Multimorbidity and risk factors of chronic diseases in healthcare workers of a general city clinical hospital

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Objective. *To assess the occurrence of risk factors (RF) and associated multimorbidity in healthcare workers of a general city clinical hospital (CCH).*

Methods. *208 healthcare workers (61 men and 147 women) and 127 non-medical professionals (61 men and 147 women, the control group) who underwent medical examination in the outpatient department of the hospital were included. The age of health workers was 45.9±16.3 years, non-medical professionals — 45.9±16.3 years. We performed physical examinations, assessed patient histories, risk factors and associated pathologies. Multimorbidity was considered if a patient had at least two of the following: arterial hypertension, diabetes, coronary artery disease, asthma or cancer.*

Results. *Among healthcare workers, the most common risk factors were unhealthy diet (55.8 %), lack of physical activity (47.2 %), and excess weight. Among non-medical professions — excess weight (77.8 %), unhealthy diet (53.6 %), and low physical activity (31.7 %). Multimorbidity was associated with age (OR 1.05, 95 % CI; 1.02–1.08; p=0.002), work in the internal medicine department (OR 11.8, 95 % CI; 3.1–45.0; p <0.001), family history (OR 3.54, 95 % CI; 1.55–82; p=0.003). The cutoff for increased risk of multimorbidity in healthcare workers was age 48.5 (sensitivity 66 %, specificity 66 %).*

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Conclusion. *Prompt detection of co-existent diseases and early detection of behavioral risk factors during the routine examinations of medical workers can reduce the likelihood of multimorbidity, especially in patients under 48.5 years.*

Keywords: *healthcare workers, chronic non-communicable diseases, multimorbidity, risk factor, health.*

Introduction

Recently there has been a rise in the number of individuals with co-existent comorbid chronic diseases, that have negative effects on clinical status, quality of life, ability to work and prognosis of these patients. Therefore, it is necessary to detect these diseases early in order to prevent their further development [1,2]. Multimorbidity is considered in individuals who have at least two chronic diseases that negatively affect their functional status and quality of life and increase the disability rate in the population [3].

High relevance of this problem determines the need of new approaches to early detection of co-existent diseases and their risk factors [4]. Elderly population growth leads to the rising need for healthcare and, therefore, increases the load on the national healthcare systems. Hence, the provision of medical services and information about the main risk factors along with prevention of chronic diseases development and progression are important problems in the healthcare of medical workers [5].

The aim of this study is to assess the prevalence of risk factors and multimorbidity in healthcare workers of a general city clinical hospital (CCH).

Materials and methods

The open-label, simultaneous, comparative non-randomized study included 208 healthcare workers of a general CCH (61 men and 147 women) who were enrolled from January 2019 — June 2019. Of these, 82 (39.2 %) had completed higher education (physicians) and 126 (60.8 %) — secondary specialized education (nursing staff).

The control group included 127 non-medical professionals (61 men and 147 women) who underwent annual check-up in the outpatient department of CCH № 13 in 2019. Of these, 65 (51.2 %) had completed higher education and 62 (48.8 %) — secondary specialized education.

We performed physical examinations, assessed patient histories, risk factors and associated pathologies in both groups.

We considered patients as: having hypertension if blood pressure exceeded 140/90 mmHg [6]; being regular smokers if they smoked at least 1 cigarette per day or quit smoking less than a year ago; having unhealthy diet if they consumed less than 300 grams of fruits and vegetables or added extra salt after cooking [7]; having low physical activity if they exercised less than 150 minutes per week or for 75 minutes per week (15 minutes for 5 days per week) [8]. We used the Quetelet formula to calculate the body mass index (BMI (kg/m^2) = weight (kg)/ height (m) 2). Those with BMI<25 kg/m^2 were considered to be in the healthy weight range, with BMI ⩾30 kg/m2 were considered to be obese, and with BMI between 25 kg/m^2 and 30 kg/m^2 were considered to be over- weight [9].

We confirmed the diagnosis of coronary artery disease (CAD) in patients with typical clinical manifestations, history of previous myocardial infarction (MI), or positive functional tests results [10].

