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How far from MACROadhering to dietary cardiovascular guidelines are women with obesity?

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Abstract

Background. Following dietary recommendations is essential in preventing and managing CVD; however, several studies show that patients with obesity are far from adhering to dietary cardiovascular guidelines. ***Aim***. Our study aimed to assess the macronutrient intake – including simple sugars, fibre, and fatty acids – among women with obesity and address it to dietary guidelines, beneficial from the cardiovascular perspective. ***Materials and Methods***. The study group included women under 50 years of age suffering from obesity and women under 50 years of age with correct body weight recruited as a control group. Dietary intakes were assessed by 4-day food records, including one day on the weekend. ***Results***. 45 women were included in the study (29 from the study group and 16 from the control group). Only SFA, PUFA, and omega-3 intakes differed significantly between women with obesity and normal body weight. However, non-compliance with cardiovascular-beneficial dietary guidelines was observed in both groups. ***Conclusions***. Women with obesity – as a group with increased cardiovascular risk – should pay more attention to macronutrient intakes, especially to the quality of fat and fibre intake, as a behavioural part of preventive and management actions in the context of cardiovascular disease. *(Farm Współ 2023; 16: 63-71) doi: 10.53139/FW.20231617*

Keywords: cardiovascular disease; women; obesity; dietary guidelines; macronutrient intake

Introduction

Cardiovascular disease (CVD) is the leading cause of death (apart from low-income countries), and in 2017 there were almost 20 million new cases of CVD in European countries. Moreover, it is estimated that over 75% of premature CVD could be prevented by changing behavioural habits, including unhealthy diet [1]. Although it could suggest a potentially straightforward approach to decrease CVD prevalence and mortality, currently available data show that many patients, especially those with obesity, are far from adhering to CVD lifestyle recommendations, including dietary guidelines [2]. Furthermore, numerous pieces of evidence suggest a strong need for undertaking sex-specific strategies that could improve guidelines for preventing and managing CVD in both sexes. More attention is also put to sex differences in dietary behaviours and their relation to health outcomes as a potential explanation for observed different CV risks between men and women [3].

Although epidemiological studies reasonably focus on overall dietary patterns, e.g., following the Mediterranean or Dietary Approach to Stop Hypertension diets, other epidemiological studies also concentrate on the role of macronutrient intake and their quality – also in women only [4] – and recommendations regarding macronutrient intake

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can still be found in general CV guidelines. However, only several studies – conducted among women with obesity – can be found that assessed macronutrient intake and chosen CV endpoints. For example, in the study of Gribbin et al., women with the lowest CV risk (OR 0.56, 95% CI 0.35 to 0.91, p=0.02) consumed 41-44.3% of total energy intake (TEI) from carbohydrates (when compared to <37.1% of TEI) [5]. Moreover, in the study of Du et al., among women with excessive body weight, dietary fibre (especially from grains) was associated with a reduced risk of systolic hypertension [6]. Furthermore, the highest intake of saturated fatty acids (SFAs) increased the risk of sudden cardiac death by two times compared to the lowest intake, and each 5% of increased SFAs intake increased the risk of SCD (sudden cardiac death) by 11% [7]. However, it should be noted that data regarding total fat intake and its quality are not always consistent, and other studies showed no correlation between fat intake (and type) and CV risk [5]. In the study of Hu et al., a protein intake equal to 24% of TEI decreased the risk of ischemic heart disease by 25% (compared to the lowest intake – 14.7% of TEI) [8].

Although the data clearly stress the value of adhering to dietary guidelines, low adherence to recommended dietary intakes can be seen among women with excessive body weight. Nevertheless, studies assessing adherence to dietary guidelines or habitual macronutrient intake, especially in the context of CVD recommendations and among women with obesity, are currently lacking. For example, in the WOBASZ II study conducted on the Polish population, 26.6%, 48.4%, and 49.7% of women consumed the recommended amount of total fat, carbohydrates, and protein, respectively [2]. Moreover, women with obesity were also far from adhering to SFAs and polyunsaturated fatty acids (PUFA) intakes – 23.3% and 30.6% of women consumed recommended amounts. Similar results in adherence to the recommended intake of SFA and PUFA can be seen in a study by Stepaniak et al., where among women with a mean BMI equal to 28.3 kg/m^{2,} the mean consumption of SFA and PUFA was 14% and 5%, respectively, which was non-compliant with dietary recommendations [9]. Interestingly, the study of Zhao et al. reported sex-related disparities in energy and macronutrient intake [10]. Women with excessive body weight consumed significantly more % of TEI from carbohydrates than males (50.6% vs. 49.5%), and the dietary protein intake was significantly lower than among males (13.1% vs. 13.4%).

