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DIETARY SUPPLEMENTS, NUTRACEUTICALS AND FUNCTIONAL FOODS USE AFTER MYOCARDIAL INFARCTION DEPEND ON THE AGE, SEX, BMI AND PROFESSIONAL ACTIVITY – A PILOT STUDY

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Abstract

Objectives: To assess dietary supplements, functional foods and nutraceuticals use among the patients after myocardial infarction (MI). **Material and Methods:** The authors prospectively enrolled 100 consecutive patients hospitalized due to MI and remaining under coordinated outpatient care after MI in the authors' cardiology department. **Results:** The authors showed that patients within median (interquartile range) 12.30 (10.18–14.57) months after MI use dietary supplements, nutraceuticals and functional foods in their everyday diet. Vitamins (53% patients), especially vitamin D (35%), were the most frequently used dietary supplements. In contrary to common usage of dietary supplements (59%), smaller proportion of patients use functional foods (21%) and nutraceuticals (5%), especially phytosterols. The authors found that the use of over-the-counter (OTC) drugs and dietary supplements is associated with age (participants <60 years old vs. participants ≥60 years old: OTC drugs: N = 8 [20.0%] vs. N = 32 [53.3%], p < 0.001; herbals: N = 3 [7.5%] vs. N = 16 [26.7%], p = 0.019), sex of the patients following MI (females vs. males: vitamins: N = 17 [70.8%] vs. N = 36 [47,4%], p = 0.045; vitamin D: N = 13 [54.2%] vs. N = 22 [28.9%], p = 0.024; omega-3 fatty acids: N = 3 [12.5%] vs. N = 1 [1.3%], p = 0.042; herbals: N = 8 [33.3%] vs. N = 11[14.5%], p = 0.040), as well as the BMI of the participants (BMI < 24.9 vs. BMI ≥ 25.0: multivitamin/multimineral dietary supplements: N = 3 [15.0%] vs. N = 31 [42.5%], p = 0.035; vitamin B_6: N = 1 [5.0%] vs. N = 21 [28.8%], p = 0.035). In the study group all participants with the age above retirement age have already withdrawn from professional activity and they more often used OTC drugs (N = 14 [25.9%] before retirement age vs. N = 26 [56.5%] above retirement age, p = 0.002). **Conclusions:** The patients following MI use supplements, functional foods and nutraceuticals. Their use depends on sex, age, BMI and professional activity. The authors believe that their potential beneficial effects require further evaluation in clinical longitudinal studies. Int J Occup Med Environ Health. 2023;36(6):732–43

Key words:
acute coronary syndrome, dietary supplements, functional food, nutraceuticals, myocardial infarction, ambulatory care

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INTRODUCTION

Nowadays the cardiovascular diseases (CVD), particularly myocardial infarction (MI) are the leading cause of death in the European region [1].

Lifestyle changes such as the smoking cessation, healthy diet, physical activity, blood pressure control, optimal weight and psychosocial wellbeing were highlighted as the important factors in the overall reduction of CVD mortality and morbidity [2,3]. Already in 2019, European Society of Cardiology (ESC) Guidelines for the management of dyslipidemias issued specific statements on the use of on dietary supplements (such as vitamins B_6, B_{11}, B_{12}, C and D) and functional foods and mentioned that phytosterols should be considered in specific groups of patients due to their lowering effect on low density lipoprotein cholesterol (LDL-C) and total cholesterol (TC) [4]. The recommendations on phytosterols were confirmed in the 2021 ESC CVD prevention guidelines. According to ESC phytosterols are effective in lowering LDL-C levels by around 10% when consumed in amounts of 2 g/day. The effect is in addition to that obtained with a low-fat diet or statins use. No studies with clinical endpoints have been performed yet [5].

Dietary supplements in CVD and MI

Dietary supplements are classified as foodstuffs intended to complete the regular diet [6]. Their potential benefits, also in CVD are constantly being sought. As for vitamins, there is no strong evidence to recommend constant supplementation. The trials on supplementation of vitamins B_6, B_{11}, B_{12}, C and D showed no beneficial effect [5]. Many substances remain a subject of clinical interest including L-carnitine or coenzyme Q_{10}, but the data is inconclusive [7].

Functional foods and nutraceuticals in CVD and MI

According to the U.S. Institute of Medicine's Food and Nutrition Board functional foods can be referred to as dietary products taken as regular foods that provide additional health benefits beyond their basic nutrition [8]. The term "nutraceuticals" was defined by U.S. Foundation for Innovation in Medicineas "any substance that is a food or a part of a food and provides medical or health benefits, including the prevention and treatment of disease" [9].

Both terms are frequently interchangeably used although according to some authors, nutraceuticals usually appear in supplement form, whereas functional foods deliver its benefits in food form only [10,11].

