REVIEW

The burden of cardiovascular disease risk factors: A current problem

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ABSTRACT

The pandemic of COVID-19, which in Poland raised all-cause and cardiovascular disease (CVD) death rates by over 15% only in 2020, naturally decreased the attention to the prevention of CVD. Nevertheless, the reports on the characteristics of COVID-19 patients and especially on factors related to the severe or fatal outcome of the disease included information on more frequent CVD risk factors and atherosclerotic CVD. This article reviews the evidence on the exposure to CVD risk factors in the Polish adult population and discusses evidence on the associations between CVD risk factors and COVID-19. CVD and CVD risk factors, obesity and diabetes, in particular, are related to the severe course or fatal outcome of COVID-19. High prevalence of CVD risk factors with an increasing prevalence of obesity and diabetes could make the Polish population more sensitive to COVID-19 incidence and put infected persons at higher risk of serious complications and fatal outcome. Likely, the increased number of CVD deaths observed during the pandemic could be explained partially by the high prevalence of CVD risk factors and atherosclerotic CVD, as well as by the direct cardiac complications of COVID-19, short-term higher risk of myocardial infarction (MI) and stroke, and possibly by the underuse of lifesaving procedures in acute and chronic CVD.

Key words: risk factors, prevalence, awareness, effectiveness of treatment, cardiovascular disease

INTRODUCTION

In Poland, mortality from diseases of the circulatory system has been decreasing since 1991. After a large decline in the 1990s, the trend slowed down, and from 1999 to 2018, standardized death rates were decreasing by an average of 2.8% per year in men and 3.0% per year in women. A decreasing trend in mortality from heart diseases (but not cerebrovascular diseases) was even more conspicuous in the age group 25–64 years after 2014 for women and 2015 for men. Despite these favorable declining trends, the standardized rates of deaths due to diseases of the circulatory system are higher than the European average by about 40%, both for men and women [1]. According to the estimates of Bandosz et al., based on the IMPACT coronary heart disease (CHD) mortality model, about 54% of the reduction in the number of CHD deaths could be attributed to favorable changes in risk factors and about 37% to the advance in treatment methods. However, at that time, only 9% could be attributed to initial treatments for acute myocardial infarction [MI] or unstable angina, and the impact of invasive cardiology on mortality was small (barely 4%) [2, 3]. The year 2020 reversed the favorable trend of declining mortality due to cardiovascular disease, with the excess of about 62 thousand all-cause deaths that could not be explained by the demographic conversion of the population. Only 43% of these deaths were reported as caused by SARS-CoV-2 infections, and 27%, occurred in infected persons, but other underlying causes of death were

Table 1. Cross-sectional studies which aimed to assess the prevalence of cardiovascular disease (CVD) risk factors carried out in Poland after the year 2000

Study name/ acronym	Sample description	Age of participants, years	Sample size	Years of examination	References
POLSCREEN	Primary care patients	≥35	724 068	2002–2005	14–18
NATPOL PLUS	National sample	18–93	3052	2002	19–21
WOBASZ	National sample	20–74	13 545	2003–2005	22–29
WOBASZ SENIOR	National sample	≥75	1096	2006	30, 31
PolSenior	National sample	≥65	5695	2008–2009	35–37
NATPOL 2011	National sample	18–79	2413	2011	32–34
WOBASZ II	National sample	≥20	6169	2013–2014	22, 23, 26, 28, 29, 38
Lipidogram 2015	Primary care patients	≥18	13 724	2015	39

Abbreviations: NATPOL (*Nadciśnienie Tętnicze oraz Inne Czynniki Ryzyka Chorób Serca i Naczyń w Polsce*), Arterial Hypertension and Other CVD Risk Factors in Poland; WOBASZ (*Wieloośrodkowe Ogólnopolskie Badanie Stanu Zdrowia Ludności*), Multicenter National Population Health Examination Survey

reported for them. The remaining 29% were not reported as related to COVID-19. Overall, the largest increase of 17% was recorded for the diseases of the circulatory system [4].

There are observations that the COVID19 pandemic caused a significant reduction in the number of patients treated for atherosclerotic cardiovascular disease (CVD). Compared to pre-pandemic time, the number of hospitalizations for MI decreased by over 40%, and the number of coronary angiographies and percutaneous coronary interventions decreased by 30%. This coincided with about a 10% decrease in the number of State Emergency Medical Services calls due to chest pain [5–7]. Further, the lockdown in the early phase of COVID-19 and the adaptation of hospital wards to COVID-19 care could have caused a significant decrease in the number of hospital admissions of patients with other manifestations of CVD, as it was observed for atrial flutter and atrial fibrillation [8]. However, the supportive evidence is not strong enough to conclude that the increase of fatality due to the underuse of diagnostic and treatment procedures, in particular in the acute state, would explain fully the unprecedented rise in the number of CVD deaths during the COVID-19 pandemic. It is worth considering the other possible explanations.