Following dietary recommendations is essential in the prevention and management of CVD. However, currently, studies assessing the adherence to dietary intakes recommendations are lacking, and, therefore, our preliminary study aimed to assess the macronutrient intake – including simple sugars, fibre, and fatty acids – among women with obesity and address it to general dietary guidelines that are beneficial from the cardiovascular perspective (dietary intakes based on European Society of Cardiology/ European Atherosclerosis Society (ESC/EAS, Nutrition Standards for the Polish population and World Health Organization (WHO)).

Materials and Methods

Participants

Patients were recruited from the Department of Gastroenterology, Dietetics, and Internal Diseases outpatient clinic. The study group included women between 30-50 years of age suffering from obesity – with body mass index (BMI) ≥ 30.00 kg/m^2 and enhanced body fat-mass content – and women under 50 years of age with normal body weight – BMI 18.50-24.99 kg/m^2 – recruited as a control group. The recruitment was based on the questionnaire survey (questions about inclusion and exclusion criteria) and included 118 patients at the beginning. However, after excluding patients not meeting the inclusion criteria, without dietary information, and with total energy intake out of predefined limits (following recommendations by Willet in Nutritional Epidemiology), a total number of 45 were included in the study (29 from the study group and 16 from the control group) (Figure 1). More specific inclusion and exclusion criteria have been listed in Supplementary Table S1. Exclusion criteria included any contraindications to performing bioimpedance analysis, following the alternative diet, and diseases affecting nutritional and hormonal status. Written informed consent was obtained from all participants, and the Ethical Committees of the Poznan University of Medical Sciences approved the study.

Dietary assessment

Participants were asked to follow their usual diet. Dietary intakes were assessed by 4-day food records, including one day on the weekend. All consumed foods and drinks were requested, and instructions on collecting appropriate dietary data were provided