The effects of functional foods on CVD prevention have been investigated. The primary interest was dietary products rich in long-chain n-3 fatty acids, dietary fiber, phytochemicals, and nutrients based on soy [10]. There is strong evidence of effectiveness of cholesterol-lowering spreads which has been confirmed in several studies [10,11].

Nutraceuticals can be distinguished in some specific categories: dietary fiber, prebiotics, probiotics, polyunsaturated fatty acids, antioxidants, and other different types of herbal or natural foods. They show multiple, including cardiovascular, health benefits [12].

To the best of the authors' knowledge, to date there is no study evaluating the usage of supplements, functional foods and nutraceuticals among patients following MI, although the use of dietary supplements was generally studied mostly among the U.S. population [13] and the population of patients with different CVDs [14]. In this pilot study the authors assess the dietary supplements, functional foods and nutraceuticals use among the patients being months after MI in a single Polish cardiology center.

MATERIAL AND METHODS

For this pilot study the clinical data was collected prospectively from 187 consecutive patients treated for MI in the authors' cardiology department in August 2021–

August 2022 in Poland. Finally, after meticulous analysis of the data obtained, only 100 patients met the inclusion criteria and were included in analysis.

Inclusion criteria:

- patients treated for acute coronary syndrome diagnosed based on ESC criteria and treated with percutaneous coronary angioplasty according to the standards for the treatment of MI,
- regular control by the cardiologist within the first 6 months after MI,
- at least 6 months from the MI at the time of the survey collection,
- consent to participate in the survey regarding the use of prescribed drugs, OTC drugs, nutraceuticals, functional foods, herbs, vitamins, and other dietary supplements,

Exclusion criteria – lack of consent to participate in the survey.

The clinical data was collected based on patients' medical records from acute phase of MI. Next, the survey was collected from the patients at least 6 months from the MI.

Survey

The survey consisting of 10 open and closed questions was conducted in 100 patients remaining under coordinated outpatient care after MI in the authors' cardiology department. All the patients consented to participate in the survey and were asked about the use of prescribed drugs, OTC drugs, nutraceuticals, functional foods, herbs, vitamins, and other dietary supplements, as well as general dietary habits. The dietary habits survey part included question about the product to spread a bread with basing on common dietary traditions in the region and an important source of fats in the patients' diet. The patients were asked to list the names of the currently taken drugs or supplements with dosages. In case the patients could not provide the above information in detail, they were provided with further specific explanation and eventually asked for a possibility to call later. After the survey the names of all the substances or foods taken regularly by the patient were evaluated and detailed data about its ingredients and dosages were collected, anonymized, and analyzed statistically.

Definitions applied:

- Dietary supplements – substances designed as concentrated sources of vitamins, minerals, or other substances with nutritional or physiological effect and foodstuffs intended to complete the regular diet [6]. The substances were assigned basing on the type including vitamin, mineral, nutritional etc. as the dietary supplement regardless of the legal registration as drug or dietary supplement.
- Functional foods-any nourishment taken as regular foods that provide additional health benefits beyond their basic nutrition [8].
- Nutraceuticals-any substance that is food or a part of food and provides medical or health benefits, including the prevention and treatment of disease [9].
- Over-the-counter (OTC) medicines-any medication that is legally allowed to be sold by pharmacists without need for a prescription [15]. The drugs were assigned as OTC drugs only when legally registered as a drug. Their content was checked and included in analysis along with substances contained in the dietary supplements (vitamins, minerals, nutritional substances).

In the survey the drugs prescribed by the doctor, even if the drugs were OTC drugs like aspirin were not counted in the OTC drugs use.

Ethics approval

This study was conducted according to the guidelines laid down in the Declaration of Helsinki and all procedures involving patients were approved by the local Ethic Examining Committee of Human Research of the Medical University of Warsaw (Decision of Approval: AKBE/291/2022).

Consent

Informed consent was obtained from all individual participants included in the study.

Statistics

The statistical analysis was performed with the use of the SPSS software, v. 28.0.1.0. The data were presented as mean (M) ± standard deviation (SD) in case of normally distributed variables, Me (1–3 quartile) in case of non-normal distribution and count (percentages) in case of categorical variables. For nominal variables 2-sided Fisher's exact test was used if the number of observations per group was <5, in other cases 2-sided Pearson's χ^2 test was applied. Maximally 11% of variables were missing.

RESULTS

The study group consisted of 100 patients, 24 (24%) females and 76 (76%) males M±SD 60.8±9.5 years old. The group characteristics were listed in Table 1. Median time from MI to the survey was 12.30 (range: 10.18–14.57) months. All the patients were taking drugs according to the ESC guidelines for patients following MI [2,3].