In August 2021, an update of the European recommendations on cardiovascular disease prevention in clinical practice was published. This valuable document is the 7th version in the series which started in 1994 and aims to summarize the evidence to help health professionals in making decisions on the management strategies for individual patients [9]. The publication and promotion of the document turned the attention back to the impact of CVD risk factors on the health of the general population and the implications for public health, which might have seemed less important in the time of the COVID-19 pandemic.

In this article, we aimed to review the exposure to CVD risk factors in the Polish population and to discuss the evidence which indicates that preventive methods which aim to reduce risk factors are even more important in the times of COVID-19.

EXPOSURE TO MAIN RISK FACTORS

Although population studies on CVD risk factors have a long history in Poland including the POL-MONICA [10, 11] and NATPOL [12, 13] surveys, more intensive investigations were carried out within the last two decades. Since 2000, six cross-sectional studies that aimed to examine independent national samples and two large studies that involved patients of primary care have been carried out (Table 1).

Hypertension

The studies, which aimed at nationally representative samples and involved participants of a broad range of ages, reported that the prevalence of hypertension is between 29% and 46% in men and between 29% and 43% in women. In the WOBASZ studies, the prevalence of hypertension varied by the geographical site of the sample (voivodship). However, the WOBASZ studies failed to examine the samples fully representative of voivodships. In younger age groups, hypertension was more frequent in men. Greater prevalence (70%–72% in men and 58%–70% in women) was found in the studies carried out among patients of primary care. The studies which involved persons at old age also reported a larger prevalence, 72%-75%, in men and 79%–87% in women. Findings of both the NATPOL and WOBASZ studies indicated that there was an increase in the percent of participants with hypertension within the decade before the last observation. Despite some improvement in hypertension control over time, 28% of persons in the NATPOL 2011 study and 41% in the WOBASZ 2 study remained unaware of having high blood pressure. Both the NATPOL and WOBASZ studies indicated that among patients with hypertension, there was an increase in the proportion of those who received treatment and achieved the treatment target of blood pressure (BP) < 140/90 mm Hg. The proportion reached 23% in the NATPOL 2011 study and in the WOBASZ II study. Nevertheless, in the WOBASZ II study about half of the persons taking blood pressure-lowering treatment had blood pressure above the general primary treatment target. [14, 19, 22, 23, 30, 32, 35, 39].

Detailed information on the prevalence and awareness of hypertension and effectiveness of treatment is given in Supplementary material, *Table S1*.

Hypercholesterolemia

Despite some differences in the age of studied groups, the differences in the prevalence of hypercholesterolemia are not large and indicate that, in Poland, about two-thirds of the general adult population have hypercholesterolemia. Hypercholesterolemia is slightly more prevalent in men than in women. There are some differences by age group indicating that at a young age and over 65 years, hypercholesterolemia is less frequent than in the middle age. This was reflected in the results of the WOBASZ SENIOR study that involved a sample of patients aged over 75 years and found that 43% of men and 62% of women had hypercholesterolemia. There was some variation in the samples studied by geographical setting. The overtime change in the prevalence of hypercholesterolemia was evaluated in the WOBASZ studies, and no significant change was found, but about a 26% increase in the prevalence of hypertriglyceridemia in men and an almost a twofold increase in the prevalence of low concentration of high-density lipoprotein cholesterol (HDL-C; for both sexes) was observed [38]. The latter changes affected the prevalence of all dyslipidemias which reached 81% in men and 74% in women at the age of 20 years and over. A slightly higher prevalence (89% in men and 82% in women) was found in primary care patients, in the LIPIDOGRAM 2015 study. In the general population, about 3% of hypercholesterolemia was severe (total cholesterol [TC] >8 mmol/l or low-density lipoprotein cholesterol [LDL-C] >6 mmol/l), but in the combined analysis of large Polish population-based samples, the definite phenotype diagnosis of familial hypercholesterolemia (Dutch Lipid Clinic Network [DLCN] score ≥8 points) was found approximately in 1 person per 1400 people (0.07%). More prevalent (404/100 000 population) was the diagnosis of potential familial hypercholesterolemia (DLCN score ≥ 6 points, i.e. definite and probable familial hypercholesterolemia combined) [40].