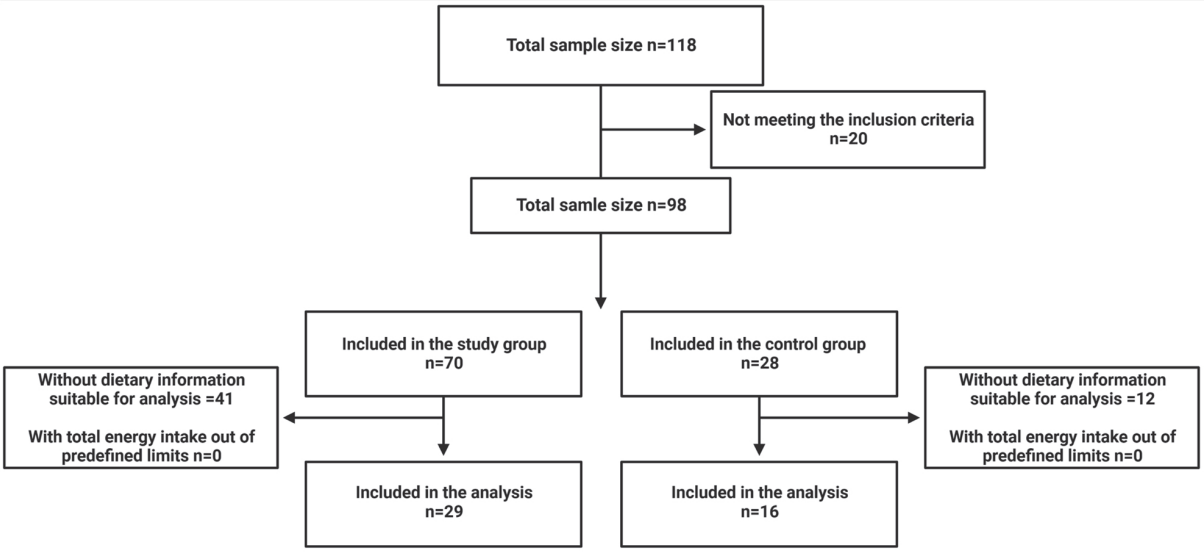

Figure 1. Flow chart of participants

to the participants. Dietary intakes were recorded by weight (encouraged) or common household servings if a weight scale was unavailable. After completion, trained nutritionists ensured a level of describing foods and food preparation methods was provided. Further, data were analyzed using Dieta 6.0 made by the National Food and Nutrition Institute (Poland). If data was recorded by household servings, the album of photographs of food products and dishes (National Food and Nutrition Institute, Poland) was used while introducing the data.

Anthropometric measures

Bioelectrical impedance measure was performed using Tanita MC180– a multifrequency segmental body composition analyzer available at the Department of Gastroenterology, Dietetics, and Internal Diseases. The measurements were performed according to the following rules: bladder voided, fasting or 2-3 hours after a meal (in this study, measurements were performed early in the morning and in the fasted state), and no alcohol the day before the measurement.

Recommended intakes of macronutrients

According to the Nutrition Standards for the Polish population, we have established 35% of total fat intake as the upper recommended intake (per the European guidelines, which discourages total fat intake higher than 35-40% of total energy intake). For SFA, Polish recommendations suggest as low intake as possible; however, as the cut-off point, we have established <10% of total energy, according to the ESC/EAS Guidelines [11]. For cholesterol intake, an upper intake equal to 300 mg was established, per the Polish and ESC/EAS recommendations. Regarding the recommended carbohydrate and simple sugars intakes, we have decided to follow ESC/EAS guidelines, which suggest intakes equal to 45-55% and <10% of total energy intake, respectively. According to the Polish recommendations, minimal fibre intake should be equal to 25 g/day; however, we have decided to increase the recommended intake to at least 30 g/day – the median value of the ESC/EAS recommendations – since higher fibre intake is recommended in both CV guidelines as a part of behavioural treatment of obesity. Similar to another study on the Polish population – WOBASZ II – we established PUFA intake according to the WHO guidelines [12].

Statistical analysis

The quantitative data were analyzed using the Student's t-test in case data followed a normal distribution (Shapiro-Wilks test). The Mann-Whitney test was applied if the data did not follow the normal distribution. The results are presented as means and standard deviations or medians and interquartile ranges. The

categorical data were compared using the chi-square test for independence. The analysis was conducted using the statistical package Statistica PL13 TIBCO Software Inc. (2017). Statistica (data analysis software system), version 13. http://statistica.io.

All tests were two-tailed and were considered statistically significant at $p < 0.05$.

Results

The main characteristic of the study participants is shown in table I. Women in the study group had significantly higher amounts of fat tissue, muscle mass, fat-free mass, and visceral tissue than those in the control group. The control group had higher percentages of total body water (%TBW) than the study group; however, it should be noted that when the amount of adipose tissue is increased – like in obesity – %TBW could be false-lowered, even when fluid intake is correct. Therefore, among patients with obesity, %TBW should always be interpreted in the context of total fluid intake, and – in this analysis – the statistically significant differences between those two groups should be interpreted with caution, as data regarding total fluid intake are not included in this study.

When comparing the intakes and the proportion of participants consuming the recommended amount of macronutrients, statistically significant differences can be seen in SFA and PUFA (for mean intakes and proportion of patients) and omega-3 intake (only for median intake) (tables II and III, figure 2).