We confirmed the diagnosis of diabetes mellitus based on specific clinical findings and history, laboratory tests results, and endocrinologist reports according to the current guidelines [11]. We considered patients as having multimorbidity if they had at least two of the following: arterial hypertension, diabetes, CAD, asthma or cancer.

Written informed consent was obtained from all participants prior to being enrolled. Study protocol was approved by Pirogov Russian National Research Medical University Ethical Committee (protocol № 178, 22nd of October 2018).

Statistical analysis was completed using the StatPlus: mac version 6 (AnalystSoft Inc, USA),), SPSS Statistics version 20.0 (IBM, USA) statistics software. The results are presented as a mean and standard deviation. We used Mann-Whitney U test to compare quantitative variables and for the comparison of qualitative variables we used Pearson's chi-squared test (χ^2) with Yates correction and Fisher's exact test. The associations between variables were evaluated with Pearson's correlation coefficient (r)

when the compared samples were normally distributed; Spearman's correlation coefficient was used for comparison of small or non-normally distributed samples. To rate the effect of a risk factor we used logistic regression analysis with odds ratio (OR) and 95 % confidence interval (CI). A two-tailed p-value less than 0.05 was considered statistically significant.

Results

Among the healthcare workers aged 20–85 years (45.9±16.3), 61 were men aged 22–85 years (39.7±17.6) and 147 were women aged 20–85 years (48.4±15.1), p<0.001. Of those, physicians were at the age of 26–70 years (36.7±12.3) and nursing staff at the age of 20–85 years (51.8±15.9), p<0.001.

Among the healthcare workers who had completed higher education 38 (46.3 %) were men aged 22–63 years (36.3±7.1) and 44 were women (53.7 %) aged 26–70 years (44±10.9), p=0.435. Among healthcare workers who had completed secondary specialized education 23 (18.2 %) were men aged 20–85 years (59.1±11.6) and 103 (81.8 %) were women aged 22–85 years (50.1± 12.7), p<0.001.

Our study involved 47 (22.6 %) healthcare workers from the internal medicine department (26 (55.3 %) physicians and 21 (44.7 %) nurses); 48 (23 %) from the department of surgery (13 (27 %) physicians and 35 (73 %) nurses); 7 (3.3 %) from the department of gynecology (2 (28.5 %) physicians and 5 (71.5 %) nurses; 15 (7.3 %) from the intensive care unit (8 (53.3 %) physicians, 7 (46.7 %) nurses); 29 (13.9 %) form the functional diagnostics department (11 (37.9 %) physicians, 18 (62.1 %) nurses); 28 (13.5 %) for the department of traumatology (10 (35.7 %) physicians and 18 (64.3 %) nurses); 10 (4.9 %) form the department of neurology (3 (30 %) physicians and 7 (70 %) nurses); 24 (11.5 %) from the department of cardiology (9 (37.5 %) physicians and 15 (62.5 %) nurses).

Among the healthcare workers, 78 (37.5 %) worked 24-hour shifts, and 130 (62.5 %) worked only day shifts. Healthcare workers had 2–18 (9.4±4.9) years of seniority: men had 8.3±5.2 years and women had 9.8±4.7, p=0.040.

Age, gender, hemodynamic parameters and BMI were similar in healthcare workers and in the control group participants (Table 1).

Risk factors in healthcare professionals and non-medical professionals are shown in Figure 1.

The prevalence of arterial hypertension was higher in the control group compared with the healthcare

Table 1. **Characteristics of the healthcare workers group and the control group**

