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Does Eating Addiction Favor a More Varied Diet or Contribute to Obesity?—The Case of Polish Adults

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Abstract: Rapidly increasing prevalence of overweight and obesity indicates a need to search for their main causes. Addictive-like eating and associated eating patterns might result in overconsumption, leading to weight gain. The aim of the study was to identify main determinants of food intake variety (FIV) within eating addiction (EA), other lifestyle components, and sociodemographic characteristics. The data for the study were collected from a sample of 898 Polish adults through a cross-sectional survey in 2019. The questionnaire used in a study included Food Intake Variety Questionnaire (FIVeQ), Eating Preoccupation Scale (EPS) and questions regarding lifestyle and socio-demographic factors. High eating addiction was found in more than half of people with obesity (54.2%). In the study sample physical activity at leisure time explained FIV in the greatest manner, then subsequently EPS factor: Eating to provide pleasure and mood improvement. In the group of people with obesity, the score of this EPS factor was the best predictor of FIV, in a way that its higher score was conducive to a greater variety of food intake. Socio-demographic characteristics differentiated FIV only within group with normal body weight (age) and with overweight (education). As conclusion, food intake variety (FIV) was associated with physical activity at leisure time, and then with EPS factor "Eating to provide pleasure and mood improvement", whereas socio-demographic characteristics were predictors of FIV only within groups identified by Body Mass Index (BMI). Nevertheless, our observations regarding Eating to provide pleasure and mood improvement factor and its associations with food intake variety indicate a need for further research in this area. Future studies should also use other tools to explicitly explain this correlation.

Keywords: overweight; obesity; food addiction; eating addiction; food intake variety; eating behavior; overeating

1. Introduction

Despite of the growing prevalence of overweight and obesity, it is still a challenge to determine their main risk factors. Body weight and body mass index (BMI) are greatly influenced by energy intake and its adequacy [1]. However, the link between diet and those anthropometric parameters cannot be solely assessed on the basis of calorie intake, but should also include other elements of dietary patterns (eating frequency, diet quality, food variety or proportions between different food groups) [2]. The lifestyle-related factors, such as unhealthy dietary patterns but also low physical activity, inadequate sleep hygiene, poor stress management, and tobacco smoking can majorly alter energy intake and expenditure, thus induce a positive energy balance [3]. Research show that lifestyle factors are correlated with each other. Low physical activity is associated with consumption of unhealthy foods [4,5]. In turn less stress or negative affect as well as high positive affect is associated with engagement in healthy behaviors, especially in physical activity [6]. Physical activity can reduce

stress as well as negative emotions and at the same time it can enhance positive emotions. In contrast, human emotional functioning is associated with food, including emotional eating [7]. Physically active emotional eaters may want to eat when under emotional distress; however, they also choose more healthy foods to cope with this distress [8]. These interrelationships between selected lifestyle components, but also within human psychological functioning implicate the necessity of including such parameters while exploring eating behaviors characteristics.

Some dietary patterns, such as uncontrolled excessive consumption, may resemble addictive behavior, and some foods may have addictive potential [9]. In 2009, Gearhardt et al. [10] developed the first tool to assess FA—the Yale Food Addiction Scale (YFAS) and next the YFAS 2.0 [11]. These tools enable to identify addictive-like eating behaviors particularly towards highly processed and palatable foods. Elevated YFAS and YFAS 2.0 scores are both positively associated with Body Mass Index (BMI), binge eating symptoms, and weight-cycling [11]. Research suggests that people diagnosed as food-addicts consume more calories [12–16], especially derived from processed, energy-dense foods like confectionary, fast-food, and salty snacks, and their diet is higher in fat [12,14,16] than non-food-addicted individuals. Several studies have revealed that food addiction can be correlated with lower consumption of fruit, vegetables and other core products [13,15].

Overeating might be associated with one of the following eating styles: Restrained, emotional, or external. In restrained eating, when someone is following a strict dietary regimen, eating something forbidden may induce "all-or-nothing" reaction leading to overconsumption [17]. Negative, positive, or neutral emotional states (e.g., sadness, anxiety, joy, boredom) might also increase food intake (emotional eating). Lastly, environmental factors, such as availability of food or presence of others eating, might also affect the consumption, in so-called external eating [18]. Studies have found that emotional eating might favor undesirable food behaviors including higher intake of snacks [19,20], "fast-food" [19] and sweet foods [21,22], whereas external eating may increase total calorie intake [19], as well as predispose to higher consumption of snacks [19,23]. Although dietary restraint can be conducive to lower intake of sweets [19] and total energy intake [19,24,25], it may simultaneously serve as a risk factor for excessive body weight [19,24,25]. The possible explanation of this phenomenon might be related to the possibility that people following strict dietary rules may be more susceptible to external and emotional eating, which can lead to weight gain [26]. Food-related thoughts are believed to be another crucial factor in the etiology of excessive food consumption. They can induce a specific food craving. When the urge to fulfill this craving arises, it can be difficult to resist overeating. Food preoccupation might therefore take the form of obsession [27].

In previous studies, also those using YFAS or YFAS 2.0, dietary assessment did not take into account food intake variety (FIV), which reflects number of food products consumed by the individual. For many years, FIV was being promoted as a vital component of dietary guidelines. It was believed that wider range of products will improve intake of macro- and micronutrients and provide adequate nutritional status [28]. Although a systematic review of 26 studies has shown that it is still unclear how total FIV affects body weight and measures of body adiposity [28], this parameter is of special concern to medical scientists and health professionals due to the growing obesity epidemic [29]. Results from the studies assessing relationship between FIV and diet quality or eating habits remain inconsistent. Some research suggest a negative impact [30,31], whereas several studies have found that FIV might favor healthy eating habits, such as adequate intake of fruit and vegetables [32,33], or predispose to greater diet quality [34,35]. The existing research results suggest that sociodemographic characteristics, such as gender and age, differentiate assessed variables and their correlations [30,33,34].

