Disease-related malnutrition (undernutrition and obesity) in patients hospitalized in the Department of Cardiology

Zaburzenia odżywiania (niedożywienie i otyłość) związane z chorobą podstawową stwierdzane u chorych hospitalizowanych w klinice kardiologicznej

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ABSTRACT

Background: The nutritional status of patients with cardiovascular diseases significantly affects prognosis and disease course. Our study, which assessed the nutritional status of patients admitted to the Cardiology Department, revealed a substantial proportion of patients at risk of malnutrition, which increased with age. Malnutrition, including undernutrition and obesity, affects 40–60% of adult patients hospitalized in Europe and is associated with increased mortality, morbidity, length of hospital stay, and costs. Although malnutrition is a disease listed in the International Classification of Diseases and should be recognized and treated as such, it is rarely identified and even less often treated, which can have tragic consequences. In this analysis, we examined the nutritional status of adults hospitalized for cardiovascular diseases.

Methods: Nutritional status was assessed using the Subjective Global Assessment (SGA), Nutritional Risk Screening 2002 (NRS 2002), Body Mass Index (BMI), and Waist-to-Hip circumference ratio (WHR). Additionally, serum concentrations of albumin, cholesterol, hemoglobin, and C-reactive protein were measured. This retrospective study included 95 consecutive patients.

Results: Using NRS 2002 and SGA, the estimated risk of undernutrition was reported in 60% and 81% of patients, respectively. The prevalence of malnutrition (undernutrition, overweight, and obesity) increased with age, regardless of the scale used.

Conclusions: Hospitalized patients with cardiovascular diseases should be screened for the risk of malnutrition using NRS 2002 or SGA. Although our data is based on a small number of patients, it should encourage clinicians to pay more attention to nutritional status to prevent malnutrition in at-risk patients.

Key words: cardiovascular disease, malnutrition, nutritional assessment

STRESZCZENIE

Wstęp: Stan odżywienia pacjentów z chorobami układu krążenia znacząco wpływa na rokowanie i przebieg choroby. Badanie przeprowadzone przez autorów niniejszego artykułu, w którym oceniano stan odżywienia pacjentów przyjmowanych na Oddział Kardiologii, ujawniło znaczny odsetek pacjentów zagrożonych niedożywieniem, które wzrastało wraz z wiekiem. Niewłaściwy stan odżywienia,

w tym niedożywienie i otyłość, dotyka 40–60% dorosłych pacjentów hospitalizowanych w Europie i wiąże się ze zwiększoną śmiertelnością, zachorowalnością, długością pobytu w szpitalu i kosztami. Choć niedożywienie jest chorobą wymienioną w Międzynarodowej Klasyfikacji Chorób i tak powinno być rozpoznawane i traktowane, jest rzadko identyfikowane, a jeszcze rzadziej leczone, co może mieć tragiczne skutki. W artykule przedstawiono stan odżywienia dorosłych hospitalizowanych z powodu chorób sercowo-naczyniowych.

Metody: Stan odżywienia oceniano za pomocą subiektywnej oceny globalnej (SGA), badania przesiewowego ryzyka żywieniowego 2002 (NRS 2002), wskaźnika masy ciała (BMI) i stosunku obwodu talii do bioder (WHR). Dodatkowo mierzono stężenia albuminy, cholesterolu, hemoglobiny i białka C-reaktywnego w surowicy. To retrospektywne badanie obejmowało 95 kolejnych pacjentów.

Wyniki: Stosując NRS 2002 i SGA, szacowane ryzyko niedożywienia obserwowano odpowiednio u 60% i 81% pacjentów. Częstość występowania niewłaściwego stanu odżywienia (niedożywienie, nadwaga i otyłość) wzrastała wraz z wiekiem, niezależnie od zastosowanej skali.

Wnioski: Hospitalizowani pacjenci z chorobami sercowo-naczyniowymi powinni być badani pod kątem ryzyka niedożywienia za pomocą NRS 2002 lub SGA. Chociaż dane autorów niniejszego artykułu opierają się na niewielkiej liczbie pacjentów, powinny zachęcić klinicystów do zwrócenia większej uwagi na stan odżywienia, aby zapobiec niedożywieniu u pacjentów z grupy ryzyka.