Variable	Healthcare workers n=208	Controls n=127	p
Age, years**	45.9**±16.3**	49.2 **±12.9**	0.050
Male sex, n (%)*	61 (29.3)	34 (26.8)	0.706
Family, n (%)*	89 (42.7)	64 (50.4)	0.176
Smoking cessation, n (%)*	29 (13.9)	28 (22)	0.078
Registered with a clinic, n (%)*	39 (18.7 %)	59 (46.4)	<0.001
Regular doctor visits, n (%)*	150 (72.1)	45 (35.4)	<0.001
SBP, mm Hg**	122.7±12.1	121.7±11.4	0.457
DBP, mm Hg **	77.9±8.7	77.8±8.6	0.932
HR, beats per minute**	72.9±5.8	73.2±10.0	0.763
BMI, kg/m²**	26.8±4.9	27.2±2.4	0.462
Excess weight, n (%)*	80 (38.5)	99 (77.8)	<0.001
Obesity, n (%)*	49 (23.6)	10 (7.9)	<0.001
Arterial hypertension, n (%)*	16 (7.7)	19 (14.9)	0.055
Family history of CVD, n (%)*	84 (40.4)	58 (45.7)	0.404

Comment: Here and elsewhere: SBP — systolic blood pressure, DBP — diastolic blood pressure; HR — heart rate; CVD — cardiovascular diseases. Data are: *-absolute number of patients, ** — M±SD; p — statistically significant difference between the two groups.

professionals group, although we have identified no statistically significant difference between the two groups (p=0.055). In the healthcare professionals group 105 (50.4 %) had never smoked compared with 70 (55.2 %) in the control group, p=0.477. Among healthcare professionals 98 (47.1 % Table) consumed more than 200 ml of wine once a week compared with 70 (55.1 %) in the control group.

Obesity was more prevalent in the healthcare professionals group (23.6 %) compared with the control group (7.9 %). At the same time, more participants from the control group were excess weight compared with healthcare professionals.

Both groups had unhealthy diet: 92 (44.2 %) healthcare workers consumed less than 300 grams of fruits and vegetables compared with 59 (46.4 %) in the control group; 68 (32.7 %) healthcare workers added extra salt after cooking compared with 47 (37 %) in the control group. Healthcare professionals exercised less compared to the control group.

The prevalence of multimorbidity was similar in healthcare professionals and in the control group (Figure 2). Among healthcare professionals 44 (74.6 %) physicians and 15 (25.4 %) nurses had non-communicable chronic diseases, p<0.001; 20 (33.9 %) men and 39 (66.1 %) women. In the control group 8 (20.5 %) men and 31 (79.5 %) women had multimorbidity (Figure 3).