The percentage of mean intakes of carbohydrates, simple sugars, fat, and protein did not differ between the two groups and can be considered adherent to

Table I. The characteristic of the study and control group

	Total (n=45)	Study group (n=29)	Control group (n=16)	p
Age (years)	41.13±5.98	40.69±6.33	41.94±5.38	
BMI kg/m², n (%) 18,5-24,9 30-34,9 35-39,9 40	 16 (35.56%) 12 (26.66%) 7 (15.56%) 10 (22.22%)	 12 (41.38%) 7 (24.13%) 10 (24.48%)	 16 (100.00%)	
BIA FT, % MM, kg FFM, kg Visceral tissue1 TBW, %	 38.80 (28.50-42.30) 52.75 (45.60-59.50) 54.90 (48.05-62.10) 8.00 (4.00-11.00) 43.70 (41.20-50.90)	 41.70 (39.00-43.20) 57.05 (52.75-62.05) 60.10 (55.55-65.35) 11.00 (8.00-12.00) 41.50 (40.60-43.60)	 27.55 (23.75-29.20) 43.70 (42.28-45.93) 46.03 (44.63-48.30) 3.50 (3.00-4.00) 51.85 (50.40-54.35)	 <0.001 <0.001 <0.001 <0.001 <0.001

Values with normal distribution are presented as mean ± SD (to compare two groups student's t-test was used), and values without normal distribution are presented as median and quartiles (to compare two groups Mann-Whitney test was used) BIA – bioimpedance analysis; BMI – body mass index; FFM – fat free mass; FT – fat tissue; MM – muscle mass; TBW – total body water. 1- according to the body composition analyzer, increased visceral tissue is when the level exceeds 12; however, even with lower values, decreasing visceral adiposity levels is recommended with the diagnosis of obesity

Table II. The consumption of macronutrients in the study and control group

Nutrient	Study group	Control group	p
Energy (kcal)	1709±633.41	1632±370.34	0.660
Carbohydrates, % of E Simple sugars, % of E Fibre, g/day	45.95±9.32 4.47±2.19 20.36±7.48	48.77±8.17 3.57±1.27 20.79±6.65	0.240 0.137 0.850
Protein, % of E	18.34±3.47	17.81±4.57	0.664
Fat, % of E SFAs, % of E MUFAs, % of E PUFAs, % of E Omega-6, g/day Omega-3, g/day Cholesterol, mg	33.37±8.65 13.30±4.55 13.22±4.19 5.04 (4.15-2.07) 6.79 (4.95-9.12) 1.80 (1.13-2.18) 210.56 (177.84-314.93)	30.99±5.14 9.60±2.26 12.28±2.75 7.20 (4.73-8.10) 8.43 (7.15-11.50) 2.11 (1.90-2.89) 179.142 (153.65-279.02)	0.320 0.004 0.428 0.032 0.066 0.038 0.180

Values with normal distribution are presented as mean ± SD (to compare two groups, student's t-test was used), and values without normal distribution are presented as median and quartiles (to compare two groups, Mann-Whitney test was used). g – grams; MUFA – monounsaturated fatty acids; PUFA – polyunsaturated fatty acids; SFA – saturated fatty acids.

Table III. The proportion of subjects consuming recommended amounts of chosen macronutrients in the study and control group

Nutrients	Recommended intake	The proportion of subjects consuming recommended amounts, n (%)		p
		Study group	Control group	
Carbohydrates, % of E	45-55	13 (44.83%)	9 (56.25%)	0.463
Fibre, g/day	>30	4 (13.79%)	2 (12.50%)	0.903
Simple sugars, % of E	<10	28 (96.55%)	16 (100.00%)	0.456
Fat, % of E	<35	15 (51.72%)	11 (68.75%)	0.268
SFAs, % of E	<10	6 (20.69%)	9 (56.25%)	0.015
PUFAs, % of E	6-10	7 (24.14%)	9 (56.25%)	0.031
Cholesterol (mg)	<300	19 (65.52%)	12 (75.00%)	0.511

Values with normal distribution are presented as mean ± SD (to compare two groups, student's t-test was used), and values without normal distribution are presented as median and quartiles (to compare two groups, Mann-Whitney test was used E- energy; PUFA – polyunsaturated fatty acids; SFA – saturated fatty acids.