Despite some improvement in comparison with earlier observations, findings of the WOBASZ 2 study confirmed that only a small proportion of hypercholesterolemia was controlled. Treatment targets, as indicated for the appropriate category of CVD risk, were achieved by 6% of men and women. The larger percentage (11%) found in the NATOPL 2011 study could be explained by the acceptance of the ultimate treatment target which refers to low-risk persons. In the WOBASZ 2 study, over 60% of persons with hypercholesterolemia were not aware of it, and 17% were aware but not treated. The next 15% were treated but did not reach the treatment target. Slight over time improvement in the effectiveness of treatment appeared to coincide with changes in the types of treatment. There was an increase in the proportion receiving intensive or moderate statin therapy, which was most marked in those at very high CVD risk, but still, fewer than 20% were taking intensive statin therapy. Proportions of persons at low-dose statin therapy and of persons on diet only decreased. On the other hand, it is worth noticing that over 10% of persons with hypercholesterolemia achieved the treatment goals not by using hypolipemic drugs but by being on diet only [15, 24, 30, 32, 33, 38, 39]. Detailed information on the prevalence and awareness of hypercholesterolemia and the effectiveness of treatment is given in Supplementary material, *Table S2*.

Smoking

The studies, which targeted nationally representative samples and involved participants of a broad range of ages, have shown that about one-third of men and over 20% of women are current smokers. Smoking rates in primary-care patients were lower than in the general population. Like other risk factors, in the WOBASZ studies, smoking rates varied by the site of the sample. In older age groups, smoking rates were lower. In the WOBASZ SENIOR study, which involved persons aged above 74 years, 11% of men and 4% of women were current smokers. Besides the decrease in smoking rates, the optimistic message from the WOBASZ studies was that the proportion of men who never smoked increased from 30% to 36%. However, the increase from 57% to 59% in women was not statistically significant [16, 20, 25, 26, 30, 32, 39]. Detailed information on the prevalence of smoking is given in Supplementary material, *Table S3*.

Obesity

The proportion of the adult population that is not overweight or obese is declining. In the WOBASZ studies, in the age group of 20–74 years, from 2003/4 to 2013/14, the decline was from 40% to 33% in men and from 49% to 47% in women. In the studies which targeted the national sample, about one-fourth of adults were obese. The percentage of those with obesity increases with age and the increase is greater in women. This was reflected in the results of the studies WOBASZ SENIOR and PolSenior, in which older age groups were studied and in which a larger proportion (by at least 10%) of obese individuals was found in women than in men. The LIPIDOGRAM study, in which patients of primary care were studied, reported a greater prevalence of obesity in men (by 5%). In other studies, differences between sexes were smaller than 5%. The proportion of overweight people was larger in men by about 10% almost in all studies. However, the prevalence of people with obesity with body mass index [BMI] ≥35 kg/m^2 was higher in women than in men — 7% vs. 5.5%, respectively. Like other risk factors, the prevalence of overweight and obesity varied by the site of the studied sample [16, 20, 25, 26, 30, 32, 39]. Detailed information on the prevalence of overweight and obesity is given in Supplementary material, *Table S4*.

Diabetes

Prevalence of diabetes differed slightly between the NATPOL 2011 and WOBASZ 2 studies — 7% and 9% respectively in men, and 6 and 8% respectively in women. In WOBASZ 2, about one-third of all cases of diabetes had been unrecognized before the date of examination. The prevalence of diabetes increases with age. The effect of age was reflected in the results of the studies such as WOBASZ SENIOR and PolSenior, in which about 18 % of participants had diabetes. The prevalence of diabetes was also higher in primary-care patients and reached a value of about 15% even though in the POLSCREEN study the diagnosis of diabetes was based on the interview only. The WOBASZ studies confirmed the increase over time in the prevalence of diabetes and showed that the prevalence of high fasting glucose doubled from 9% to 18 % [18, 29, 31, 34, 37, 39]. Detailed information on the prevalence of diabetes is given in Supplementary material, *Table S5*.

Lifestyle

The observations from the WOBASZ studies indicate a large decline in the physical activity of the Polish population. While the percent of men who were inactive at work was stable (about 35%), the percentage of women inactive at work increased from 43% up to nearly 50%. There was a strong decline in commuting and leisure-time physical activity. Inactivity in commuting reached almost 80% in men and over 70% in women. The percentage of persons inactive or only occasionally active at leisure time reached 57% in women and 55% in men. Fewer than 30% of men and women are active at leisure time most days of a week [41].