The results of the survey are presented in Table 2. Among 100 patients surveyed, 40% of the patients claimed to use any OTC drugs not prescribed by the doctor, and 59% used any dietary supplements. Vitamins were the most common dietary supplements used (53%), out of which the most popular was vitamin D (35%) with a median dose of 2100 IU (2000–4000 IU) then vitamin C (20%) with a median dose of 100 mg (60–900 mg). Next, the use of vitamin B_6 (24%) with a median dose of 5 mg (4.25–5 mg) was often reported as a common product with magnesium, which was used in combination or separately in 34% of all patients. Omega-3 fatty acids were less common (4%). The patients' dietary habits included use of functional food with bread (margarine with plant stanol esters) in 16%, bread spread with butter in 48% and bread spread with margarine in 6%. Twenty-five percent of the patients did not use any additional fat to spread the bread with. The herbals or botanicals were used in 19% (Table 2). Other supplements were used in 13% and are listed in Table 3.

For further analysis in this pilot study the usage was compared according to sex, age, professional activity, body mass index (BMI), left ventricular ejection fraction, smoking, type of the MI, previous history of MI, and presence of diabetes mellitus or hypertension (Table 4). All patients who presented with age above retirement age (N = 46) claimed to withdraw from professional activity.

Statistically significant differences were observed in 4 comparisons according to sex (female vs. male), age (<60 years old vs. ≥60 years old), retirement age (≥60 years old for women and ≥65 years old for men) and BMI (<24.9 kg/m^2 vs. ≥25.0 kg/m^2). Females statistically more often used all vitamins (70.8% vs. 47.4%, p = 0.045), vitamin D (54.2% vs. 28.9%, p = 0.024), omega-3 fatty acids (12.5% vs. 1%, p = 0.042) and herbs and botanicals (14.5% vs. 11%, p = 0.040) in their everyday diet (counts are presented in Table 4). Next, patients in the age of ≥60 years as well as the patients above the retirement age and not active professionally had a significantly more frequent use of OTC drugs (53.3% vs. 20%, p < 0.001 and 56.5% vs. 25.9%, p = 0.002). The participants >60 years also use more herbals or botanicals (23.3% vs. 17.5%, p = 0.019). The use of multivitamin/multimineral dietary supplements was significantly less common among patients with normal weight compared to overweight and obese (15% vs. 42.5%, p = 0.035). The differences between the study groups were not observed in the comparison of magnesium use and vitamin C use.

The difference in the use of the most reported dietary supplements, vitamins, herbs, and functional foods in the study population was compared according to the type of MI (ST-segment elevation myocardial infarction [STEMI]/non-ST-segment elevation myocardial infarction [NSTEMI]), history of MI (yes/no), smoking (yes/no), diabetes mellitus type 2 or hypertension was evaluated and the authors observed no significant differences. The only

Table 1. Characteristics of the study group of patients treated for myocardial infarction (MI) in the Medical University of Warsaw cardiology departments in August 2021–August 2022, Poland

Variable	Participants (N = 100)
Age [years] (M±SD)	60.8±9.5
Sex (male) [n]	76
Smoking status [n]	
smokers	42
non-smokers	58
history of smoking	7
Age ≥60 years [n]	60
Retiring age reached* [n]	46
BMI	
≥25.0 kg/m^2 [n]	73
kg/m^2 (Me (1st–3rd quartile))	27.9 (25.8–30.7)
Ejection fraction	
<50% [n]	50
% (Me (1st–3rd quartile))	49 (45–55)
Myocardial infarction [n]	
STEMI	45
NSTEMI	53
History of MI [n]	11
Hypertension [n]	65
Diabetes mellitus type 2 [n (%)]	23 (22)
Impaired fasting glucose [n]	28
Cholesterol [mg/dl]	
total (M±SD)	182±42
LDL (M±SD)	113±36
HDL (Me (1st–3rd quartile))	41 (34–49)
Triglycerides [mg/dl] (Me (1st–3rd quartile))	118 (69–188)
HbA_{1c} [%] (Me (1st–3rd quartile))	5.5 (5.2–5.7)

HbA_{1c} – glycated hemoglobin A_{1c}; NSTEMI – non-ST-segment elevation myocardial infarction; STEMI – ST-segment elevation myocardial infarction.
* ≥60 years for women and ≥65 years for men.

statistically significant difference in the use of margarine containing plant stanol esters, margarine, butter, or no additional fat to spread the bread in comparison between the groups was that the patients with STEMI more frequently used butter (p = 0.019).

Table 2. Use of over-the-counter (OTC) drugs, dietary supplements, nutraceuticals, herbs, functional foods and dietary habits among the study group of patients treated for myocardial infarction (MI) in Medical University of Warsaw cardiology departments in August 2021–August 2022, Poland

Substance/Product/Food	Participants (N = 100) [n]
OTC drugs	40
Any dietary supplements	59
Vitamins	53
Magnesium	34
Multivitamin/multimineral dietary supplements	36
Vitamin D	35
Vitamin C	20
Vitamin B_6	24
Omega-3 fatty acids	4
Other supplements	13
Any functional food	21
bread spread with margarine containing plant stanol esters	16
other functional food	5
Bread spread	
with butter	48
with margarine	6
without additional fat	25
Herbals or botanicals	19
Other non-classified	1

It needs to be noted that in clinical practice some proportion of patients does not undergo PCI following coronarography. Therefore the presented results – in particular the STEMI vs. NSTEMI subgroup comparison – should be interpreted only in the context of invasively managed MI.