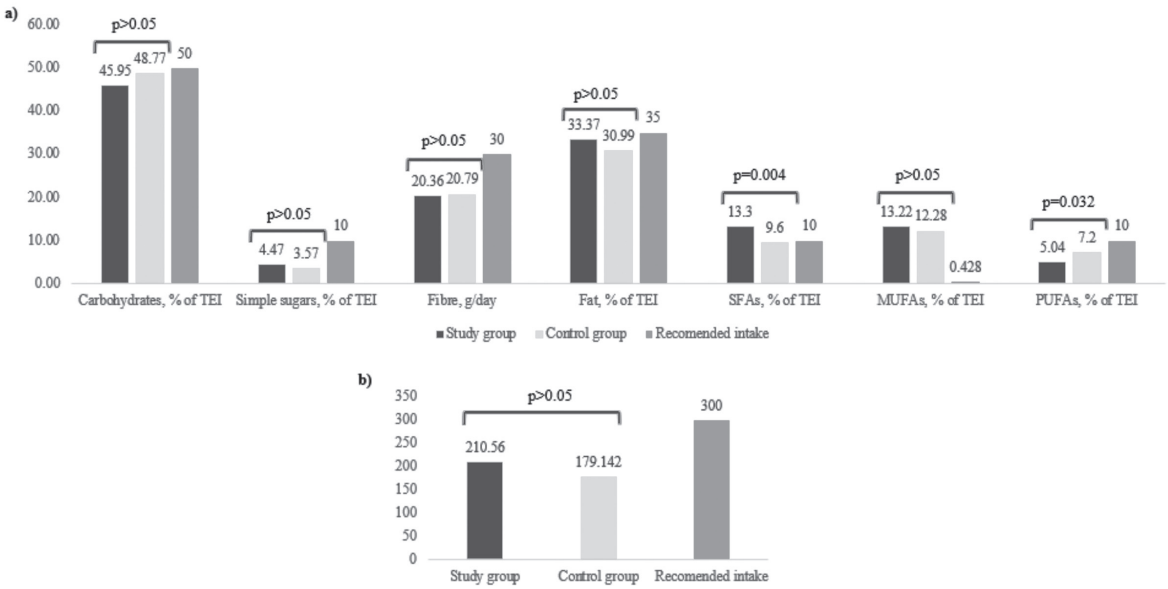

Figure 2. The consumption of macronutrients. a) the consumption of carbohydrates, simple sugars, fibre, total fat, SFAs, MUFAs, PUFAs in the study and control group and the recommended intake (when the ranges are available, the upper limit was shown, in regard to carbohydrates – middle); b) the consumption of cholesterol in the study and control group and the recommended intake.

TEI – total energy intake; SFAs – saturated fatty acids; MUFA – monounsaturated fatty acids; PUFA – polyunsaturated fatty acids.

dietary guidelines. However, in both groups, the mean fibre intake could be considered low, especially in the study group, since, as a part of the dietary treatment of obesity, a high-fibre diet is recommended. Although the mean consumption of total fat did not differ between the two groups, more differences can be seen in its quality. Women with obesity had a significantly higher intake of SFA and a significantly lower intake of PUFA than women with the correct weight. Moreover, women from the control group had a higher median intake of omega-3 and omega-6 than women from the study group.

Regarding the proportion of subjects consuming recommended amounts, only 20.69% and 24.14% of women with obesity consumed recommended amounts of SFA and PUFA, respectively (table 3). It is worth

noting that although significantly more women from the control group consumed recommended amounts of SFA and PUFA, over 40% of this group did not meet the criteria for recommended intakes. Moreover, although the recommended intakes of the rest of the macronutrients did not differ between the two groups, it should be noted that women from the study and control groups were far from adhering to dietary guidelines, especially in the context of fibre. Although the proportion of subjects consuming recommended amounts of other macronutrients did not differ between the two groups, it is worth noting that only around 50% of women with obesity had recommended intake of carbohydrates and total fat. The best adherence to recommended intakes was for simple sugars and cholesterol in both groups.

Discussion

In this study, only SFA, PUFA, and omega-3 intakes differed statistically significantly between women with obesity and correct body weight. However, non--compliance with cardiovascular-beneficial dietary guidelines was observed in both groups when analyzing the proportion of subjects consuming recommended amounts.