Characteristics of healthcare workers are shown in Table 2.
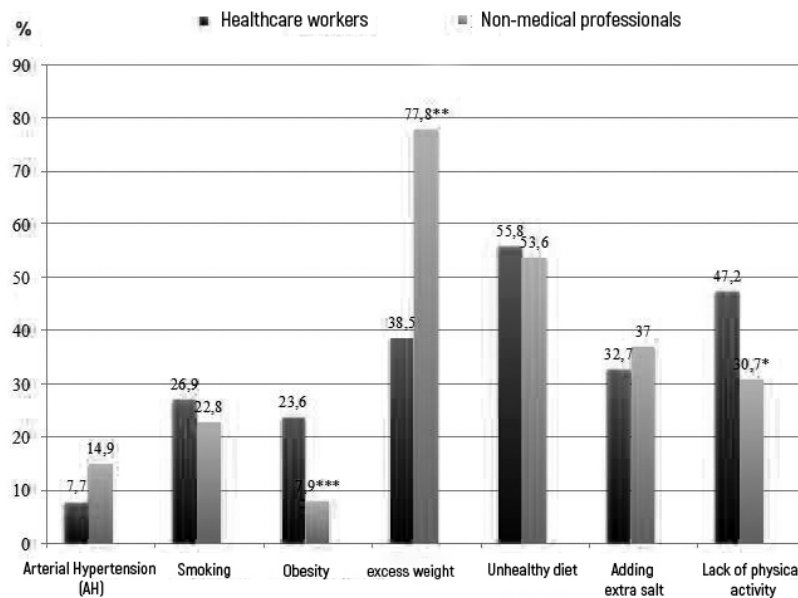
Figure 1. Risk factors in healthcare workers and non-medical professionals; *p* — statistically significant difference between the two groups:
* -p=0.005, ** -p=0.001; ***-p=0.002.
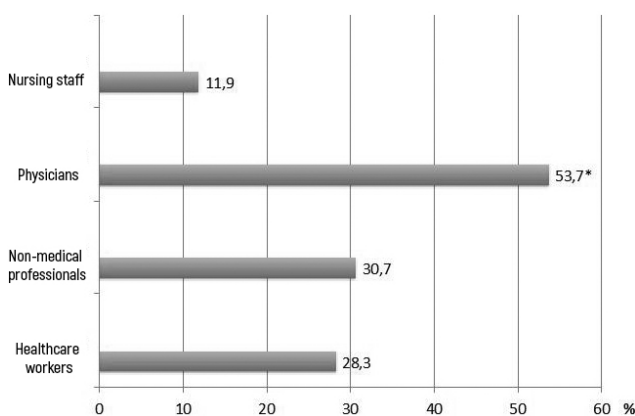
Figure 2. Multimorbidity in healthcare workers (physicians and nursing staff) and non-medical professionals: *-p=0.009 (statistically significant differences between the two groups).
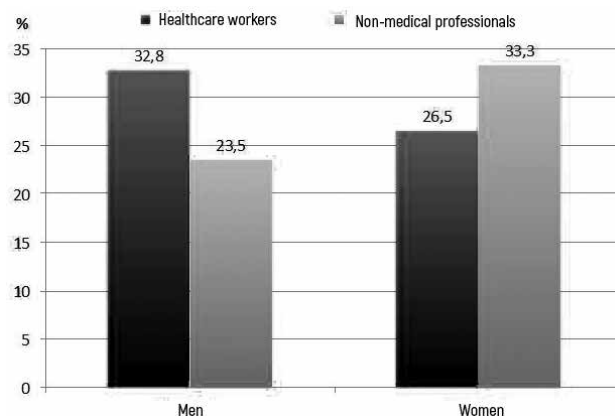
Figure 3. Prevalence of at least two chronic diseases in healthcare workers and non-medical professionals depending on gender.

Older healthcare workers and those who had lower seniority tended to have more comorbid diseases. Hemodynamic parameters and BMI were comparable in both groups of healthcare professionals. We present the characteristics of healthcare workers and non-medical professionals in Table 3.

Age, BMI, blood pressure level and heart rate were similar in healthcare workers and non-medical professionals.

We found positive correlation between the age (p<0.001, r=0.25), work in the internal medicine department (p<0.001, r=0.35), and family history of premature cardiovascular disease (CVD) (p<0.001, r=0.24) of healthcare workers and multimorbidity. We also found negative correlation between active living and multimorbidity (p<0.026, r=-0.15).

Table 2. **Characteristics of healthcare workers with and without multimorbidity**

Value	Multimorbidity		
	Yes (n=59)	No (n=149)	P
Age, years	52.2±**17.5**	43.1±**14.9**	<0.001
Seniority, years	7.1±3.9	10.3±**4.9**	<0.001
BMI, kg/m²	27.4±3.95	26.6±**5.3**	0.298
SBP, mm Hg	124.9±11.8	121.8±12.1	0.091
DBP, mm Hg.	79.3±8.1	77.36±8.9	0.143
HR, beats per minute	72.3±6.8	73.2±**5.4**	0.334

**Comment:** Data are M±*SD; p* — statistically significant difference between the two groups.

Multimorbidity was associated with age (OR 1.05; 95 CI 1.02–1.08; p=0.002), work in the internal medicine department (OR 11.8; 95 % CI 3.1–45.0, p<0.001), family history of premature CVD (OR 3.54; 95 % CI 1.55–8.2; p=0.003).

Table 3. **Characteristics of healthcare workers and non-medical professionals with multimorbidity**

Value	Healthcare workers (n=59)	Non-medical professionals (n=39)	p
Age, years	52.9±17.5	50.1±11.31	0.380
MBI, kg/m²	27.4±3.9	27.1±2.2	0.614
SBP, mm Hg	124.9±11.8	123.3±11.4	0.510
DBP, mm Hg	79.3±8.1	78.8±8.2	0.766
HR, beats per minute	72.3±6.8	73.3±10.22	0.560

Comment: Data are M±*SD; p* — statistically significant difference between the two groups.