We assume that differences in food intake variety (FIV) can be explained by eating addiction assessed using the Eating Preoccupation Scale (EPS). However, we hypothesize that EPS explains the differences in FIV to a lesser extent than some components of lifestyle (i.e., physical activity, using diet, smoking) but the importance of these factors may vary depending on BMI. Thus, the aim of the study is to assess eating addiction in a group of Polish adults, and then to answer the following questions: 1) Does eating addiction show relationship with food intake variety? 2) Do such lifestyle components as

using diet, smoking and physical activity differentiate the food intake variety more than the eating addiction? 3) Do the relationships between the examined variables differ after taking BMI into account?

2. Materials and Methods

2.1. Study Design and Sample Collection

The data were collected from February to March 2019 through a cross-sectional quantitative survey. The study was approved by the Ethics Committee of the Faculty of Human Nutrition and Consumer Science, Warsaw University of Life Sciences, in Poland on the 29 October 2018 (Resolution No. 22/2018). Informed consent to participate in the study was collected from participants.

According to the study design, recruitment and data collection were conducted by a research agency—ARC Market and Opinion. Adults aged 18–65 were recruited from the panel (epanel.pl) of approximately 64,000 adult people. After sending an invitation to participate in the study, 2025 people gave consent to participate in the study. Quota selection using gender, age, place of residence, and education was used to ensure the representativeness of the Polish population. During the recruitment, 78 people stopped filling out the questionnaire during the interview, and 932 people did not qualify due to filling the quota, while eight people were removed from the database at the collection control stage because of errors indicating the lack of credibility of their answers. As a result, the study consisted of 1007 participants. The computer-assisted web interviewing (CAWI) technique was used to collect all data. During the data checking 71 participants were excluded from the sample due to missing data, i.e., body mass and height, which did not allow the BMI calculation. Then during the data analysis, one more criterion of exclusion was used, namely being underweight (Body Mass Index—BMI < 18.5 kg/m^2). Thirty eight participants were excluded from the analyses due to BMI lower than 18.5 kg/m^2. The total sample consisted of 898 people.

2.2. Food Intake Variety

Food intake variety was assessed using the food consumption frequency method, applying Food Intake Variety Questionnaire (FIVeQ) [36]. Information on the consumption of 63 food product groups over the last 7 days was collected using the FIVeQ questionnaire [36]. Quantity was specified for each product: Seven slices for cereal products, seven cups for dairy and beverages, with the exception of wine (quantity defined as 1 glass of wine—100 mL) and spirits (one shot of liquor—50 mL), amount sufficient for one slice of bread well covered (approx. 20 g) for cold cuts and sausages, 10 cubes for chocolate, and two tablespoons for the rest of the food products (e.g., groats, nuts, fish, and butter). The participant declared the consumption of such quantity of each product within the last 7 days (yes or no). Food intake variety is expressed in the food intake variety index (FIVeI). FIVeI was calculated as the number of product groups eaten weekly (maximum 60 products/week), after excluding 3 groups of alcoholic beverages (beer, wine, vodka, and other strong alcohols). According to the methodology and assessment criteria developed by the authors of the questionnaire [35], the following groups of people with a varied food intake (FIV) were distinguished:

Inadequate FIV (<20 food products weekly),
Sufficient FIV (20–29 food products weekly),
Good FIV (30–39 food products weekly), and
Very good FIV (≥40 food products weekly).

2.3. Eating Addiction

Eating Preoccupation Scale (EPS) was used to assess eating addiction [37]. EPS consists of 18 statements, to which the respondent answers on a scale of 1—hardly never; 2—rarely; 3—sometimes; 4—often; up to 5—almost always (Table 1). This scale allows measuring overall score of eating addiction and three EPS factors, which include: Focusing on eating activities, eating to provide pleasure

and mood improvement, and compulsion to eat and loss of control over food. The overall score (range from 18 to 90 points), which was the sum of all ratings, allows evaluating person's behaviors characteristic for eating addiction (EA) included in EPS. A score above 48 points indicates a high EA, 40–48 points—average EA, result below 40 points—low EA [37].

Table 1. The Eating Preoccupation Scale (EPS).

Statements from the Eating Preoccupation Scale (EPS)	Mean Score ± Standard Deviation *
EPS factor: Focusing on eating activities	
2. I think about eating and about my body weight	3.0 ± 1.2
6. I believe that my relationship with food is terrible	2.3 ± 1.1
8. I feel embarrassed about the amount of food I eat	2.2 ± 1.1
9. I plan ahead situations when I will be able to eat alone	1.9 ± 1.0
10. I am worried about being unable to control the amount of food consumed	2.3 ± 1.1
16. I have a low self-esteem because of my uncontrolled eating	2.1 ± 1.1
EPS factor: Eating to provide pleasure and mood improvement	
1. Eating is a very important part of my life	3.4 ± 1.1
11. Eating greatly enhances my mood	3.2 ± 1.0
12. Eating is a great pleasure of mine	3.6 ± 1.0
13. I make myself "food feasts" for no clear reason	2.2 ± 1.1
17. I feel great satisfaction after an abundant meal	2.8 ± 1.1
18. I am willing to sacrifice other pleasures for eating	2.3 ± 1.0
EPS factor: Compulsion to eat and loss of control over food	
3. I eat vast amounts of high-calorie foods in a short period of time	2. 6 ± 1.0
4. I snack throughout the day	2.9± 1.0
5. I eat even when I am not feeling the hunger	2.4 ± 1.0
7. I eat more than I had planned	2.7 ± 1.0
14. I wake up to eat at night	1.8 ± 1.0
15. I clear up my plate even when I am not feeling hungry anymore	2.9 ± 1.2

* 5-point scale: 1—hardly never; 2—rarely, 3—sometimes, 4—often, 5—almost always.

The internal compliance of the questionnaire was assessed using the Cronbach's coefficient, which is 0.89. Internal stability, measured using a correlation coefficient in studies conducted after 6 weeks on a group of 30 women, is 0.72. Validity of the Eating Preoccupation Scale was tested by assessing correlation of its results with results of the Eating Related Behaviors Questionnaire [37], which measures tendency to habitual, and emotional overeating but also following dietary restrictions.