The dietary habits in the adult Polish population are far from the recommendations for CVD prevention. Although about 55% of persons believe that their diet is appropriate, a healthy diet was found only in 15% of the studied population, and in about 60 %, their diet could be classified as being of poor quality. The recommended intake of all fats and saturated fatty acids was reported by fewer than 20% of men and fewer than 30% of women. A low-fat and low-cholesterol diet was reported by only 8% of participants and a low-calorie diet by 1%. The recommended intake of fats, saturated and polyunsaturated fatty acids was found in 18%–37% of the respondents. Adding salt to already served dishes was reported by 27% of men and by 18% of women, and 56% men and 30% women used to consume meat products with visible fat. A desired level of folate intake was found only in 13%–26% of the respondents [42].

At the national level, little is known about the role of dietary habits in Poland. However, in one large Polish population-based study (Polish component of The HAPIEE Study), the traditional Eastern European diet was found to increase the risk of CVD death, and the Mediterranean diet had a protective effect. High adherence to traditional diet patterns was found in 30% of Polish respondents and adherence to the Mediterranean pattern in 30% [43, 44].

In the overall assessment based on the lifestyle index, only about 2% of the population followed a healthy lifestyle, and in the case of 25%, their lifestyle was classified as poor. Low education was the strongest sociodemographic factor contributing to a poor lifestyle [45].

The COVID-19 pandemic, combined with lockdowns and further limitations in interpersonal contacts, has further contributed to a non-healthy lifestyle. Over one-third of the adult population declared decreased physical activity, over 40% declared eating more food and 50% snacking more. Moreover, worsening dietary habits affected mostly already overweight and obese people, and losing physical activity affected the oldest group [1, 46]. Because of these unfavorable changes, about 30% of the Polish population declared weight gain [1].

Secondary prevention

In Poland, there is no information on CVD risk factors control in secondary prevention collected at the national level. However, some information could be drawn from the findings of the multicenter POLASPIRE survey, which was carried out in connection with the EUROASPIRE V survey. The study included observations of CHD patients, 6–18 months after hospitalization for acute coronary syndrome or myocardial revascularization procedure [47, 48]. Nearly 85% of them declared that they remained under the control of a cardiologist and 97% were using at least one antiplatelet drug or anticoagulant, 89% a β-blocker, 86% an angiotensin-converting enzyme inhibitor or a sartan, and 90% at least one lipid-lowering drug [47]. However, the good utilization of cardioprotective medication did not correspond with sufficient control of CVD risk factors. Over 40% of patients had BP ≥140/90 mm Hg and 62% had LDL-C >1,8 mmol/l [47]. The subsequent analyses showed that health-system-related factors are associated with the utilization of lipid-lowering drugs, whereas patient-related factors are mainly related to the control of hypercholesterolemia [49].

Over half of patients who smoked before the hospitalization continued smoking at 6 to 18 months after discharge [47, 50]. The use of treatments that facilitate smoking cessation was marginal, and the average smoking rate was 17% [47].

Observations on the prevalence of hypercholesterolemia, hypertension, and smoking in CHD patients collected within the two decades before POLASPIRE suggest that there has been only a small improvement since 1997 [51–53]. Only one out of seven Polish patients after acute coronary syndrome or a myocardial revascularization procedure has regular physical activity (30 min on average, at least five times a week) as recommended [9, 47]. Results of the surveys carried out every 4–5 years starting in 1997 have shown a gradual increase in mean BMI, as well as in the proportion of patients with obesity and central obesity. In POLASPIRE participants, only 15% had BMI <25 kg/m^2 and 42% were obese [54]. The high and rising prevalence of obesity explains at least partially

why about half of CHD patients have diabetes, out of whom 31% were treated with antidiabetic agents, and the remaining 22% had fasting glucose concentration ≥7,0 mmol/l [47, 55].

Overall, only 2.3% of CHD patients had all 5 main risk factors controlled, 17.9% had one, and further 40.9% had two out of five risk factors controlled [47].

One of the important explanations for poor control of risk factors is that a cardiac rehabilitation program was offered to only one-third of CHD patients. The proportion of patients offered places in the rehabilitation programs remained on the same level between 1997 and 2017 [56, 57]. The new system of managed care for acute myocardial infarction survivors introduced in Poland later increased access to cardiac rehabilitation in participating cardiac centers. In patients covered by the new system, the rate of participation in outpatient cardiac rehabilitation was six times greater than in patients who were not. A smaller but notifiable evident was recorded for the participation rate in the inpatient cardiac rehabilitation that was higher by about 53% [58]. Earlier experience from an experimental study carried out in Polish CHD and high-risk patients suggested that a managed, comprehensive cardiac prevention and rehabilitation program is an effective lifesaving procedure [59]. Analysis of the new system of managed care confirm that improved access to cardiac rehabilitation, along with improved access to cardiac consultations and invasive treatment procedures, might contribute to the 30% lower risk of death, observed within 1 year after hospitalization in patients participating in the new system compared to those who are not [58]. However, no information is available on how much of the effect on mortality could be attributed to the reduction of risk factors.