The cut-off for point increased risk of multimorbidity in the healthcare workers was age 48.5 (sensitivity 66 %, specificity 66 %). Area under the curve was 0.662±0.045, p=0.001, 95 % CI 0.57–0.75 (Figure 4).
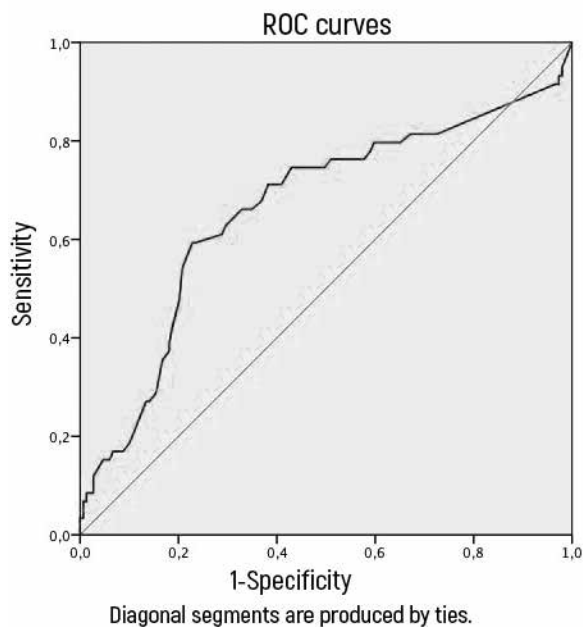
Figure 4. ROC-curve to identify the cut-off for increased risk of multimorbidity in healthcare workers

Discussion

World population ageing and rising life expectancy are accompanied by the increasing number of people who have risk factors such as high blood pressure (19 % of all mortality), excess weight or/and obesity and chronic diseases that undoubtfully affect the development of chronic non-communicable disease complications [12].

The total risk model considers many risk factors that affect the development of one or several diseases and can be effectively used to predict disease progression. Therefore, apart from etiological factors, there are general risk factors that affect the development of multimorbidity.

High workload and responsibility affect emotional and physical health of medical workers, decrease their quality of life, cause diseases and disability. It, therefore, puts healthcare workers in the 'unprotected' segments of the population.

The majority of people involved in healthcare in 2005 were aged 40–44 years and 50–54 years in 2016 [13]. These findings show that the mean age of healthcare workers increases. Therefore, they require special attention in order to stay healthy.

Our study involved 208 healthcare workers (mean age 25.9 years). Of those, 60.8 % were nursing staff. Seniority was 2–18 years (9.4±4.9), 42.7 % had families, 37.5 % worked 24-hour shifts, 62.5 % worked only day shifts. The workers of the internal medicine department and the department of surgery comprised the majority of the sample (22.6 % and 23 % respectively).

High prevalence and low detection of risk factor are still relevant today. Detection of high-risk groups and primary advising of the importance of reducing risk factors are the most important goals of primary health care. It should be applied on the physicians working with healthcare professionals with special attention [14].

Unhealthy diet was the most prevalent risk factor in the healthcare workers (55.8 %). Lack of physical activity was second most prevalent risk factor in this group (47.2 %), followed by excess weight (38.5 %). In general, excess weight was more prevalent in the control group (77.8 %), p < 0.001.

We also frequently detected the following risk factors in healthcare workers: adding extra salt after cooking (32.7 %), smoking (26.9 %), obesity (23.6 %), arterial hypertension (7.7 %).

Among non-medical professionals excess weight (77.8 %) was the most prevalent risk factor, followed by unhealthy diet (53.6 %) and low physical activity (31.7 %).

We would like to emphasize the importance of behavioral risk factors that people voluntarily let to appear in their lives. Some risk factors are closely related with childhood eating habits that to a large extent determine physical health. Unhealthy eating is associated with over 2 million death cases that are caused by CVD. Lack of fresh fruits in diet (12.5 %) and high sodium concentration in food products (12.0 %) compromise the majority of lethal cases [15]. Excessive salt intake is a significant behavioral risk factor that is widespread in Russia (49.9 %) and is associated with economical loss [16]. Findings of 'Epidemiology of cardiovascular disease in Russian regions' study

show that half of Russia's population aged 25–64 years consume excessive amounts of salt (more men than women) [17].