Interestingly, women in the study and control group did not differ in energy intake, which is surprising, especially in the context of the study group. Although women were asked to follow their usual diet, it could be suggested that women changed their dietary behaviours before or during collecting food records or failed to report total consumption (e.g., snacks, drinks, alcohol etc.). Moreover, underreporting among individuals with obesity was observed in several studies [13]. Scagliusi et al. found that low income, social desirability, BMI, and body dissatisfaction were variables differentiating women with obesity as occasional or frequent under reporters [14]. Similar findings were shown in Moran et al. study among pregnant women with excessive body weight, where socioeconomic status, BMI, past dietary behaviour, and risk of depression helped identify under reporters [15]. Nevertheless, it should be noted that the type of dietary assessment method – whether it is a food frequency questionnaire, food record, diet history, or dietary recall – could be crucial in decreasing the risk of under or overreporting. In the systematic review, Burrows et al. showed that energy intake was underestimated in 11-41% of food records [16]. Waterworth et al. presented data that suggest that when allometrically scaling total energy expenditure and energy intake, weight-stable adults with obesity do not underreport dietary intake to a greater extent than individuals without obesity [17]. Therefore, assuming that the energy intake in our study group was in line with reality, despite the lack of differences in energy intake, we noticed differences in the quality of the diet.

In this study, the mean intake of carbohydrates was 45.95±9.32% of TEI among women with obesity. In the study of Gribbin et al., including Australian women (15 years of follow-up), on multivariable analysis, carbohydrates intake in the fourth quintile – 44.3-48.1% of TEI – was associated with 40% lower CVD risk (OR 0.60, 95%CI 0.34 to 1.06, p=0.08) when compared with the first quintile (<37.1% of TEI) [5]. However, considering carbohydrate intake, the lowest CV risk (OR 0.56, 95% CI 0.35 to 0.91, p=0.02) was in the third quintile – 41.0-44.3% of TEI. Although the mean intake of the study group in our study was in accordance with the fourth quintile, it should be remembered that only 44.83% of the study group adhered to 44-55% of TEI as carbohydrates. However, except for the percentage of TEI, the quality of carbohydrates is also essential in the CV risk. In our study, the adherence to the recommended intake of simple sugars (<10% of TEI) was satisfactory – 96.55% and 100.00% of the study and control groups, respectively, followed this recommendation. However, the fibre intake was relatively low in both groups – even if we had addressed our results to the Polish guidelines with recommended intake equal to 25 grams/day. In the study of Zhang et al., in a multivariable model, higher dietary fibre density was significantly associated with lower long-term CVD risk (OR 0.57, 95%CI 0.38 to 0.86, p=0.010) in high-risk atherosclerotic CVD women [18]. Although we did not distinguish fibre sources or types in our analysis, their effect on CV risk is worth discussing. In a prospective study by Mirmiran et al., soluble and insoluble fibre were significantly associated with lower CVD risk, and fibre from legumes, vegetables, and fruits had a more substantial impact on CVD outcomes than nut and cereal fibre [19]. However, in another study, insoluble fibre cereals and vegetables were inversely associated with coronary heart disease and CVD risk, but fruit fibre was inversely associated with CVD risk only [20]. Further, in the study of AlEssa et al., the carbohydrate-to-cereal fibre ratio and the starch-to-cereal fibre ratio were associated with an increased risk for incident coronary heart disease (mainly driven by cereal fibre) [21].

Although no significant difference was observed in the total fat intake between the study and control group, significant differences were observed in the fat quality. Based on other studies' findings, these results can possibly increase the CV risk among our study group. In the study of Chiuve et al., in an age and energy-adjusted model, SFA intake was positively associated with SCD – the fifth quintile of SFAs (43.9% of total fat) intake was associated with increased risk of SCD when compared with the lowest quintile (RR=2.04) [7]. Moreover, each 5% increase in SFAs, increased the risk of cardiac death by 11%. On the contrary, PUFAs intake was significantly and inversely associated with the risk of SCD (RR=0.42) – in the fourth and fifth quintile of intakes, 17.8% and 20.7% of total fat, respectively – and each 5% increase decreased the risk of SCD by 21%. However, data regarding total fat intake and its quality are not always consistent. For example, in the Zhu et al. meta-analysis, total fat, SFA, MUFA, and PUFA were not associated with CV risk; however, higher trans-fatty acids (TFA) intake increased the risk of CVD by 14%, and each 2% energy from TFA increased CV risk by 16% [22]. Nevertheless, considering our results, the recommendation to replace SFAs dietary sources with PUFAs in the habitual diet of our study group should be made.