MAIN BENEFITS FROM RISK FACTORS CONTROL

There is overwhelming evidence on the causal relations between risk factors and atherosclerotic CVD [9]. Most of the reduction of mortality due to atherosclerotic CVD could likely be attributed to favorable changes in risk factors [2]. Two decades ago, European scientific societies under the leadership of the European Society of Cardiology (ESC) recommended an individual assessment of CVD risk using the information on age (rounded to a decade), sex, current smoking status, and categorized total cholesterol and blood pressure [60]. In 2021, in the 7th version of the ESC Guidelines on cardiovascular disease prevention in clinical practice, a new version of the scoring system (SCORE2 combined with SCORE2-OP) was introduced [9]. The new system allows for a more precise assessment of the risk of fatal and non-fatal atherosclerotic CVD by sex and five-year age groups for the broader age range, i.e. from 40 to 79 years. Then, instead of blood total cholesterol, the assessment requires information on blood non-HDL-C, which is easily deliverable and reflects better a concentration of LDL-C. Finally, the new system adopted an age-group dependent classification of low-, medium-, high- and very high CVD risk. SCORE 2 and SCORE 2 OP were elaborated in four versions for the four groups of countries according to the CVD death rates. Poland was classified as a high-risk country [61, 62].

Estimation of 10-year fatal or nonfatal CVD risk with SCORE2 or SCORE2-OP is recommended in apparently healthy people at the age over 39 years, without established atherosclerotic CVD, diabetes mellitus, chronic kidney disease, lipid disorder, or elevated BP [9]. This assessment aims to help physicians to identify patients at high risk, who would benefit most from the treatment. Further, the use of CVD risk tables or their electronic version may facilitate discussing patient treatment plans tailored to their individual needs.

The new value in the last version of the ESC guidelines is the "LIFE CVD model," which allows for the assessment of the mean number of years free of CVD gained after quitting smoking and after lowering LDL-C or blood pressure. The assessment can be made for each risk group according to the SCORE2/SCORE-OP [9]. The number of years gained is higher in women and non-smokers, and the younger the age is, the greater is the number of years gained. Then, in general, the gain is related to the overall risk assessment, i.e. the greater the risk score is, the higher is the number of years free of CVD gained (Figure 1 and Figure 2). The system is novel in terms of its application to the general population and might appear to be very helpful in the promotion of prevention and discussions with individual patients.

CVD RISK FACTORS AND COVID-19

The COVID-19 pandemic cost the world population over 5 ml deaths within two years, 2020 and 2021, and in Poland, in 2020, raised all-cause death rates by about 15%. It also decreased the attention to the prevention of CVD. However, soon after the outbreak of the pandemic, the reports on the characteristics of COVID-19 patients and especially on factors related to the severe or fatal outcomes of the disease included information on hypertension, diabetes, obesity, hypercholesterolemia, and CVD. The evidence was growing rapidly and before April 2021, Harrison et al. [63] identified 84 reviews on the relationship between COVID-19 and clinical characteristics. According to the AMSTAR 2 critical appraisal tool [64], most of them were classified as of low, or even of critically low quality. Only one was classified as a high-quality review and 31 as moderate quality reviews. Out of the latter 32 reviews, 23 included at least one meta-analysis on the relationship between COVID-19 and CVD or CVD risk factors [65–87]. The results of the meta-analyses are summarized in Tables 2 and 3. Even though some of the original reports were included in several meta-analyses, relative risk estimates varied, but mostly indicated significant, higher risk of serious course of the disease or death in COVID-19 patients with coexisting CVD and with hypertension and diabetes. Weaker homogenious results were obtained for smoking and obesity.