Both physicians (48.8 %) and nursing staff (60.3 %) had an unhealthy diet (p=0.136). The majority of non-medical professionals (53.6 %) had lack of fresh fruits and vegetables in their diets, although no difference between non-medical and healthcare professionals was identified (p = 0.692).

Both non-medical professionals and healthcare professionals added extra salt after cooking (37 % and 32.7 % respectively). Physicians were more likely to add extra salt (39.7 %) compared with nursing staff (32.5 %). This is consistent with the fact that 67.6 % of physicians have an unhealthy diet and consume less than 400 grams of fresh fruits and vegetables [18], and 68.3 % of healthcare workers of CCH add extra salt after cooking [19].

Kobyakova et al. [20] identified lack of physical activity (less than 30 minutes of walking per day) in 45.7 % of physicians (mean age 42.02 years). Tkachenko et al. [19] also identified high prevalence of low physical activity in 74.7 % of healthcare workers of CCH (one out of five was a physician and one out of four was a nurse, mean age 51.6 years).

Our findings are fully consistent with the modern experts' position that complex measures, such as life and work habits modification and formation of positive environment offering support for those trying to live healthy are necessary [21].

Excess weight and obesity are additional problems associated with high risk of cardiovascular disease [7]. 'Epidemiology of cardiovascular disease in Russian regions' study showed that the general prevalence of obesity was 29.7±0.3 %, 30.8±0.4 % in women and 26.6±0.5 % in men (p<0.001).

Kobyakova et al. [20] identified that 34.7 % of Tomsk Oblast physicians aged 42.0±11.3 years were excess weight. Tkachenko et al. [19] also identified high prevalence of obesity (42.5 %) and unhealthy diet (37.1 %) in healthcare workers of CCH aged 51.6 (90.6 % were women).

According to our findings, obesity was less prevalent in physicians (14.6 %) compared with nursing staff (29.3 %), p=0.023. It is consistent with the 'Epidemiology of cardiovascular disease in Russian regions' study findings that education status influences eating habits in adult population. Russian population who had completed higher education tend to have healthier eating habits. Compared with those who had completed secondary specialized education

they consume more fresh fruits and vegetables, less salt and animal fat, irrespectively of gender [22]. Most European studies also show that more educated people eat more fruits and vegetables [23].

Smoking is one of the most widespread and significant behavioral risk factors of CVD and their complications. It is crucial to reduce this risk factor in order to reduce mortality rate and improve prognosis of people with and without CVD [24].

According to the 'Epidemiology of cardiovascular disease in Russian regions' study the prevalence of smoking was 25.7±0.3 %. in adults aged 25–64 years. The prevalence of smoking was similar in men (24.6 %) and women (27.9 %). Kobyakova et al. [20] identified that 15.1 % of physicians smoked (mean age 42.02 years). In our study the prevalence of smoking was similar in healthcare workers (26.9 %) and in non-medical professionals (22.8 %), p=0.481. In healthcare workers smoking was less prevalent in physicians (19.5 %) compared with nursing staff (31.7 %), p=0.075. There was no difference in the number of people who had never smoked in healthcare workers compared with non-medical professionals. However, in healthcare workers there were more physicians (68.3 %) who had never smoked compared with nursing staff (38.9 %), p<0.001.

Many studies confirm that behavioral risk factors such as smoking are incredibly widespread [19]. The prevalence of smoking in physicians over 40 years (50.5±11.7) was 14 %, 39 % in men and 6.7 % in women [25]. Zadionchenko et al. showed that 37 % of physicians are regular smokers and 10 % smoke only occasionally [26]. These results indicate that it is important to change the attitude towards smoking in healthcare professionals. Being smokers themselves the majority of physicians are not able to fully support their patients in achieving healthier lifestyle.