Słowa kluczowe: choroby układu krążenia, niedożywienie, ocena żywieniowa

INTRODUCTION

Malnutrition has a significant impact on the prognosis and course of all chronic disorders, including cardiovascular diseases. This applies to both undernutrition, caused by a lower-than-needed intake of macronutrients and energy, and overnutrition caused by a higher-than-needed food and energy intake, resulting in overweight and obesity. In our study, using a validated method of nutritional assessment, we demonstrated that more than 60% of cardiac patients have a risk of malnutrition preceding the occurrence of hospital malnutrition first described in 1955 by two American surgeons Rhoads and Alexander [1]. Despite the passage of 65 years since the term hospital malnutrition was introduced into clinical practice, 32 years since malnutrition was introduced by WHO into the International Classification of Diseases [2], and 20 years since the Council of Europe recognized hospital malnutrition as a disease requiring diagnosis and treatment, practically nothing has changed [3]. Regarding the utterly passive attitude of the hospital staff, more than 50% of patients still develop malnutrition within only 7 to 10 days of hospital admission [4, 5]. According to Council of Europe Resolution AP (2003) [3], the leading causes of hospital malnutrition are: lack of knowledge of physicians about the energy and nutrient requirements and modern possibilities of food delivery to every patient regardless of their clinical condition; lack of knowledge of physicians about the importance of good nutritional status in the prevention and treatment of diseases, and lack of interest in proper nutrition of patients as a treatment-supporting strategy [6]. Additional factors responsible for hospital malnutrition in Poland include the lack of nutrition requirement standards for patients in hospitals and the absence of nutritional and energy values in the daily menu provided to patients by catering services, which were introduced to almost all hospitals in 1999. Inadequate investment in patient nutrition, adapted to the actual costs, has resulted in the majority of patients receiving meals prepared from low-quality products, unsuitable for their needs and lacking adequate nutritional value [7]. According to data published by WHO in 2003 [6], diet-related non-communicable diseases such as ischemic heart disease, overweight and obesity, arterial hypertension, cerebrovascular diseases, and atherosclerosis were the leading causes of 60% of the 56.5 million deaths worldwide. This highlights the need to detect and treat malnutrition early and monitor the nutritional status of all hospitalized patients, including those with cardiovascular diseases. Particular attention should be paid to elderly patients, in whom nutritional deficiencies are most common. Proper assessment of nutritional status and the implementation of effective therapy require cooperation with the nutritional treatment teams available in most hospitals. Early recognition of the risk of malnutrition allows preventive and/or therapeutic measures to be taken in the form of clinical nutrition adapted to the patient's needs and clinical situation [5, 6].

METHODS

The study included 95 consecutive patients, comprising 36 women and 59 men, aged 19–89 years. The inclusion criteria required at least three days of inpatient hospitalisation, confirmed cardiovascular disease as the primary reason for hospitalisation, stable patient condition, and voluntary consent from the patient. Exclusion criteria were lack of verbal-logical contact, severe general condition, and lack of consent to participate in the study. All measurements were conducted within 48 hours of hospital admission using interview techniques, questionnaires, anthropometric measurements, and laboratory tests. The interview included an assessment of the patient's diet,

Table 1. Subjective Global Assessment (SGA) Form [9]

History

Age (years)…….Height (cm)…….Weight (kg)…… Gender ☐ F ☐ M

1. Weight change, overall loss in past 6 months amount =……kg, % …….

Change in past 2 weeks: increase…….decrease…….. no change……

2. Dietary intake change (relative to normal). No change…….Change…….. Duration ……weeks. Suboptimal solid diet……..
Full liquid diet……..Hypocaloric liquids…… Starvation……..

3. Gastrointestinal symptoms (that persisted for > 2 weeks): none…….nausea……vomiting……diarrhea…… anorexia……

4. Functional capacity

No dysfunction (e.g. full capacity).....

Dysfunction, duration ……weeks…….type: working suboptimally .....

ambulatory……bedridden…….

5. Disease and its relation to nutritional requirements

Primary diagnosis (specify).....

Metabolic demands (stress)…..no stress…….. low stress……...moderate stress ……... high stress……

B. Physical (for each trait specify: 0 = normal, 1+ = mild, 2+ = moderate, 3+ = severe)

Loss of subcutaneous fat (triceps, chest).....

Muscle wasting (quadriceps, deltoid).....

Ankle edema.....