2.4. Physical Activity and Other Lifestyle Factors

Self-reported physical activity was recorded in the questionnaire on a 3-point scale: 1—"low", 2—"moderate" to 3—"high" [38]. The description of the scale was presented separately for the physical activity during leisure and work/school time. For leisure time "low" was described as "sedentary lifestyle, watching TV, reading the press, books, light housework, taking a walk for 1–2 h a week"; "moderate"—"walks, cycling, gymnastics, gardening or other light physical activity performed for 2–3 h a week ", and "high"—"cycling, running, working on a plot or garden, and other sports activities requiring physical effort, taking up more than 3 h a week". "Low" activity at work/school time was described as "over 70% of the time in a sitting position", "moderate" as "approximately 50% of the time in a sitting position and about 50% of time moving", and "high" as "about 70% of the time in motion or doing physical work associated with a lot of effort" [38].

Two questions were used to assess smoking: "*Do you smoke cigarettes?*" (Yes/No) and "*If you smoke, how many cigarettes a day do you smoke?*" (I smoke occasionally; up to 10 pieces a day, 10–20 pieces a day, more than 20 pieces a day). In addition, respondents answered the question "*Have you used a special diet in the last 3 months?*" (Yes/No).

2.5. Socio-Demographic Characteristics

The questionnaire collected information about sociodemographic characteristics of the study sample, i.e., gender, age, education, and place of residence. Body Mass Index (BMI) was calculated using self-reported body weight and height and categorized according to International Obesity Task Force (IOTF) standards [39]. During the data analysis, three categories of respondents were identified, i.e., people with normal weight (BMI between 18.5 kg/m^2 and 24.99 kg/m^2), with overweight (BMI between 25.0 kg/m^2 and 29.99 kg/m^2), and with people who were obese (BMI ≥ 30 kg/m^2).

2.6. Statistical Analysis

Descriptive statistics were performed. The chi-square test and the one-way analysis of variance ANOVA test were used to compare variables, and $p < 0.05$ was considered significant.

The classification tree was used to determine independent variables explaining differences in food intake variety. This method was used because it allows computing both numerical and categorical data. Moreover, it offers clear graphic data presentation and it is easy to interpret [40]. Separate classification trees were made in the study sample, and then in a group of people with normal body weight, overweight and obesity. The method CHAID (Chi-squared Automatic Interaction Detector) was used to build the tree. The first node (Node 0) is always the distribution of the dependent variable (FIV). The next nodes can include sociodemographic variables (gender, age, education, place of residence), variables describing eating addiction (eating addiction—overall score, 3 factors of eating addiction: focusing on eating activities, eating to provide pleasure and mood improvement, compulsion to eat and loss of control over food) and lifestyle variables (using a diet, smoking, physical activity during leisure time and work/school time).

Statistical analysis was conducted using IBM SPSS Statistics for Windows, version 24.0 (IBM Corp, Armonk, NY, USA).

3. Results

3.1. Characteristics of the Study Sample

The sample consisted of 898 participants (433 women and 465 men) aged 18 to 65 years. Some details concerning socio-demographic characteristics of the study sample are displayed in Table 1.

More men than women were overweight or obese. Among people with normal weight the majority were people of the age of 18–34, while among overweight and people with obesity respondents aged 45–65 were the most numerous group. The average age of people with overweight and obesity did not differ, but was significantly higher compared to people with normal body weight. Education and place of residence did not differentiate groups identified due to BMI (Table 2).

3.2. Food Intake Variety and Other Lifestyle Factors

About 60% of the study sample displayed good or very good food intake variety (36.8% and 23.7%, respectively). FIV did not differ in BMI groups (Table 3).

Slightly more than 10% of participants declared using a diet. Almost two thirds of the study participants (64.0%) declared they did not smoke. In the study sample were less heavy smokers (10 or more cigarettes a day) than light smokers (16.6% and 19.4%, respectively). About two fifths of the study sample (38.3%) described their physical activity at work/school as low, and the same numbers of people evaluated their leisure activities in the same way. More than a half of people with BMI ≥ 30 kg/m^2 (57.6%) declared low physical activity in leisure time. More people with overweight than ones with normal body weight indicated low activity in leisure time (37.7% and 32.8%, respectively) (Table 3).

3.3. Eating Addiction

Over 2/5 of study sample (42.1%) displayed a high eating addiction (EA) on the EPS. The mean value of the overall score from the EPS was 46.4 points, which indicates the average EA. Only differences in the overall score of EPS between people with normal weight and people with obesity were shown. The mean value of the overall score in the obese group exceeded 48 points, and therefore meant a high EA. Low EA was displayed by 33.7% of people with normal body weight and by almost three times less of those with obesity (13.1%). However, a high EA was found in more than half of people with obesity (54.2%) and in more than 1/3 of people with normal body weight (37.7%). Compulsive eating and loss of control of food consumption characterized eating behaviors of people with obesity to a higher extent compared to people with normal body weight. There were differences in the mean score for the "Focusing on eating activities" factor in the BMI groups. The larger the BMI, the more focused on eating behaviors were people (Table 4).

3.4. Relationship between Food Intake Variety and Eating Addiction

Food intake variety (FIV) has shown differences only due to EPS factor—Eating to provide pleasure and mood improvement—Figure 1. In the group of people with high or moderate physical activity at leisure time and at work/school time a higher score for EPS factor—"Eating to provide pleasure and mood improvement" (above 18 points) favored increase of FIV (node 7 and 8). Almost 2/5 of people with the score above 18 had very good FIV. Similarly, in the group of people with low physical activity at leisure time (node 5 and 6) a higher score for this EPS factor (above 16 points) was conducive to a greater variety of food intake (Figure 1).