DISCUSSION

This pilot study among Polish patients after a median time of 12.3 months from MI, evaluated the usage of dietary supplements, nutraceuticals and functional foods in their everyday diet. According to the authors' best knowledge

Table 3. Using specific herbs, botanicals, or other nonvitamin/nonmineral dietary supplements after 6 months from myocardial infarction in the study group of patients treated for myocardial infarction (MI) in the Medical University of Warsaw cardiology departments in August 2021–August 2022, Poland

Substance/Product/Food	Participants (N = 100) [n]
Vitamins	
vitamin D	35
vitamin C	20
vitamin B_6	24
vitamin B_{12}	6
vitamin K	4
vitamin E	4
vitamin A	3
vitamin B_2	1
vitamin K_2	1
Other dietary supplements	
magnesium and vitamin B_6	23
ginseng, iron and vitamin B	1
coenzyme Q10 and vitamin B_2	1
taurine	1
coenzyme Q10	1
other	6
Minerals	
magnesium	34
iron	6
potassium	6
zinc	2
Functional food	
plant stanol esters	16
omega-3 fatty acids	3
omega-6 fatty acids	1
Nutridrink®	1
high protein foods	1
products for diabetics	1
Herbs	
lemon balm and hop cones	2
ginkgo biloba	2
evening primrose oil	2
Morbus alba	2
medical cannabis	2
acai berry	1
lemon balm and hawthorn fruit	1
Levicistum officinale	1
citrus bioflavonoids	1
Tagetes erecta and chokeberry extract	1
Gymnema Sylbestre leaf	1
lutein	1
artichoke oil	1
black turnip extract	1
ashwagandha	1

it is the first study addressing this issue among patients in the early months after MI.

In the authors' pilot study the patients mostly reported to use dietary supplements in form of vitamins. The authors observed that these patients more often used dietary supplements than it was reported in the general Polish population. According to the study conducted by Stoś et al. [16] minority of adults in Poland declared the use of food supplements during the year (up to 10%) in comparison to 59% in the study group.

In this study group all patients above retirement age claimed to withdraw from professional activity. This is more than in general population. According to the data for Poland, 2022, as many as 70.3% of those eligible were granted pension by Social Insurance Fund on the date they reached retirement age, including as many as 77.7% of men and 64.5% of women [17]. Nevertheless, according to the law people receiving pension can still be professionally active [18]. As the data on how many pensioners are professionally active is not published, the authors cannot compare exact numbers concerning professional activity. When patients after MI are considered, around 81% of all patients after various coronary events including MI

Table 4. The use of chosen results for products/drugs/supplements/drugs in the specific groups of the patients in the study group in the study group of patients treated for myocardial infarction (MI) in the Medical University of Warsaw cardiology departments in August 2021–August 2022, Poland