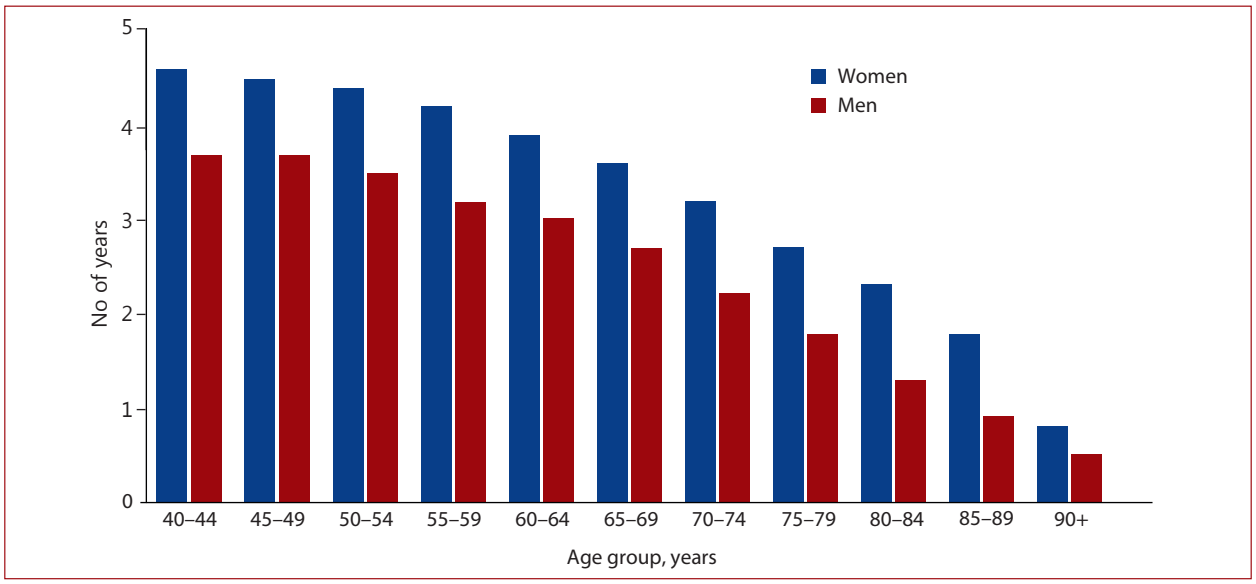

Figure 1. CVD (cardiovascular disease)-free lifetime gain (in years) from smoking cessation for apparently healthy persons with systolic blood pressure 140–159 mm Hg and non-high-density lipoprotein-cholesterol (non-HDL-cholesterol) concentration 4.0–4.9 mmol/l [9]

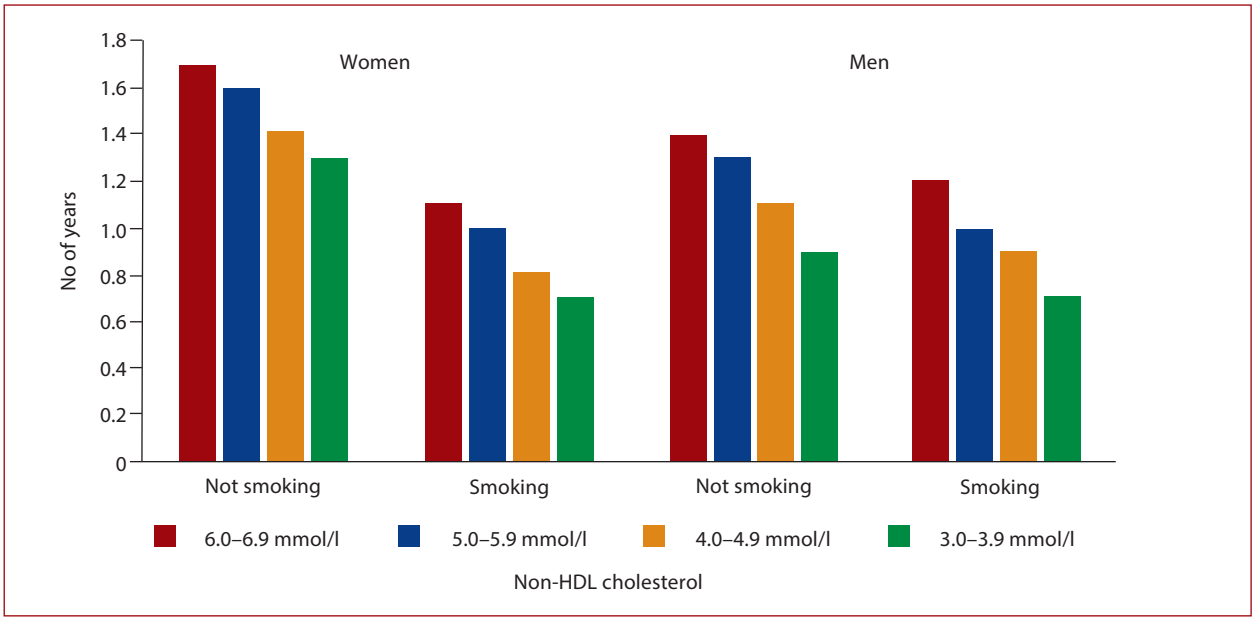

Figure 2. CVD-free lifetime gain (in years) from lowering systolic blood pressure by 10 mm Hg for apparently healthy persons at age 40–44 years, with systolic blood pressure 140–159 mm Hg by smoking status and non-HDL-cholesterol concentration [9]