In the group of people with obesity, the score of EPS factor—"Eating to provide pleasure and mood improvement" differed FIV as the most powerful predictor (node 1 and 2). A higher score for this EPS factor (above 16 points) was conducive to a greater variety of food intake. Almost three times more people with a score above 16 (29.5%) than with a score of 16 and below (10.3%) had a very good FIV (Figure 2).

3.5. Relationship between Food Intake Variety and Lifestyle and Sociodemographic Variables

In the study group FIV has shown differences due to physical activity at leisure time (node 1 and 2) and physical activity at work/school (node 3 and 4)—Figure 1. Higher FIV was demonstrated in people with moderate and high physical activity at leisure time ($p < 0.001$). Over 1/4 of people (27.6%) with moderate or high physical activity and 17.7% of those with low physical activity at leisure time were characterized by very good FIV. Twice as many people with low physical activity in their leisure time were characterized by inadequate FIV compared to other people. Twice as many people with high and moderate physical activity in leisure time and the same physical activity at work/school showed very good FIV (32.5%) compared to people with low physical activity at work/school (15.5%) (node 3 and 4) (Figure 1).

In the group of people with overweight (node 1 and 2) more people with secondary education than others had good FIV (46.8%, 34.9%, respectively) and very good FIV (29.4%, 22.2%, respectively—Figure 3.

In people with normal body weight, FIV differed among age groups (nodes 1, 2, and 3). The fewest people aged 18–24 showed very good FIV (8.3%), while the most people aged 55–65 (31.8%). More than two-thirds of people aged 18–24 had inadequate FIV (11.1%) or sufficient FIV (56.9%). In contrast, more than three-quarters of people aged 25–54 years were characterized by good (40.9%) or very good FIV (25.5%). In this age group (node 4 and 5) more people with moderate or high physical activity in leisure time than others had good (44.4%, 34.3%, respectively) and very good FIV (29.9%, 17.2%, respectively)—Figure 4.

Table 2. Characteristics of the study sample.

Variables		Total (N = 898)		18.5 kg/m^2 ≤ BMI < 25 kg/m^2 (N = 424)		25.0 kg/m^2 ≤ BMI < 30 kg/m^2 (N = 321)		BMI ≥ 30 kg/m^2 (N = 153)	
		N	%	N	%	N	%	N	%
Gender *	Female	433	48.2	234	55.2	131	40.8	68	44.4
	Male	465	51.8	190	44.8	190	59.2	85	55.6
Education	Lower than secondary	348	38.8	153	36.1	123	38.3	72	47.1
	Secondary	309	34.4	153	36.1	109	34.0	47	30.7
	Higher	241	26.8	118	27.8	89	27.7	34	22.2
Place of residence	Rural area	329	36.6	159	37.5	113	35.2	57	37.3
	City ≤ 100,000 residents	291	32.4	140	33.0	106	33.0	45	29.4
	City > 100,000 residents	278	31.0	125	29.5	102	31.8	51	33.3
Age *	18–24 years	97	10.8	72	17.0	18	5.6	7	4.6
	25–34 years	205	22.8	117	27.6	62	19.3	26	17.0
	35–44 years	209	23.3	105	24.8	67	20.9	37	24.2
	45–54 years	168	18.7	64	15.1	70	21.8	34	22.2
	55–65 years	219	24.4	66	15.5	104	32.4	49	32.0
Age (years)	Mean; standard deviation	42.0; 13.7		38.0 ^{a}; 13.3		45.6 ^{b}; 13.1		45.5 ^{b}; 12.9	
Height (cm)	Mean; standard deviation	171.4; 9.5		170.8 ^{a}; 9.1		172.4 ^{a}; 9.6		170.8 ^{a}; 9.9	
Weight (kg)	Mean; standard deviation	76.6; 15.8		65.7 ^{a}; 9.2		81.0 ^{b}; 10.2		97.6 ^{c}; 13.8	
BMI (kg/m^2)	Mean; standard deviation	26.0; 4.5		22.4 ^{a}; 1.8		27.2 ^{b}; 1.4		33.4 ^{c}; 3.6	

N—Number of participants; * Significant at $p < 0.001$ between BMI groups (Chi-square test); ^{a,b,c} different letters in each line mean significant differences at $p < 0.05$ between BMI groups (ANOVA test).

Table 3. Food intake variety and other lifestyle characteristics of the study sample.

Variables		Total Sample (N = 898)		18.5 kg/m^2≤ BMI < 25 kg/m^2 (N = 424)		25.0 kg/m^2≤ BMI < 30 kg/m^2 (N = 321)		BMI ≥ 30 kg/m^2 (N = 153)	
		N	%	N	%	N	%	N	%
Food intake variety—FIV	inadequate	79	8.8	38	9.0	25	7.8	16	10.5
	sufficient	276	30.7	139	32.7	92	28.7	45	29.4
	good	330	36.8	147	34.7	125	38.9	58	37.9
	very good	213	23.7	100	23.6	79	24.6	34	22.2
Using the diet	yes	97	10.9	42	10.0	37	11.6	18	12.0
Number of cigarettes smoked **	no smoking	575	64.0	266	62.7	223	69.5	86	56.2
	less than 10 cigarettes a day	174	19.4	91	21.5	56	17.4	27	17.6
	10 or more cigarettes a day	149	16.6	67	15.8	42	13.1	40	26.2
Physical activity during work/school time	low	329	38.3	137	34.3	123	39.4	69	47.3
	moderate	329	38.3	158	39.5	120	38.5	51	34.9
	high	200	23.4	105	26.2	69	22.1	26	17.8
Physical activity during leisure time ***	low	344	38.8	137	32.8	120	37.7	87	57.6
	moderate	415	46.8	208	49.8	153	48.1	54	35.8
	high	128	14.4	73	17.4	45	14.2	10	6.6
Food intake variety—FIV (number of products)	Mean; standard deviation	32.6; 10.7		32.4 [a]; 10.6		33.0 [a]; 10.5		32.6 [a]; 11.3	

N—Number of participants; ** Significant at $p < 0.01$; *** Significant at $p < 0.001$ between BMI groups (Chi-square test). [a] same letters mean no significant differences at $p < 0.05$ between groups (ANOVA test).