Variable	OTC drugs		Any dietary supplements		Multivitamin/ multimineral dietary supplements		Vitamin						Omega-3 fatty acids		Functional foods		Herbals or botanicals	
							all		D		B_6							
	n (%)	p	n (%)	p	n (%)	p	n (%)	p	n (%)	p	n (%)	p	n (%)	p	n (%)	p	n (%)	p
All participants	40 (40.0)	–	59 (59.0)	–	36 (36.0)	–	53 (53.0)	–	35 (35.0)	–	24 (24.0)	–	4 (4.0)	–	21 (21.0)	–	19 (19.0)	–
Sex		0.503		0.068		0.507		**0.045**		**0.024**		0.895		**0.042***		0.089		**0.040**
female	11 (45.8)		18 (75.0)		10 (41.7)		17 (70.8)		13 (54.2)		6 (25.0)		3 (12.5)		8 (33.3)		8 (33.3)	
male	29 (38.2)		41 (53.9)		26 (34.2)		36 (47.4)		22 (28.9)		18 (23.7)		1 (1.3)		13 (17.1)		11 (14.5)	
Age																		
years		**<0.001**		0.135		0.061		0.086		0.199		0.214		0.648*		0.483		**0.019***
<60 years	8 (20.0)		20 (50.0)		10 (25.0)		17 (42.5)		11 (27.5)		7 (17.5)		1 (2.5)		7 (17.5)		3 (7.5)	
≥60 years	32 (53.3)		39 (65.0)		26 (43.3)		36 (60.0)		24 (40.0)		17 (28.3)		3 (5.0)		14 (23.3)		16 (26.7)	
professional activity		**0.002**		0.115		0.308		0.146		0.424		0.652		0.331*		0.509		0.095
pre-retirement	14 (25.9)		28 (51.9)		17 (31.5)		25 (46.3)		17 (31.5)		12 (22.2)		1 (1.9)		10 (18.5)		7 (13.0)	
retirement	26 (56.5)		31 (67.4)		19 (41.3)		28 (60.9)		18 (39.1)		12 (26.1)		3 (6.5)		11 (23.9)		12 (26.1)	
BMI		0.478		0.514		**0.035***		0.624		0.870		**0.035***		0.574*		1*		0.471
<24.9	7 (35.0)		11 (55.0)		3 (15.0)		10 (50.0)		7 (35.0)		1 (5.0)		0 (0.0)		4 (20.0)		5 (25.0)	
≥25.0	32 (43.8)		46 (63.0)		31 (42.5)		41 (56.2)		27 (37.0)		21 (28.8)		4 (5.5)		15 (20.5)		13 (17.8)	
Ejection fraction		0.592		0.269		0.578		0.132		0.162		0.510		0.617*		0.430		0.474
<50%	21 (42.0)		32 (64.0)		19 (38.0)		30 (60.0)		21 (42.0)		13 (26.0)		3 (6.0)		9 (18.0)		11 (22.0)	
≥50%	18 (36.7)		26 (53.1)		16 (32.7)		22 (44.9)		14 (28.6)		10 (20.4)		1 (2.0)		12 (24.5)		8 (16.3)	
Myocardial infarction																		
history		0.517*		1*		0.741*		0.943		1*		0.287*		1*		1*		0.117*
yes	3 (27.3)		7 (63.6)		3 (27.3)		6 (54.5)		4 (36.4)		1 (9.1)		0 (0.0)		2 (18.2)		0 (0.0)	
no	37 (42.0)		52 (59.1)		33 (37.5)		47 (53.4)		31 (35.2)		23 (26.1)		4 (4.5)		19 (21.6)		19 (21.6)	
type		0.573		0.501		0.650		0.326		0.716		0.631		0.622*		0.377		0.162
STEMI	17 (37.8)		25 (55.6)		15 (33.3)		21 (46.7)		16 (35.6)		10 (22.2)		1 (2.2)		7 (15.6)		6 (13.3)	
NSTEMI	23 (43.4)		33 (62.3)		20 (37.7)		30 (56.6)		17 (32.1)		14 (26.4)		3 (5.7)		12 (22.6)		13 (24.5)	
Smoking status		0.741		0.252		0.082		0.359		0.470		0.970		0.137*		0.161		0.124
smokers	16 (38.1)		22 (52.4)		11 (26.2)		20 (47.6)		13 (31.0)		10 (23.8)		0 (0.0)		6 (14.3)		5 (11.9)	
non-smokers	24 (41.4)		37 (63.8)		25 (43.1)		33 (56.9)		22 (37.9)		14 (24.1)		4 (6.9)		15 (25.9)		14 (24.1)	

Table 4. The use of chosen results for products/drugs/supplements/drugs in the specific groups of the patients in the study group in the study group of patients treated for myocardial infarction (MI) in the Medical University of Warsaw cardiology departments in August 2021–August 2022, Poland – cont.

Variable	OTC drugs		Any dietary supplements		Multivitamin/ multimineral dietary supplements		Vitamin						Omega-3 fatty acids		Functional foods		Herbals or botanicals	
							all		D		B_6							
	n (%)	p	n (%)	p	n (%)	p	n (%)	p	n (%)	p	n (%)	p	n (%)	p	n (%)	p	n (%)	p
Diabetes mellitus type 2		0.298		0.155		1		0.914		0.911		0.578*		1*		0.430		0.553*
yes	11 (50.0)		16 (72.7)		8 (36.4)		12 (54.5)		8 (36.4)		4 (18.2)		1 (4.5)		6 (27.3)		3 (13.6)	
no	29 (37.7)		43 (55.8)		28 (36.4)		41 (53.2)		27 (35.1)		20 (26.0)		3 (3.9)		15 (19.5)		16 (20.8)	
Hypertension		0.750		0.586		0.873		0.610		0.664		0.905		0.605*		0.355		0.428
yes	27 (41.5)		40 (61.5)		24 (36.9)		36 (55.4)		22 (33.8)		16 (24.6)		2 (3.1)		12 (18.5)		11 (16.9)	
no	13 (38.2)		19 (55.9)		12 (35.3)		17 (50.0)		13 (38.2)		8 (23.5)		2 (5.9)		9 (26.5)		8 (23.5)	

NSTEMI – non-ST-segment elevation myocardial infarction; STEMI – ST-segment elevation myocardial infarction.
Bolded are p-values <0.05.
* The results of Fisher's exact test; otherwise χ^2 was used.

return to work, but only 65% among patients aged ≥54 years according to the metanalyses [19]. Although, it should be noticed that the authors' study population was older (M = 60.76 years).