Sacral edema.....

Ascites.....

C. SGA rating (select one)

A = Well nourished

B = Moderately (or suspected of being) malnourished

C = Severely malnourished

changes in food intake over the past month, weight loss over the past three months, and the presence or absence of comorbidities. The following screening tools were used to assess the patients' nutritional status, as mandated by the Minister of Health's 2011 regulation that requires mandatory nutritional status assessments for all hospitalised patients [8]: the Subjective Global Assessment (SGA — Tab. 1) and the Nutritional Risk Score 2002 (NRS 2002 — Tab. 2). Additionally, the body mass index (BMI) and waist-to-hip ratio (WHR) were calculated for each patient using standards [9–11]. According to the current standards, the following interpretation of the SGA results was adopted: SGA A. — Normal nutritional status: no loss of body weight (BW); no changes in food intake or distressing gastrointestinal (GI) symptoms; no disturbances in normal functioning; no abnormalities on physical examination. Patient does not require nutritional intervention, but weekly rescreening of nutritional status was recommended during the patient's hospital stay. SGA B. — Moderate malnutrition or suspected malnutrition, with a loss of 5% of body weight in one month or 10% in six months, marked reduction in food intake (lack of appetite, nausea, vomiting, diarrhoea, low satiety threshold), moderate functional impairment, weakness, slight loss of subcutaneous fat and muscle mass and strength, and the need for consultation with a member of the nutritional support team or a clinical dietician to plan a nutritional intervention. SGA C. — Severe malnutrition is characterized by weight loss, a significant decrease in food intake, and GI symptoms, as described above. It also involves significant functional decline and visible signs of malnutrition (significant loss of subcutaneous fat and muscle mass, decreased strength, and possible edemas). Patients require nutritional intervention, which can involve oral nutritional supplements (ONS) or enteral tube feeding with industrial diets available in hospital pharmacies. Before introducing clinical nutrition, it is necessary to consult

Table 2. Nutritional Risk Screening (NRS 2002) [13]

Initial screening

1	Is BMI < 20.5?	Yes	No
2	Has the patient lost weight within the last 3 months?		
3	Has the patient had a reduced dietary intake in the last week?		
4	In the patient severely ill? (e.g. in intensive therapy)		

Yes: If the answer is 'Yes' to any question, the screening in Table 2 is performed.

No: If the answer is 'No' to all questions, the patient is re-screened at weekly intervals. If the patient e.g. is scheduled for a major operation, a preventive nutritional care plan is considered to avoid the associated risk status.

Final screening

Impaired nutritional status		**Severity of disease (increase in requirements)**	
Absent **Score 0**	Normal nutritional status	Absent **Score 0**	Normal nutritional requirements
Mild **Score 1**	Wt loss > 5% in 3 mths or Food intake below 50–75% of normal requirement in preceding week	Mild **Score 1**	Hip fracture* Chronic patients, in particular with acute complications: cirrhosis*, COPD*. *Chronic hemodialysis, diabetes, oncology*
Moderate **Score 2**	Wt loss > 5% in 2 mths or BMI 18.5–20.5 + impaired general condition or Food intake 25–60% of normal requirement in preceding week	Moderate **Score 2**	Major abdominal surgery* Stroke* *Severe pneumonia, hematologic malignancy*
Severe **Score 3**	Wt loss > 5% in 1 mths (> 15% in 3 mths) or BMI < 18.5 + impaired general condition or Food intake 0–25% of normal requirement in preceding week in preceding week	Severe **Score 3**	Head injury* Bone marrow transplantation* *Intensive care patients (APACHE > 10)*
Score:	+	**Score:**	= **Total score**
Age	if ≥ 70 years : add 1 to total score above	= **age-adjusted total score**	

Score ≥ 3: the patient is nutritionally at-risk and a nutritional care plan is initiated
Score < 3: weekly rescreening of the patient. If the patient e.g. is scheduled for a major operation, a preventive nutritional care plan is considered to avoid the associated risk status

NRS-2002 is based on an interpretation of available randomised clinical trials. *indicates that a trial directly supports the categorisation of patients with that diagnosis. Diagnoses shown in italics are based on the prototypes given below. Nutritional risk is defined by the present nutritional status and risk of impairment of present status due to increased requirements caused by stress metabolism of the clinical condition.
A nutritional care plan is indicated in all patients who are (1) severely undernourished (score = 3), or (2) severely ill (score = 3), or (3) moderately undernourished + mildly ill (score 2 + 1), or (4) mildly undernourished + moderately ill (score 1 + 2).