Table 4. Eating addiction in the study sample.

Variables		Total Sample (N = 898)		18.5 kg/m^2 ≤ BMI < 25 kg/m^2 (N = 424)		25.0 kg/m^2 ≤ BMI < 30 kg/m^2 (N = 321)		BMI ≥ 30 kg/m^2 (N = 153)	
		N	%	N	%	N	%	N	%
Eating Preoccupation Scale (EPS)—total score ***	low	237	26.4	143	33.7	74	23.1	20	13.1
	average	283	31.5	121	28.6	112	34.8	50	32.7
	high	378	42.1	160	37.7	135	42.1	83	54.2
Eating Preoccupation Scale (EPS)—total score	Mean; standard deviation	46.4; 11.0		45.2 ^{a}; 11.6		46.7 ^{a,b}; 10.6		49.1 ^{b}; 9.9	
EPS factor: Focus on eating activities	Mean; standard deviation	13.7; 4.8		12.9 ^{a}; 5.0		13.8 ^{b}; 4.6		15.5 ^{c}; 4.1	
EPS factor: Eating to provide pleasure and mood improvement	Mean; standard deviation	17.5; 4.4		17.5 ^{a}; 4.5		17.6 ^{a}; 4.2		17.5 ^{a}; 4.3	
EPS factor: Compulsion to eat and loss of control over food	Mean; standard deviation	15.2; 4.2		14.8 ^{a}; 4.4		15.3 ^{a,b}; 4.1		16.1 ^{b}; 3.9	

N—Number of participants; *** Significant at $p < 0.001$ between BMI groups (Chi-square test). ^{a,b,c} different letters in each line mean significant differences at $p < 0.05$ between groups (ANOVA test).

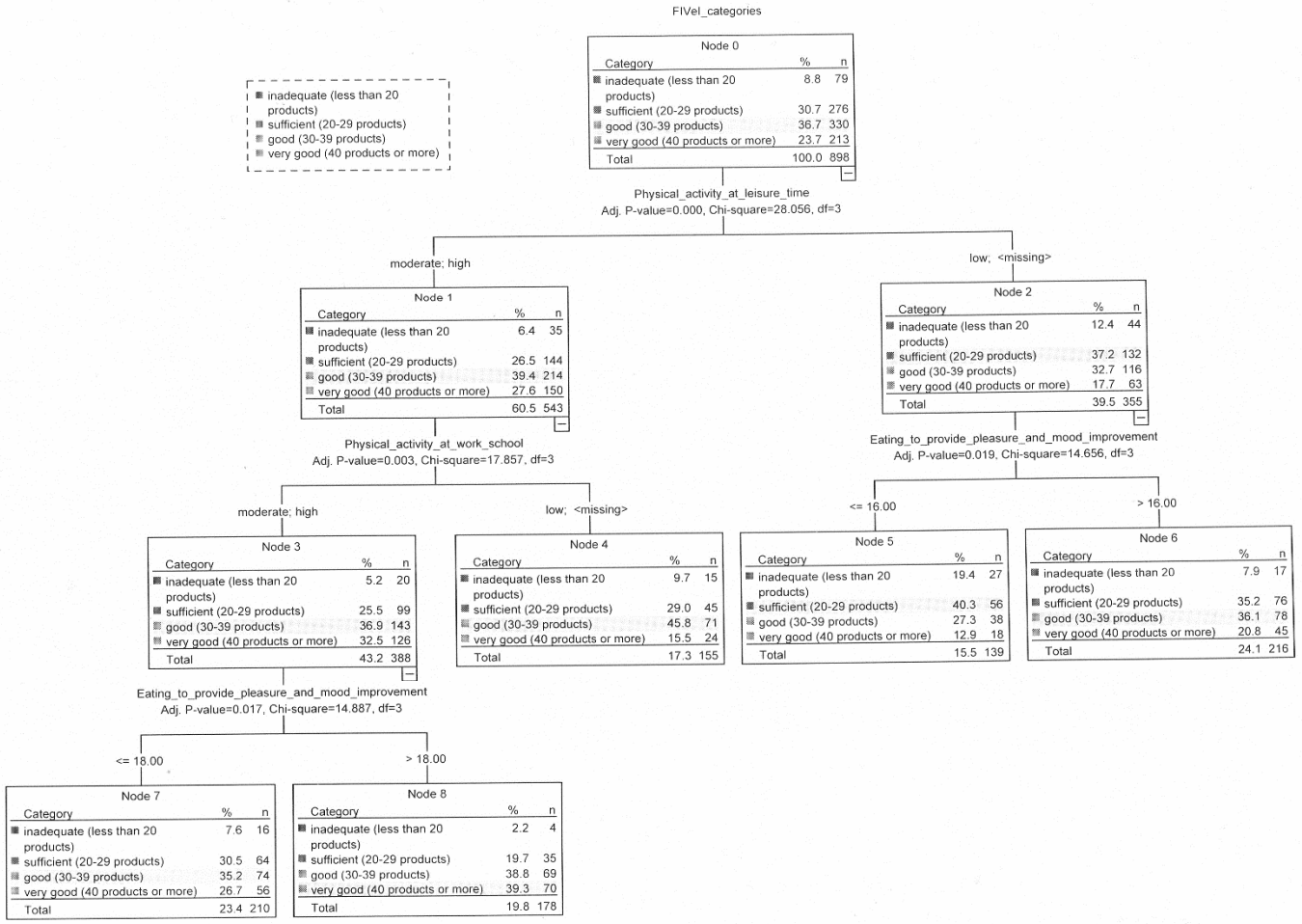

Figure 1. Relationship between food intake variety, eating addiction, selected lifestyles variables and sociodemographic characteristics in the study sample.