Older patients from the study group ≥60 years old as well as the patients that have already reached the retirement age were more likely to use the OTC drugs. The OTC drugs compromise a variety of substances which can be bought without doctor's prescription nor indication. They are often misunderstood by the patients as they assign dietary supplements or minerals use as OTC drugs use. Generally, less restrictive regulations apply to the production and sale of dietary supplements [6] than drugs, nevertheless their use should be always advised, especially among the patients with past medical history. Significant effort on the education should be put, especially among the older patients to increase the awareness about the difference between drugs and supplements and prevent any fatal consequences of the overuse or drug-to-drug or drug-to-supplement interactions.

All vitamins and the most common vitamin D were also more frequently used by women. Basing on the demographic data the authors assume that the use of vitamin D in women M±SD 61±9 years old observed in study may be also associated with recommendations on prevention and treatment of osteoporosis [20]. More studies on the usage of dietary supplements among females experiencing CVDs are needed.

Vitamin D supplementation generally may have multiple potential ways in which it may be positive for general health, but it may be also advantageous in prevention of CVDs [21,22]. However, systematic reviews performed on longitudinal studies and randomized controlled trials proved that the data on vitamin D supplementation impact on CVD risk is rather inconclusive, randomized control trials of its supplementation do not lower the incidence of cardiovascular events, and the newest ESC guidelines on prevention of CVDs do not clearly recommend its use [5,23,24].

As for the other frequently used vitamin B_6, more popular among patients with BMI ≥25 kg/m^2, the data from the literature on its supplementation is inconclusive, and it is not recommended by the guidelines [5,25].

Apparently, unlikely any dietary supplements use, the use of nutraceuticals and the use of polyunsaturated fats such as omega-3 fatty acids has been widely proven to be effective in the prevention of CVD and coronary artery disease [5]. Both American Heart Association (AHA) [26] and ESC [5] clearly recommend their use. However, in the authors' study group the most used nutraceutical, the omega-3 fatty acids were used only by 4% patients, which was a relatively low proportion in comparison to dietary supplements use. Women were more likely to use omega-3 fatty acids than men. Further studies should address this issue and the guidelines should be applied more into the everyday practice, especially among the patients under the current care of cardiologists and dieticians.

Next, the ESC suggests a target LDL-C of ≥55 mg/dl (1.4 mmol/l) and a minimum reduction of LDL-C >50% from baseline levels in patients after MI [4]. In Poland, one of the available functional foods for the patients following MI is the margarine containing plant stanol esters. Sterols/stanols have the potential to modify the plasma lipid profile [10,11]. Therefore, the questions provided in the survey also included the product to spread the bread with, basing on common dietary traditions in the region. Minority of the patients surveyed used margarine containing plant stanol esters. In contrary, despite the consultation with dietician and recommendations from cardiologist in the coordinated care program, 48% of patients still used butter to spread the bread with.

Nevertheless, the product used to spread the bread with, as well as the use of omega-3 fatty acids may depend on many possible factors such as the regional availability, marketing, financing, education, attitude, habits etc.[27].

The authors found that older patients were more likely to use herbs than the patients <60 years, although still relatively few of them, as each of the herb was used max. in 2%. There are more and more preclinical studies on possible positive impact of herbs such as *Gingko biloba* and flavonoids on CVDs [28]. Unfortunately, the clinical data on herbs impact on CVDs is very limited. Although some possible positive effects have been proven in preclinical studies [28], none of the substances have been proven effective in randomized clinical trials, therefore are recommended in the guidelines [5]. Moreover, the uncontrolled use of herbs may lead to adverse effects and herb-drug interactions [29]. Further studies are needed to establish their role in the prevention of CVD.

As for the population studies, dietary supplements use has been widely studied mostly on the population of USA. In the National Health and Nutrition Examination Survey (NHANES) conducted in USA, 52% of adults reported taking any dietary supplement in the past 30 days [13]. Recently the authors have observed an alarming increase in the dietary supplements' market in the region. Their availability and intensive advertising may result in their unjustified use, although according to the data from 2019/2020 claim that minority of Polish residents use any dietary supplements [16,30,31].

The authors' preliminary findings however must be interpreted in the context of some limitations. The data from surveys may not be accurate as the patients may have not listed everything they usually take, or change the name of the products, or list the products they do not use, therefore there is a risk of under- or overreporting of nutrients intake in this study. What is more, supplement intake may not necessarily correspond to the nutritional status measured by the laboratory methods because of varied bioavailability of nutrients from different foods and individual differences in metabolism. Next, the authors did not collect the information about the time the patients were using the product. Further research on larger popu-

lation is warranted to further evaluate this issue including blood sampling in order to objectively measure the effect of intake.