Table 2. Minimum and maximum estimates for the associations between cardiovascular disease or cardiovascular risk factors and mortality with COVID-19. Only moderate- or high-quality reviews included. Selection of reviews and classification according to the AMSTAR 2 criteria by Harrison et al. [63, 64]

Risk factor	Number of publications/number of meta-analyses	Statistically significant results	Minimum estimate	Maximum estimate	References
Smoking (current or former)	5/6	3	OR, 1.19 (95% CI, 0.48– 2.92)	OR, 2.24 (95% CI, 1.399–3.58)	65–69
Diabetes	14/16	15	OR, 1.33 (95% CI, 0.78–2.28)	RR, 3.34 (95% CI, 2.79–4.0)	65, 67, 68, 70–80
Hypertension	11/11	11	RR, 1.74 (95% CI, 1.31–2.30)	OR, 3.25 (95% CI, 2.15–4.91)	65, 67, 68, 71–75, 77, 79, 80
Obesity	2/2	1	RR, 2.18 (95% CI, 1.10–4.34)	OR, 2.28 (95% CI, 0.76–6.90)	67, 68
CVD	11/11	11	RR, 2.25 (95% CI, 1.60–3.17)	OR, 7.87 (95% CI, 2.12–28.57)	65 ,67, 68, 71–73, 75, 77, 79, 80, 82
MI	1/1	1	RR, 3.9 (95% CI, 1.5–8.6)		80
Cerebrovascular disease	8/8	6	RR, 2.16 (95% CI, 0.97–4.80)	OR, 5.84 (95% CI, 3.63–9.39)	65, 67, 68, 72, 73, 79, 80, 81

Abbreviations: CI, confidence interval; CVD, cardiovascular disease; MI, myocardial infarction; OR, odds ratio; RR, relative risk

Table 3. Minimum and maximum estimates for the associations between cardiovascular disease or cardiovascular risk factors and severe COVID-19. Only moderate- or high-quality reviews included. Selection of reviews and classification according to the AMSTAR 2 criteria by Harrison et al. [63, 64]

Risk factor	Number of publications /number of meta-analyses	Statistically significant results	Minimum estimate	Maximum estimate	References
Smoking (current of former)	6/17	8	RR, 0.72 (95% CI, 0.42–1.24)	OR, 3.05 (95% CI, 1.18–7.84)	66, 69, 72, 83–85
Diabetes	9/11	11	RR, 1.88 (95% CI, 1.10–3.23)	OR, 3.20 (95% CI, 2.26–4.53)	72, 75–77, 80, 83, 85–87
Hypertension	8/10	10	RR, 1.4 (95% CI, 1.1–1.7)	OR, 4.37 (95% CI, 2.99–6.39)	72, 75, 77, 80, 83, 85–87
Obesity	1/1	0	SMD, 1.27 (95% CI, 0.88–3.42)		85
CVD	9/11	11	RR, 2.1 (95% CI, 1.3–3.2)	OR, 5.12 (95% CI, 3.09–8.48)	72, 75, 77, 80, 82, 83, 85–87
MI	1/1	0	OR, 11.2 (95% CI, 0.44–285.9)		87
Cerebrovascular disease	4/45 [?]	4	RR, 1.9 (95% CI, 0.9–4.0)	OR, 5.73 (95% CI, 2.52–13.04)	72, 80, 85, 87

Abbreviations: SMD, standardized mean difference in BMI (severe disease vs. not severe disease); other — see Table 2

However, there is some concern about the figures presented in Tables 2 and 3. Many of the early studies which were included in the meta-analyses were done on small samples, frequently, the analysis was limited to the comparison of the prevalence of risk factors between those who developed severe disease or died from it and those who did not. One of such early reports was from Poland [88]. Such studies do not allow for more advanced statistical analysis which would control confounding factors like age, sex, and other important characteristics. For example, in one of the early reviews, only two out of 20 source studies reported adjustment for age [71]. Further, most of the early reports focused on patients in China where the pandemic began. Consequently, confounding by race and ethnicity was possible. For example, the effect of obesity could likely be underestimated in the lean Chinese population. The later studies, carried out in the European and American COVID-19 patients, which involved larger samples, confirmed a strong relationship between severe COVID-19 and age, but after adjustment for age, sex, and other covariates, did not confirm the relation between hypertension and fatal outcome or severe course of the disease. Results for diabetes, obesity, and hypercholesterolemia were heterogeneous. However, most of the more recent studies confirmed a relationship with cardiovascular disease, obesity, and diabetes, but not with hypercholesterolemia [63, 89–92].