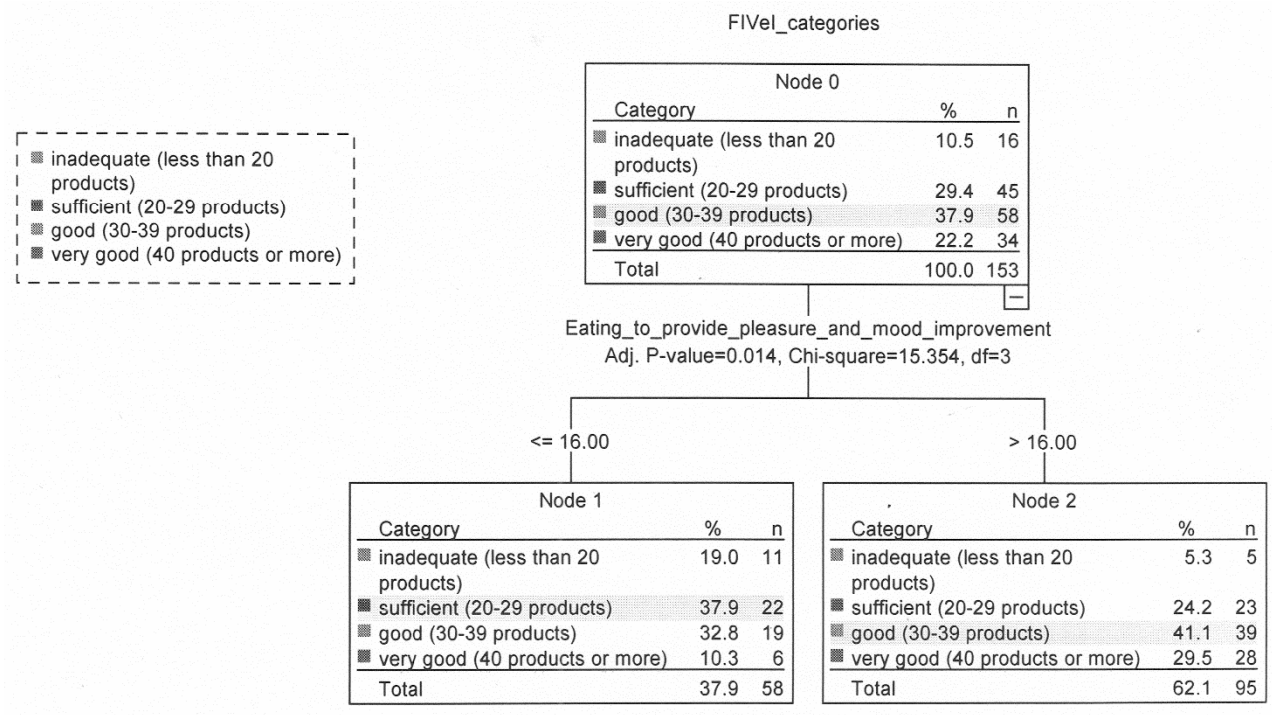

Figure 2. Relationship between food intake variety, eating addiction, selected lifestyles variables and sociodemographic characteristics in the group with obesity.

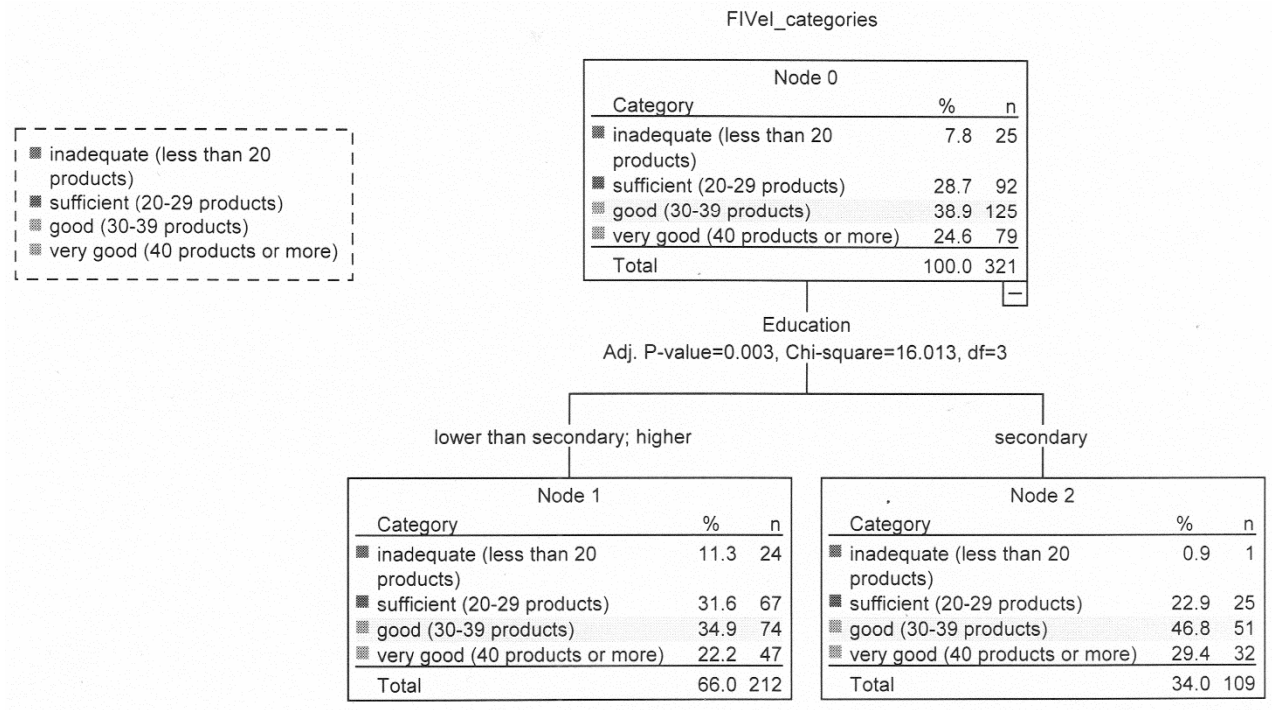

Figure 3. Relationship between food intake variety, eating addiction, selected lifestyles variables and sociodemographic characteristics in the group with overweight.