CONCLUSIONS

Taking into consideration the societal development as well as changing social and marketing trends, interventional and pharmacological treatment should be supported by the lifestyle modification and particularly dietary habits enhancement among the patients following MI. In the pilot study the authors showed that the patients in a long-term follow-up after MI use dietary supplements, nutraceuticals and functional foods in their everyday diet more often in comparison to population studies. Vitamins, especially vitamin D are the most commonly used dietary supplements among the patients following MI.

The use of dietary supplements, especially vitamins is associated with age, and therefore the professional activity. Also, it depends on the sex of the patients following MI, as well as their BMI. In contrary to the significantly more common usage of dietary supplements, relatively small proportion of patients following MI use functional foods. The potential beneficial effect of functional foods requires further evaluation in clinical longitudinal studies.

Author contributions

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REFERENCES

1. Timmis A, Vardas P, Townsend N, Torbica A, Katus H, De Smedt D, et al. European Society of Cardiology: cardiovascular disease statistics Eur Heart J. 2022;43:716-799. https://doi.org/10.1093/eurheartj/ehab892.
2. Ibanez B, James S, Agewall S, Antunes MJ, Bucciarelli-Ducci C, Bueno H, et al. ESC Scientific Document Group 2017 ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation: The Task Force for the management of acute myocardial infarction in patients presenting with ST-segment elevation of the European Society of Cardiology (ESC). Eur Heart J. 2018; 39(2):119-177. https://doi.org/10.1093/eurheartj/ehx393.
3. Collet JP, Thiele H, Barbato E, Barthélémy O, Bauersachs J, Bhatt DL, et al. ESC Scientific Document Group 2020 ESC Guidelines for the management of acute coronary syndromes in pa-tients presenting without persistent ST-segment elevation. Eur Heart J 2021;42(14):1289-1367. https://doi.org/10.1093/eurheartj/ehaa575.
4. Mach F, Baigent C, Catapano AL, Koskinas KC, Casula M, Badimon L, et al. 2019 ESC/EAS Guidelines for the management of dyslipidaemias: lipid modification to reduce cardiovascular risk [published correction appears in Eur Heart J. 2020 Nov 21;41(44):4255]. Eur Heart J. 2020;41(1):111-188. https://doi.org/10.1093/eurheartj/ehz455.
5. Visseren FLJ, Mach F, Smulders YM, Carballo D, Koskinas KC, Bäck M, et al. ESC National Cardiac Societies; ESC Scientific Document Group 2021 ESC Guidelines on cardiovascular disease prevention in clinical practice. Eur Heart J 2021;42(34):3227-3337. https://doi.org/10.1093/eurheartj/ehab484.