Prototypes for the severity of disease

Score = 1: a patient with chronic disease admitted to hospital due to complications. The patient is weak but out of bed regularly. Protein requirement is increased but can be covered by an oral diet or supplements in most cases.

Score = 2: a patient confined to bed due to illness, e.g. following major abdominal surgery. Protein requirement is substantially increased but can be

covered, although artificial feeding is required in many cases.

Score = 3: a patient in intensive care with assisted ventilation etc. Protein requirement is increased and cannot be covered even by artificial feeding.

Protein breakdown and nitrogen loss can be significantly attenuated.

with a member of the nutrition support team, who are available in most hospitals in Europe. NRS 2002 is a scoring system used to identify patients at risk of malnutrition. A total score of ≥ 3 indicates a risk of malnutrition that requires nutritional intervention to cover protein and energy requirements. Body mass index (BMI) is the simplest method of assessing nutritional status, requiring just the patient's weight and height measurements to calculate BMI using the following formula: weight (kg) / height (m^2). According to WHO guidelines [12], a BMI < 18.5 kg/m^2 indicates underweight, 18.5–24.9 indicates normal weight, 25.0–29.9 indicates overweight, and > 30 kg/m^2 indicates obesity. Waist-to-hip ratio (WHR) is a measurement that indicates body fat distribution in the human body. A score > 0.80 in women and > 0.94 in men indicates abdominal obesity. Blood laboratory tests are also used to assess nutritional status, including levels of albumin, triglycerides, total cholesterol, and HDL and LDL fractions, as well as C-reactive protein (CRP), platelet count, leukocyte count (including lymphocytes), erythrocyte count, and hemoglobin and hematocrit levels.

The study plan and program were approved by ethical committee. The study was conducted according to the guidelines of the Declaration of Helsinki, updated in 2013. Each patient signed an informed consent form to participate in the study and received written information on the program and the purpose of the study. Upon completing the study, each patient received written information at discharge regarding the recommended diet, physical activity, and lifestyle for their disease. Statistical analysis was performed using Statistica 13 PL software from Statsoft. The normality of the distribution of variables was checked using the Shapiro-Wilk test. The results were subjected to a one-way analysis of variance for independent groups in the ANOVA scheme. The relationships between diagnoses according to NRS 2002 and SGA scales were examined using Spearman's rank correlation coefficient. A value of $p < 0.05$ was considered statistically significant for all tests.

RESULTS

The study included 95 individuals aged 19–89 years (M = 66.75; SD = 15.33), comprising 36 women aged

Table 3. Diseases being the reason for hospitalization (n = 95)

Diagnosis	Overall		Males		Females	
	N	%	n	%	n	%
Coronary artery disease	44	46.3%	29	65.9%	15	34.1%
Cardiac arrhythmia and conduction disorders	31	32.6%	16	51.6%	15	48.4%
Heart failure	20	21.1%	14	70%	6	30%
Total	95	100%	59	62.1%	36	37.9%

Table 4. Mean age of patients and nutritional status (n = 95)

Questionnaire	Mean age	Nutritional status	p-value
NRS 2002	59.18 (16.86)	Normal	< 0.0001
	71.79 (11.92)	Risk of malnutrition	
	57.29 (19.89)	Normal	0.0337
SGA	68.13 (14.08)	At risk of malnutrition or mild malnutrition	
	73.25 (10.37)	Severe malnutrition	

NRS — nutritional risk screening; SGA — subjective global assessment

27–86 years (M = 70.06; SD = 13.27) and 59 men aged 19–89 years (M = 64.73; SD = 16.24). The subjects' body height ranged from 151 to 189 cm (M = 168.29; SD = 8.55), while body weight ranged from 45 to 117 kg (M = 78.2; SD = 13.62). The most common reasons for hospitalization were coronary heart disease, cardiac arrhythmia and conduction disorders, and heart failure (Tab. 3). The nutritional status of the patients was statistically significantly related to age (Tab. 4). The mean age of subjects with normal nutritional status, as assessed by the NRS 2002 scale, was 59 years, while those at risk of malnutrition were 71.8 years ($p < 0.0001$). A similar relationship was found when the SGA scale was used to assess nutritional status. The mean age of those who were adequately nourished was 57.3 years, those at risk of malnutrition or mildly malnourished were 68.1 years, and severely malnourished were 73.3 years ($p < 0.337$) (Tab. 4). Anthropometric measurements results are summarized in Table 5, which indicates statistically significant differences in the recognition of nutritional status disorders depending on the assessment method used. According to the SGA, only 14.7% of the subjects had normal nutritional status, while according to the NRS 2002, 40% had normal nutritional status.