Although its limitations, the food record method also has some strengths, and the fact that it does not rely on memory is one of them. Furthermore, it enables the subjects to weigh food products, which provides more accurate data and facilitates introducing, more precisely, to software. Moreover, data were collected from four different days, including one on the weekend, increasing dietary intake reliability. At this point, it could be discussed whether the number of days collected was sufficient to provide reliable data; however, according to Willet, four to five days should be sufficient for assessing individual intake of energy and macronutrients. Our study also provides valuable insight into the habitual dietary habits of women with and without obesity, highlighting that – in terms of macronutrient intakes – several aspects of diet still need improving, especially regarding fat quality and fibre intake.

Except for the relatively small number of participants, this study has some other limitations that should be discussed. Firstly, we cannot exclude that obtained data are in full accordance with actual individual consumption. Despite the carefully collected information through food records, there is still the possibility of confounding by unmeasured or incompletely controlled variables that might influence dietary behaviours. Next, the study consisted of women from outpatients clinic, mostly from one voivodeship (however, the control group was recruited randomly outside the outpatient clinic); hence, the results may not be generalizable to other voivodeships or the Polish population in general. We believe that the information presented here is interesting from the practitioner view (e.g., it highlights the role of constant education on fat quality); however, we cannot generalize those results to the whole population of women with obesity (this needs to be confirmed in a bigger study). Due to the lack of data on the consumption of the source of the protein (plant *vs* animal), it was also impossible to assess the mean intakes in both groups, which would provide more CVD-focused information (% of energy intake is not as essential from CV perspective as dietary protein sources). Lastly, it could be beneficial to include the aforementioned variables associated with the possibility of underreporting since current data show that it could be a phenomenon worth paying attention to when investigating individuals with obesity.

Conclusions

Although the results of the study should be confirmed on a larger group, it could be suggested that women with obesity – as a group of increased cardiovascular risk – should pay more attention to macronutrient intakes, especially the quality of fat and fibre intake, as a behavioural part of preventive and management actions in the context of cardiovascular disease. However, it should be noted that based on our results, the same recommendation could be made for women with correct body weight as a part of following a healthier diet. Moreover, among women with obesity and correct body weight, more focus should be paid to consuming recommended amounts of fibre – especially from legumes, fresh fruits and vegetables, seeds, nuts, and whole grains. In order to improve the quality of dietary fat, in both groups decreasing the intake of SFA-rich products – e.g., rich in fat and processed meats, hard margarine, fast foods, coconut oil – and increasing the intake of vegetable fats – e.g., olive oil, rapeseed oil, seed, nuts – and fish oil could be beneficial and suggested by clinical practitioners to the patients. Those two dietary aspects are essential from a CV perspective, as both fatty acids quality and fibre

intake are essential in preventing and improving lipid disorders and decreasing CV risk. However, it should be remembered that those recommendations are based on general guidelines and do not mean that different dietary approaches with different macronutrient compositions should be discouraged. Moreover, in general, the literature is limited regarding adherence to dietary guidelines, beneficial from a CVD perspective, and more studies should be performed in this context in various risk groups.

Author Contributions

Concept: AMR, AZ, and IKK. Methodology: AMR and IKK. Investigation: AMR, AZ, AERP, KS, IKK, DN. Formal analysis: MM. Supervision AD and IKK. Writing – original draft: AMR and IKK. Writing – reviewing and editing: AMR, AZ, AERP, KS, DN and IKK. All authors edited and approved the final version of the manuscript.

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Institutional Review Board Statement

The study was conducted in accordance with the Declaration of Helsinki, and approved by the Ethics Committee) of Poznan University of Medical Sciences (resolution no. 40/20, the 16th of January 2020).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

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Conflict of interest

None

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