males aged 30–65 and only 8.9% in those aged 66+ [13]. The results obtained in this study seem exceptionally high. A possible lack of compliance among senior academic staff (i.e. not fasting before the blood had been drawn) may also have been an important factor.

The study was conducted on highly educated individuals on the academic staff of a university, many of whom therefore may have considered that they did not need medical check-ups and



ignored doctors' instructions. Another reason may be that most academic work involves considerable sedentary time, which is an important risk factor of insulin resistance [14].

**Dyslipidaemia.** The percentage of patients with TC > 4.9 mmol/l was slightly lower in this study than in the Polish population observed in the NATPOL study, where this percentage for patients aged 40–59 was 72%. The percentage was lower in the older age group (60–79) at 59%[4]. In the light of these data, surprisingly few patients in the male HAB group had TC>4.9mmol/l (51%), significantly fewer than in the NHAB group. A possible explanation may be that more of them could have been aware of having dyslipidaemia and were already receiving adequate treatment. This is supported by data from the Swiss FIRE project which demonstrated that the prevalence of abnormal lipid profiles in males aged 55–64 is only slightly higher than in males aged 45–54 [15]. The prevalence of dyslipidaemia treated with drugs is, however, was almost twice as high.

The difference between NHAB and HAB is even more pronounced in terms of LDL, with only 45% in the male HAB group presenting levels over 3mmol/l, compared to 65% in NHAB, and 75% in the NATPOL study. The results in females were similar across the HAB and NHAB groups, but also lower than in the NATPOL population. This is in accordance with a recent study demonstrating a lower prevalence of dyslipidaemia in individuals with higher education [16].

The age distribution of the prevalence of dyslipidaemia in adults varies considerably according to different studies in different countries [4, 17, 18]; the diagnostic criteria also vary, as do the age brackets for the presented age groups, which makes age standardization difficult to perform and interpret. The raw OR of having an abnormal TC level was as low as 0.45 for the male HAB group. This is unlikely to be attributed solely to the age gap, given the above-mentioned results from the FIRE project. Thus, other reasons could be considered, such as differences in lifestyle or access to healthcare. A possible explanation might be a potentially higher income level achieved by the HAB group, and therefore better access to private healthcare on a regular basis, receiving more and/or better preventive advice and treatment. The higher social status and wider social connections, among others with medical doctors, which the HAB group members may have, may also improve access to high quality healthcare. This situation could be due to the relatively poor quality of primary care in Poland [19]. It might also be that the older workers in the HAB group more often work part-time and have more free time for a healthy lifestyle, but this was not analysed in the presented study.

Furthermore, members of the HAB group are likely to be highly motivated and ambitious, given their advanced career, and therefore may also be more motivated to care for their own health.

## CONCLUSIONS

A more advanced academic career, defined as achieving the title of a postdoctoral fellow, is not the main factor determining the analysed health status parameters, but it does appear to be in a way protective against abnormal LDL and TC. Conversely, it may be associated with an increased risk of elevated blood pressure and hyperglycaemia.

Further studies are required to determine the the exact causes of the described relationships and their clinical importance, and whether they would influence such key parameters as mortality or risk of CVD. Adequately planned occupational medicine examinations provide an opportunity to diagnose dyslipidaemia, hyperglycaemia, or high blood pressure, and offer the opportunity for counselling about CVD risk factors in all groups of employees, including highly educated academics.

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