In the recent, multivariable analysis of over 540 thousand adults with COVID-19, hospitalized in the United States, obesity contributed to a 13% higher risk of admission to an intensive care unit (ICU), a 50% higher risk of invasive mechanical ventilation, and a 30% higher risk of death. Diabetes with complications contributed to a 16% higher risk of ICU admission, a 42% higher risk of invasive mechanical ventilation, and a 26% higher risk of death. Coronary atherosclerosis or other heart disease was related to an 8% higher risk of ICU admission, a 10% higher risk of invasive mechanical ventilation, and a 14% higher risk of death. Diabetes with no complications, essential hypertension, and disorders of lipid metabolism were not related to an increased risk of death or severe course of the disease. Surprisingly, they indicated slightly (1%–9%) lower risk. However, essential hypertension increased the risk of death by 25% in the age group below 40 years. Accumulation of 10 conditions, out of which essential hypertension, dyslipidemia, obesity, and complicated diabetes were the most frequent, was related to the increased risk of ICU admission, invasive mechanical ventilation, and fatal outcome with a clear dose-related relationship [93].

Most studies on the relationship between CVD risk factors and COVID-19 were carried out in COVID-19 patients. Risk factors were mostly only a part of the studied characteristics, which were suspected to be related to serious outcomes of COVID. Less is known on the relationship between risk factors and the incidence of COVID-19. However, available information on obesity and diabetes supports the hypothesis that both are related to a higher risk of getting the disease. In the meta-analysis of 75 studies, obesity was related to a nearly 50% higher risk of being COVID-19 positive, over the two-fold risk of hospitalization for COVID-19, over 70% risk for ICU hospitalization, and nearly a 50% increase in the risk of death due to COVID-19 [94]. Observations made in the entire population of Scotland, at the first wave of the pandemic, indicated that, after adjustment for age and sex, about a 40% greater risk of fatal or critical ICU-treated COVID-19 was found in type 2 diabetes and over a twofold risk in type 1 diabetes as compared to the general population [95]. In a large French study, diabetes duration and BMI were predictors of hospitalizations for COVID-19 [96].

The statement of the World Health Organization (WHO) on the relationship between hypertension and COVID-19 underlines that available evidence suggests that hypertension increases the risk of severe COVID-19. However, the statement warns that it remains unclear whether this prognostic profile was independent of other risk factors, and there is not enough evidence whether people with hypertension, in comparison to otherwise healthy individuals, are at higher risk of being infected by SARS-CoV-2 [97]. Indeed, no results of systematic reviews or meta-analysis are available, which would elucidate whether people with hypertension or dyslipidemia, in comparison to healthy individuals, are at higher risk of SARS-CoV-2.

COVID-19 AND ATHEROSCLEROTIC CVD

Most evidence on the impact of COVID-19 on cardiovascular health was collected for the acute phase of the disease. In general, as assessed in the meta-analysis of the studies, which involved over 77 thousand COVID-19 patients, the acute myocardial injury was present in 10% [98]. Among other described cardiovascular complications were incident arrhythmias, heart failure, cerebrovascular disease, incident venous thromboembolism, pulmonary embolism, and deep vein thrombosis. All of them were found to be associated with the fatal outcome of COVID-19 [63]. The longer perspective was taken in the extensive analysis of over 86 thousand patients matched with over 348 thousand controls in Sweden. In the first week after the exposure, the risk of MI and stroke was threefold higher; then it decreased and was 1.6 times higher (60% excess) for MI and twofold higher for stroke in weeks 3 and 4 [99]. The impact of COVID-19 on longer-term cardiovascular outcomes, in particular atherosclerotic CVD events, requires a follow-up longer than the history of the pandemic.

CONCLUSIONS

CVD and CVD risk factors, obesity, and diabetes in particular, are related to the severe course or fatal outcome of COVID-19. High prevalence of CVD risk factors with an increasing prevalence of obesity and diabetes could make the Polish population more sensitive to COVID-19 incidence and put infected persons at higher risk of serious complications and fatal outcomes of the disease. Therefore, it is likely that the increased number of CVD deaths observed during the pandemic could be partially explained by the high prevalence of CVD risk factors and atherosclerotic CVD, as well as by the direct cardiac complications of COVID-19, short-term higher risk of myocardial infarction and stroke, and possibly by the underuse of lifesaving procedures in an acute and chronic CVD.

Supplementary material

Supplementary material is available at https://journals.viamedica.pl/kardiologia_polska.

Article information

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