6. [Directive 2002/46/EC of the European Parliament and of the Council of 10 June 2002 on the approximation of the laws of the Member States relating to food supplements. Off. J. Eur. Communities L 183:51–57.
7. Goudarzi S, Memar Montazerin S, Najafi H, Shojaei F, Chi G Effect of Vitamins and Dietary Supplements on Cardiovascular Health. Crit Pathw Cardiol. 2020;19(3):153-159. https://doi.org/10.1097/HPC.0000000000000212.
8. Defelice SL Foundation for Innovation in Medicine Rationale and Proposed Guidelines for the Nutraceutical Research and Education Act. J nutraceuticals funct med foods 2020;2(1):43-52. https://doi.org/10.1300/J133v02n01_05.
9. Gul K, Singh AK, Jabeen R. Nutraceuticals and Functional Foods: The Foods for the Future World. Crit Rev Food Sci Nutr 2016;56(16):2617-2627. https://doi.org/10.1080/10408398.2014.903384.
10. Christiansen LI, Lähteenmäki PL, Mannelin MR, Seppänen-Laakso TE, Hiltunen RV, Yliruusi JK. Cholesterol-lowering effect of spreads enriched with microcrystalline plant sterols in hypercholesterolemic subjects. Eur J Nutr 2001;40(2):66-73. https://doi.org/10.1007/s003940170017.
11. AbuMweis SS, Jones PJ. Cholesterol-lowering effect of plant sterols. Curr Atheroscler Rep. 2008;10(6):467-472. https://doi.org/10.1007/s11883-008-0073-4.
12. Das L, Bhaumik E, Raychaudhuri U, Chakraborty R. Role of nutraceuticals in human health. J Food Sci Technol 2012; 49(2):173-183. https://doi.org/10.1007/s13197-011-0269-4.
13. Radimer K, Bindewald B, Hughes J, Ervin B, Swanson C, Picciano MF. Dietary supplement use by US adults: Data from the National Health and Nutrition Examination Survey, 1999–2000. Am J Epidemiol 2004;160(4):339-349. https://doi.org/10.1093/aje/kwh207.
14. Rabito MJ, Kaye AD. Complementary and alternative medicine and cardiovascular disease: an evidence-based review. Evid Based Complement Alternat Med 2013 2013;2013: 672097. https://doi.org/10.1155/2013/672097.
15. Marathe PA, Kamat SK, Tripathi RK, Raut SB, Khatri NP. Over-the-counter medicines: Global perspective and Indian scenario. J Postgrad Med 2020;66(1):28-34. https://doi.org/10.4103/jpgm.JPGM_381_19.
16. Stoś K, Woźniak A, Rychlik E, Ziółkowska I, Głowala A, Ołtarzewski M. Assessment of Food Supplement Consumption in Polish Population of Adults. Front Nutr. 2021;8:733951. https://doi.org/10.3389/fnut.2021.733951.
17. Information on cash benefits from the Social Insurance Fund and certain social security benefits – Q4/period I–XII 2022 in Poland [Internet] [cited 2023 Jun 16]. Available from: https://www.zus.pl/baza-wiedzy/statystyka/kwartalne-informacje-o-swiadczeniach-pienieznych-z-fus-oraz-o-innych-swiadczeniach.
18. [The Polish Act dated 17 December 1998 on Old-Age and Disability from Social Insurance Fund as amended.] Polish.
19. Kai SHY, Ferrières J, Rossignol M, Bouisset F, Herry J, Esquirol Y. Prevalence and determinants of return to work after various coronary events: meta-analysis of prospective studies. Sci Rep 2022;12(1):15348. https://doi.org/10.1038/s41598-022-19467-z.
20. [Directive 2002/46/EC of the European Parliament and of the Council of 10 June 2002 on the approximation of the laws of the Member States relating to food supplements.] European Union
21. Avenell A, Mak JC, O'Connell D. Vitamin D and vitamin D analogues for preventing fractures in post-menopausal women and older men. Cochrane Database Syst Rev. 2014; 2014(4):CD000227. https://doi.org/10.1002/14651858.CD000227.pub4.
22. Aggarwal R, Akhthar T, Jain SK.Coronary artery disease and its association with Vitamin D deficiency. J Midlife Health 2016;7(2):56-60. https://doi.org/10.4103/0976-7800.185334.
23. Dziedzic EA, Gąsior JS, Pawłowski M, et l.. Vitamin D level is associated with severity of coronary artery atherosclerosis and incidence of acute coronary syndromes in non-diabetic cardiac patients. Arch Med Sci. 2019;15(2): 359–368. https://doi.org/10.5114/aoms.2019.83291.
24. Manson JE, Cook NR, Lee IM, et al. Vitamin D Supplements and Prevention of Cancer and Cardiovascular Disease. N Engl

J Med. 2019;380(1):33-44. https://doi.org/10.1056/NEJMoa1809944.

25. Pittas AG, Chung M, Trikalinos T, Mitri J, Brendel M, Patel K, Lichtenstein AH, Lau J, Balk EM (2010) Systematic review: Vitamin D and cardiometabolic outcomes. Ann Intern Med. 2010;152(5):307-314. https://doi.org/10.7326/0003-4819-152-5-201003020-00009.
26. Friso S, Lotto V, Corrocher R, Choi SW. Vitamin B6 and cardiovascular disease. Subcell Biochem 2012;56:265-290. https://doi.org/10.1007/978-94-007-2199-9_14.
27. Siscovick DS, Barringer TA, Fretts AM, Wu JH, Lichtenstein AH, Costello RB, et al.American Heart Association Nutrition Committee of the Council on Lifestyle and Cardiometabolic Health; Council on Epidemiology and Prevention; Council on Cardiovascular Disease in the Young; Council on Cardiovascular and Stroke Nursing; and Council on Clinical Cardiology Omega-3 Polyunsaturated Fatty Acid (Fish Oil) Supplementation and the Prevention of Clinical Cardiovascular Disease: A Science Advisory From the American Heart Association. Circulation 2017;135:e867-e884. https://doi.org/10.1161/CIR.0000000000000482.
28. Iłowiecka K, Maślej M, Czajka M, Pawłowski A, Więckowski P, Styk T, et al. Lifestyle, Eating Habits, and Health Behaviors Among Dietary Supplement Users in Three European Countries. Front Public Health 2022;10:892233. https://doi.org/10.3389/fpubh.2022.892233.
29. Shaito A, Thuan DTB, Phu HT, Nguyen THD, Hasan H, Halabi S, et al. Herbal Medicine for Cardiovascular Diseases: Efficacy, Mechanisms, and Safety. Front Pharmacol 2020;11:422. https://doi.org/10.3389/fphar.2020.00422.
30. Piórecka B, Koczur K, Cichocki R, Jagielski P, Kawalec P. Socio-Economic Factors Influencing the Use of Dietary Supplements by Schoolchildren from Małopolska Voivodship (Southern Poland). Int J Environ Res Public Health 2022;19:7826. https://doi.org/10.3390/ijerph19137826.
31. Hys K Impact of Advertising on the Sale of Medical Products and Food Supplements in Poland. Zarządzanie Teoria i Praktyka 2018;22:27–33.