The study found that a high percentage of patients (81% and 60%) were at risk of protein-energy malnutrition (PEM), despite only one person being underweight according to BMI assessment. The majority of subjects were either overweight (41%) or obese (30.5%), with only 27.4% having a normal body weight. The extremely frequent coexistence of overweight and abdominal obesity with cardiovascular diseases was confirmed by the WHR study, which showed that from 36 examined women and 59 men 86.1% and 81.4% respectively had abdominal obesity, and most of them symptoms of metabolic syndrome. Malnourished patients had lower levels of albumin and haemoglobin, as well as decreased erythrocyte counts, which suggested iron-deficiency anaemia. Additionally, elevated levels of CRP indicated the presence of inflammation, which is often associated with malnutrition.

The dietary questionnaires revealed that 56% of patients consumed excessive amounts of saturated fatty acids, monosaccharides, and salt, while not consuming enough fruits, vegetables, and fibre.

DISCUSSION

The increasing number of older adults being admitted to hospitals for cardiovascular diseases has led cardiologists to deal with a new and unrecognized condition: malnutrition. Malnutrition appears to be a common condition in older hospitalized patients, with a high prevalence that was first described in the late 1970s. Since its initial description, malnutrition continues to be present on admission in 12% to 75% of hospitalized subjects, with further deterioration in their nutritional status during their hospital stay. Even though disease-related malnutrition worsens treatment outcomes, prolongs hospital stays, increases morbidity, mortality, and treatment costs [5, 14, 15], medical universities, whose task is to educate personnel prepared for disease prevention and treatment, often do not take into account the recommendations of the Council of Europe issued in 2003 [3]. In a resolution entitled "Food and Nutritional Care in Hospitals," the Council of Europe called on the governments of all European countries to immediately supplement pre-graduate medical education with the compulsory subject "Nutrition of healthy and sick individuals, including clinical nutrition," and to introduce a specialty in clinical nutrition of adults and children [3]. Despite the passage of 17 years since its publication, patients' nutritional status is still not assessed in most hospitals. Moreover, both the authorities of medical universities and most physicians are not interested in patients' nutritional status or nutritional treatment, the importance of which was fully confirmed by a European Society for Parenteral and Enteral Nutrition (ESPEN) survey conducted in

Table 5. Nutritional status assessment — anthropometric measurements results (n = 95)

	SGA		NRS 2002	
	n	%	n	%
Normal result	14	14.7	38	40
PEM risk or mild PEM	77	81.1	57	60
Severe PEM	4	4.2	–	–
	BMI (kg/m²)			
	n		%	
Underweight (< 18.5)	1		1.1	
Normal body weight (18.5–24.9)	26		27.4	
Overweight (25.0–29.9)	39		41	
Obesity (> 30)	29		30.5	
	WHR — abdominal obesity			
	n		%	
Females > 0.80	31		86.1	
Males > 0.94	48		81.4	

PEM — protein-energy malnutrition; SGA — subjective global assessment; NRS — nutritional risk screening; BMI — body mass index; WHR — waist-to-hip ratio