It is not possible to fully compare our findings with the findings of other studies on risk factors in healthcare workers. Investigators compare groups with different characteristics, such as inclusion criteria, gender, age or type of medical institution. It is clear, though, that main risk factors are highly prevalent in healthcare workers. Low physical activity, unhealthy diet and obesity are the leading risk factors that contribute to multimorbidity development. We hope that in the future individual characteristics of patients will be considered together with risk factors in order to improve diagnosis and treatment of a multimorbid patient [7].

Multimorbidity risk factors are divided into non-modifiable (age, gender, race) and modifiable. Modifiable risk factors such as arterial hypertension,

obesity, lack of physical activity, smoking) are strongly associated with cardiovascular diseases. These findings show that multimorbidity may be prevalent not only in older patients but also in the younger ones.

Findings of Cardiovascular Disease Registry that involved 3690 out-patients with arterial hypertension, coronary artery disease, and atrial fibrillation show that 77.5% of patients aged 66.1±12.9 had several CVD [27].

There are sparse data on multimorbidity prevalence in healthcare workers. Navrotsky et al. [28] identified that 66.1% of healthcare workers have at least two CVD. According to a survey carried out by Zadionchenko et al. [26], 68% of healthcare workers had arterial hypertension (30.5%), CAD (17.6%), and diabetes mellitus (2.6%). According to Nikolaeva et al. [29], CVD were highly prevalent in physicians (53.5%) and nursing staff (46.7%).

According to our findings one out of three healthcare workers and non-medical professionals had chronic non-communicable diseases. The prevalence of multimorbidity was higher in in physicians compared with nursing staff (p=0.009), although the mean age of physicians was lower (p<0.001). Multimorbidity was more prevalent in the older healthcare workers (54<5 years) compared with those of younger age (40.9 years), p<0.001 (9% men, 91% women; 56% physicians, 44% nursing staff). Therefore, our findings show that the prevalence of multimorbidity increases with age (OR 1.05; p=0.002). Multimorbidity burden requires special attention to physical health of healthcare workers.

Today it is well confirmed that prevalence of diseases increases with age: in people aged 20–29 years the prevalence is 136.2 per 100 full-time workers; in people aged 40–49 years — 176.3 per 100 full-time workers. Hospital managers and physicians tend to have more illnesses (190.2 and 167.7 per 100 full-time workers respectively) [30]. We obtained similar results in our study.

Our study showed that working in healthcare is a health risk by itself as medical workers suffer from significant workload and emotional stress. Among healthcare workers, multimorbidity was associated with age, work in the internal medicine department (OR 11.8; p<0.001) and family history (OR 3.54; p=0.003). The cut-off for increased risk of multimorbidity in the healthcare workers was age 48.5.

Behavioral risk factors are the most prevalent risk factors in healthcare workers. Multimorbidity was more prevalent in physicians (74.6%) and women (66.1%). Multimorbidity was associated with age, work in the internal medicine department and family history.

Conclusion

The obtained results show that it is important to detect co-existent diseases and behavioral risk factors (unhealthy diet, lack of physical activity, and excess weight) early during the routine examinations of medical workers as it can reduce the likelihood of multimorbidity. It is also important to ask the patients about their jobs during routine examinations in order to identify high-risk groups.

We have concluded that:

1. The most common risk factors for chronic non-communicable diseases in healthcare workers were unhealthy diet (55.8%), lack of physical activity (47.2%), excess weight (38.5%);

2. Obesity (23.6%), lack of physical activity (47.2%), and low medical knowledge (52.4%) were more prevalent in healthcare workers compared with non-medical professionals; obesity and lack of physical activity were more prevalent in nursing staff compared with physicians.

3. Multimorbidity was prevalent in 28.3% of healthcare workers aged 45.9 years (74.6% in physicians and 66.1% in women). Multimorbidity was associated with older age (over 48.5 years) and family history

4. High-risk groups with priority in chronic non-communicable diseases prophylaxis are: healthcare workers (especially nursing staff) in CCH with obesity and lack of physical activity.

Conflict of interests: None declared.

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