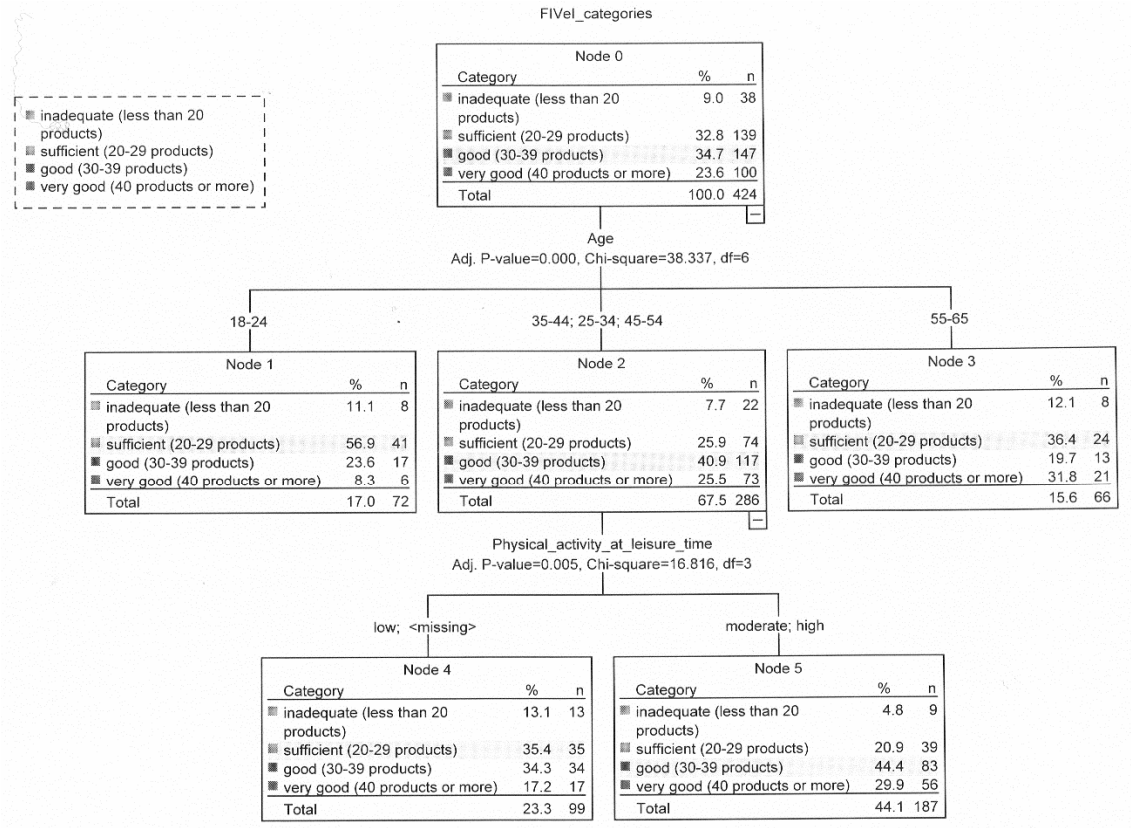

Figure 4. Relationship between food intake variety, eating addiction, selected lifestyles variables, and sociodemographic characteristics in the group with normal body weight.

4. Discussion

The study provided some support for our hypotheses that differences in food intake variety (FIV) can be explained by eating addiction assessed using the Eating Preoccupation Scale (EPS). The results concerning associations between FIV and EPS indicate that only one of the EPS factor, "Eating to provide pleasure and mood improvement", was related to FIV. Moreover, this indicator did not serve as a most important predictor of FIV, as physical activity during leisure time explained this parameter in a greater manner. Other EPS factors and total EPS did not differentiate FIV. In view of the previous research, it can be assumed that "Eating to provide pleasure and mood improvement" as a factor correlated with FIV might favor both overall dietary variety and dietary variety within particular food groups only. Few available studies, which attempted to explain differences in food intake variety, indicate that this parameter might be linked to the amount of food consumed as regards to selected foods [13,41]. People with overeating tendencies usually opt for a wide range of food products, yet it only applies to products considered as palatable. Thus, a wide range of palatable foods might be a factor involved in the development of addictive-like eating behaviors [42]. Other authors also point out that not all foods seem to be equally related to addictive-like eating behaviors. Foods rich in refined carbohydrates and added fat are more likely to be consumed in an addictive manner than low-processed foods [43,44]. High-fat and high-sugar foods were consumed more frequently among individuals who met criteria on the Yale Food Addiction Scale for food addiction [13]. These foods also appear to trigger behavioral responses that are consistent with addictive-like eating behavior, for example such foods are frequently consumed during binge episodes [45]. Moreover, foods high in fat and sugar are more likely to be intensely craved [41,46,47] and consumed in greater quantities in response to negative affect [48,49]. The results of these studies are consistent with those obtained in our research among people with obesity. Within this group, EPS factor "Eating to provide pleasure and mood improvement" was the most important factor in explaining FIV. Almost 3 times more people with higher score of this EPS factor were characterized by higher FIV in comparison to people scoring lower on this subscale. It might be considered as a cause of overconsumption though longitudinal research is required to determine the direction of causality.

Our hypothesis that EPS explains the differences in FIV to a lesser extent than some components of lifestyle (i.e., physical activity, using diet, smoking) but the importance of these factors may vary depending on BMI was also supported. Physical activity at leisure time was the most important predictor of FIV in the study sample, while in the groups distinguished by BMI, differences in FIV predictors were observed. Greater food intake variety (FIV) correlated with moderate or high physical activity during leisure time, which may be the result of higher awareness on healthy lifestyle, healthier food choices and greater adherence to dietary rules among physically active people [50,51]. Similarly as for the whole study group, among individuals with normal body weight aged 25–54 association between food intake variety (FIV) and physical activity in leisure time was supported and greater FIV was observed in those more physically active among this age group. According to our knowledge, association between FIV and physical activity was not a subject of the previous research. Nevertheless, some studies have shown that physical activity favors healthier food choices among adults [52–54]. However, a few research have revealed that being physically active might not always determine healthy eating and prevent from unfavorable eating behaviors [55]. On the premise that FIV might be linked both to health benefits or higher intake of unhealthy foods, our results indicating that among physically active people greater FIV is observed supported previous studies.