2016 [16]. Furthermore, among 57 countries, including Poland, there is no separate course on the nutrition of healthy and sick individuals in the curricula of medical students, nor clinical nutrition, which has been an important part of surgical and pharmacological treatment of diseases since 1968 [16]. Assuming, that lack of knowledge appears to be the main reason for the current situation, the European Society for Parenteral and Enteral Nutrition (ESPEN) established two groups of experts in 2017: the Nutrition Education Study Group (NESG) and Nutrition Education in Medical Schools (NEMS) [17]. The aim of these groups is to develop a curriculum and implement education on the nutrition of healthy and sick individuals, including clinical nutrition, in medical schools. This effort may eventually lead to the integration of nutritional care into clinical practice as one of the essential elements of disease diagnosis and treatment. However, as of now, early diagnosis of malnutrition and timely nutritional intervention tailored to the clinical situation, which could substantially improve patient outcomes and reduce treatment costs, remains uncommon [14, 15]. It is widely recognized that older individuals are more prone to developing cardiovascular diseases and nutritional disorders than younger individuals. In elderly cardiac patients, abnormal nutritional status poses a significantly higher risk of complications and death. This risk is present in patients with undernutrition, the primary symptom of which is unintentional loss of body mass, often masked by edema. It is also applicable to overweight and obese patients, in whom weight gain is mainly due to uncontrolled fat gain [14, 15]. Despite the simplicity of some of the most important symptoms of undernutrition, such as unintentional weight loss, weakness, functional impairment, a decrease in serum albumin < 3.4 g/dL, haemoglobin < 12 g/dL, and CRP increase ≥ 10 mg/L, malnutrition in hospitalised patients is often overlooked and rarely treated. In our study population, the mean body weight was 78.2 kg with a mean body height of 168 cm. BMI measurements revealed that 41% were overweight and 30.5% were obese. Therefore, 71.5% of the patients were overweight or obese, and more than half of them were at risk of malnutrition (see Tab. 5). Contrary to the common belief that obese individuals are well-nourished, they are often undernourished and require nutritional intervention, particularly during acute or chronic illness when their food intake is severely limited or halted for more than seven days. In addition, individuals over 65 years of age develop sarcopenic obesity due to the simultaneous occurrence of obesity and sarcopenia, which is a loss of muscle mass. The most significant increase in body fat occurs between 60 and 75 years of age, and progressive muscle loss begins after 30 years, leading to a decline in muscle strength and physical performance [18]. Indeed, heart failure patients with overweight and obesity of the first degree may live longer than malnourished patients. However, this only applies to patients who suffer from chronic malnutrition due to anorexia without symptoms of inflammation and catabolism, which is a rare occurrence. In most cases, obesity is caused by excessive energy intake, an unbalanced diet, and a lack of physical activity, which can lead to the development of atherosclerosis, ischaemic heart disease, arterial hypertension, and generalised inflammation. It is worth noting that individuals between the ages of 18.5 and 24.9 kg/m² have the lowest mortality rate, regardless of their age. Therefore, weight control is considered an essential component of cardiac rehabilitation, and even a modest reduction in excess body weight by 5–10% can lead to measurable health benefits for the patient [19–23]. The results of the waist-to-hip ratio (WHR) analysis showed that more than 80% of the examined women and men had excessive abdominal fat accumulation, which is classified as android obesity. Similar results were obtained by Bogacka et al. [24]. This type of obesity should be diagnosed and treated as early as possible because it is associated with an increased risk of de-

veloping cardiovascular diseases, metabolic syndrome, and certain types of cancer. According to Pathiran et al., only 43.7% of cardiac patients assessed for nutritional status using the NRS 2002 scale had normal nutritional status. The remaining 56.3% were at risk of malnutrition or undernutrition, which was associated with a longer hospital stay due to complications [25]. Tonet et al. [26] found that 4% of patients with acute coronary syndrome (ACS) had malnutrition, and 40% were at risk of malnutrition. Among the malnourished patients, 31% died, while 19% of patients at risk of malnutrition died. In contrast, only 3% of well-nourished patients died. According to the authors, disease-related malnutrition worsens treatment outcomes, increasing morbidity and mortality in elderly patients. The authors [26] used the Short Form of Mini Nutritional Assessment (MNA-SF) questionnaire designed for patients aged ≥ 65 to assess nutritional status [27], which they believe is an independent predictor of all-cause mortality and should be included in the Global Risk of Acute Coronary Events (GRACE) assessment. Upon analyzing the results of blood tests of study participants, we observed significant differences in the concentrations of examined parameters based on nutritional status, gender, and examination method. For well-nourished women examined with the SGA scale, the mean albumin concentration was 4.24 g/dL, and for men, it was 4.06 g/dL. For patients at risk of malnutrition, the mean albumin concentrations were 3.91 g/dL and 3.93 g/dL for women and men, respectively. In severely malnourished patients, the mean albumin concentrations were 3.15 g/dL for women and 3.25 g/dL for men. For well-nourished women assessed with the NRS 2002 scale, the mean albumin concentration was 4.14 g/dL, while for men, it was 3.74 g/dL. For patients at risk of malnutrition, the mean albumin concentrations were 3.77 g/dL and 3.83 g/dL for women and men, respectively. Regardless of the method used to assess nutritional status, we found that the differences in albumin concentration between the well-nourished and malnourished groups were statistically significant ($p = 0.0274$ for the NRS 2002 questionnaire and $p = 0.0005$ for the SGA questionnaire). The concentrations of total cholesterol, LDL cholesterol, HDL cholesterol, and triglycerides did not exhibit statistically significant differences. However, in patients at risk of malnutrition, we found statistically significant reductions in haemoglobin levels, indicating iron-deficiency anaemia, in 43% of the subjects. Elevated CRP levels were present in 35% of patients and were associated with the risk of malnutrition. Tonet et al. [26] also demonstrated decreased haemoglobin levels in malnourished patients with acute coronary syndrome compared to patients with normal nutritional status. Overall, the research presented highlights that in malnourished patients undergoing treatment in cardiac units, special attention should be given to indices such as haemoglobin levels, erythrocytes, albumin, CRP, and lipid profile. According to Bogacka et al. [24], 70% of women and 50% of men attending a cardiology outpatient clinic had an abnormal lipid profile, which was shown to be diet-related. This implies that lipid disorders are a common phenomenon observed in this group of patients. Therefore, efforts should be made to normalize these indices while still on outpatient treatment, resulting in a reduction in cardiovascular risk, thereby improving the quality of life and reducing mortality. The same applies to excess body weight. In the latest 2017 guidelines, the American Heart Association highlights that the main risk factors for cardiovascular diseases are high blood pressure, high levels of low-density lipoprotein cholesterol (LDL-C) and triglycerides, and low levels of high-density lipoprotein cholesterol (HDL-C), poor diet, smoking, alcohol abuse, and a sedentary lifestyle leading to overweight, and obesity observed in up to 70% of the subjects in our study [28]. The authors recommend the DASH diet for patients with arterial hypertension and the Mediterranean diet for patients with cardiovascular diseases (without hypertension), as well as physical activity adapted to the patient's ability. Regarding diet and physical activity, the same recommendations were given to our patients in the study group. There is no doubt that modern treatment of cardiovascular diseases should be comprehensive and based on three pillars: pharmacotherapy, nutritional therapy, and lifestyle changes. To realize the above-mentioned recommendations, the therapeutic team should include a clinical dietician.

Despite our results, our study does have limitations. Firstly, this is a retrospective study with all of its inherent weaknesses. Secondly, observations of patients were limited to their stay in hospital, so we do not know their fate in the long term. Thirdly, the examined group of patients is relatively small, but we think that the results concerning the prevalence of malnutrition and overweight/obesity will encourage cardiologists to pay more attention to the nutritional status of patients suffering from cardiovascular diseases.

CONCLUSIONS

According to the results of our study, more than 60% of patients hospitalized for heart diseases had nutritional disorders in the form of the risk of undernutrition, overweight, or obesity. The frequency of these disorders increased with age.

Both our results and data from the literature confirm the close relationship between diet, physical activity, lifestyle, and cardiovascular disease incidence. These observations should be taken into account in the prevention and treatment of cardiovascular disease.

We have demonstrated that malnutrition continues to be a significant problem of hospitalized patients that is under-recognized by medical staff.

The obtained results prompt us to remind that in Poland, since 2012, the assessment of the nutritional status of all hospitalized patients is obligatory, as well as nutritional treatment which should be introduced in patients with the risk of malnutrition.

Conflict of interests: The authors declare no conflict of interests. All authors contributed to the manuscript and approved its content. AU contributed to the study design, supervised the realization of particular parts of the study, and described the study results. JB was responsible for the data integrity and preparation of study results. MS was responsible for the accuracy of data analysis and statistical analysis. AK-C and GO contributed to data interpretation and manuscript drafting. The paper has not been published previously, in any language, in whole or in part, and is not currently under consideration elsewhere. The study was approved by the Bioethics Committee of the Warsaw Medical University with approval number AKB-98/2019. The research did not receive any specific grant from funding agencies in the public, commercial, or non-profit sectors

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