Higher level of physical activity observed in individuals presenting eating addiction symptoms might be caused by the attempt to make up for the excessive amount of calories consumed after exercises [56]. Physically active people are able to self-regulate food intake more precisely due to the lowering effect of working out on brain reward system reactivity to food stimuli [57]. Moreover, among individuals in the group of moderate or high physical activity, both in the leisure or school/work time, a positive correlation was seen for the result of "Eating to provide pleasure and mood improvement" subscale and FIV, which can be linked to self-contentment associated with satisfaction from living a

healthy lifestyle, beneficial for health and well-being. A similar correlation was noted in the group with low physical activity in the leisure time. It seems that low physical activity can induce food cravings in a manner resembling addiction mechanism [58]. In those individuals, food can serve as a major source of pleasure, since sedentary behaviors favor food consumption. This association was not seen for eating addiction total score in our study and these results were supported by Li et al. [56].

Sociodemographic features as predictors of FIV were noticed only in groups separated due to BMI. Food intake variety in individuals with normal body weight was associated with age, which can be confirmed by previous research. Due to the involutional processes, but also environmental and psychological factors, older people tend to change their eating habits, which lead to lower calorie, macro- and micronutrients intake. Inadequate intake of nutrients increases the risk of malnutrition [59,60]. Greater FIV among older adults in our study, including the largest number of very good FIV and at the same time the largest number of inadequate FIV, indicates that recommendations on dietary diversity in older people [35,60] are being partly fulfilled. Higher FIV in older people were also noted by Drewnowski et al. [61].

The age was not associated with food intake variety in individuals with overweight and obesity. However, people with overweight with secondary education had greater FIV than the others. The impact of education on the FIV in people with overweight may be explained in different ways. Environment, awareness of physical activity, dietary knowledge, and health literacy, as well as social roles and cultural norms related to health and nutrition seem to be significant factors affecting this correlation [62]. Among people with lower educational status, less varied diet might be linked to their living environment with limited access to more diverse and affordable fresh foods, but also to other components of a healthy lifestyle, including safe places for physical activity. On the other hand, alcohol, tobacco and fast-food might be more accessible, which conduce to high-calorie diet combined with sedentary behaviors [63]. In contrast, people with higher education are expected to have more opportunities for being physically active, but also greater access to diverse food products. Educational status might be considerably associated with salary, thus influence food choices and food variety [64,65]. Moreover, higher educated people should be more predisposed to favor new or unfamiliar foods [66]. Nonetheless, the above possible explanations and mechanisms involving dietary knowledge and health literacy [67,68] cannot explain results revealed in our study indicating that among overweight group, people with higher education had lower FIV than individuals with secondary education. Despite of having greater nutrition knowledge, higher educated individuals might be more conformed to cultural norms, e.g., thin ideal, which is often perceived as a condition of success [69]. Some authors suggested that body weight dissatisfaction might serve as a driver for unhealthy dieting behaviors [70,71]. It can be assumed that in our study sample, people with overweight with higher education could have been particularly susceptible to social norms, which in turn led to following a strict dietary regimen, thus resulting in lower FIV [70,71].

Strengths and Limitations

Strength of our study is a relatively large representative sample of Polish population in terms of the region of residence and gender, education and age. Although our findings are specific to Polish population and should not be generalized to the population of other cultural background, the observations could be of potential use in designing research and interventions. We believe that including in the analysis both lifestyle components of great importance for health, i.e., diet (variety and using a diet), and physical activity, and eating addiction brought a wider perspective on adequate diet. To the best of our knowledge, this paper is the first to study the association between eating addiction and food intake variety. The use of the hitherto unknown Eating Preoccupation Scale can be considered as both a strength and a weakness. On one hand, it may be noticed by other researchers and recognized as a tool that deserves further use. On the other hand, the use of this scale is a limitation of our study. The measure of eating addiction used in the present study (EPS) has not been used extensively and there is a need for additional research on its psychometric properties and its

association with measures of related constructs such as food addiction, emotional eating, and binge eating. Additionally, this cross-sectional study design does not provide an opportunity to find a causal relationship between food intake variety and other variables. Some limitation relates to the potential biases that may occur when self-reported data are analyzed [72]. People tend to underreport their weight and overreport their body height [73], which may have led to underestimation of individuals with excessive body weight according to BMI categories in our research. Self-reported indicators of lifestyle can be considered not quite satisfying, however, using other measurement indicators confirms the results from the analysis of self-reported data [74].

5. Conclusions

The study found that food intake variety (FIV) was associated with physical activity at leisure time, and then with EPS factor "Eating to provide pleasure and mood improvement", whereas socio-demographic characteristics were predictors of FIV only within groups identified by BMI. In the study sample, physical activity both at leisure and at work/school time proved to be a stronger predictor than EPS factor related to pleasure and mood. However, EPS factor "Eating to provide pleasure and mood improvement" was the only predictor of FIV among people with obesity. Socio-demographic characteristics differentiated FIV only within group with normal body weight (age) and with overweight (education). Based on the findings of this study, it is possible to better understand the relationships between food intake variety and some components of lifestyle including addictive behaviors. Moreover, additional focus on the groups identified by BMI and performed analysis allow to use their results in dietary practice. However, there is still a need for further research involving the use of tools that can identify "eating addiction" construct. Symptoms of eating addiction might serve as a marker of disordered eating, while early diagnosis can significantly affect both prevention and treatment of overweight and obesity. Further research attempting to clarify the association between FIV and EA should use also other tools to explicitly explain this correlation.

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