Food Addiction, a Potential Psychological Factor Involved in Cardiovascular Risk

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Abstract

Introduction: *The literature indicates the presence of specific elements of addiction in connection with eating behavior.*

Objectives: *The first sub-study of the paper had as objective the analysis of the psychometric properties of the Romanian version of an assessment scale, and the second had as objectives the analysis of the differences in food addiction, in BMI, in the frequency of addictive food consumption, between people with and without cardiovascular diseases, as well as the analysis of BMI predictors in people with and without diseases.*

Methods: *The research group consisted of 375 adult participants, aged between 20 and 65 years, of whom 100 had cardiovascular diseases, who completed instruments for food addiction, compulsive eating and consumption habits.*

Results: *Statistical analyses supported good test fidelity, as well as content, convergence, and criterion validity, and the factorial structure with one factor was supported. Research data do not support the existence of significant differences, regarding food addiction, between people with cardiovascular diseases and those without, but it has been observed that people with diseases have a statistically significantly higher BMI compared to those without diseases. The research data support the existence of statistically significant differences between groups only in terms of frequency of consumption of sweets, not starchy foods, fats, or sweetened beverages. The best predictors of BMI in people without diseases were compulsive eating, age, frequency of fat consumption, which together explain 14.8% of the variance. Food addiction and frequency of fat consumption were the best predictors, explaining together 28.9% of the BMI variance, in the case of people with cardiovascular diseases.*

Conclusions: *The results support the usefulness of the concept of food addiction and of the Yale Food Addiction Scale 2.0 in psychological assessment and counseling for preventing and managing obesity and cardiovascular risk.*

Keywords: food addiction, cardiovascular risk, compulsive eating, frequency of consumption, body mass index

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I. Introduction

The issue of food addiction

Highly processed foods with fats, additives and sugar activate the nerve centers of the reward, by releasing dopamine (Onaolapo & Onaolapo, 2018), the occurrence of the craving phenomenon present in other addictions being observed in the case of certain foods, as well. The use of addictive foods leads to activations in the hippocampus, the island and the caudate nucleus, a mechanism similar to that activated in drug or alcohol users (Pelchat et al., 2004). Volkow, Wise and Baler (2017) draw a parallel between food use and drug use, talking about the dopamine motivational system, which, if affected, can lead to an increased, habitual, and inflexible response, contributing to both drug addiction, as well as food addiction and obesity.

Despite evidence of food addiction, controversy persists, and the field still requires attention from the scientific community, as foods, even those with a pleasant taste, are probably not addictive in themselves, but other factors are also involved. Thus, it is about how access to those foods is possible and how they are consumed (Corwin & Grigson, 2009). There are authors in the literature who argue caution in comparing the addiction of certain foods with drug addiction. Controversies arise especially in connection with the idea of differentiating food addiction from eating disorders, as there are some who consider that food addiction is just another form of eating disorder (Ziauddeen et al., 2012). There are also controversies regarding the neuronal changes that occur in animal models, which may not be generalizable in the case of humans (Fletcher & Kenny, 2018). Therefore, there are authors who consider that the hypothesis of food addictive potential is unfounded and propose replacing the term food addiction with that of eating addiction, considering that the activity of eating is similar to addiction (Hebebranda et al., 2014).

However, the evidence is more in favor of food addiction advocates, and large-scale studies to determine the prevalence of the disease in the population have been conducted in various cultural contexts, with differences between geographical regions but also according to target populations. Thus, the prevalence in China is 6.9-9.2% among adolescents, 10.4% among Malaysian obese people (Khine et al., 2019). In a sample of Japanese students, the prevalence was 3.3% (op. cit., 2019), without identifying significant correlations with the body mass index, the authors' explanations being that in Japan there are different eating habits compared to western countries, the obesity rate being also much lower for this nationality. In France, the prevalence among students was 8.2% (Brunault et al., 2017). In Germany, the prevalence was 10% among students and 47% in a sample of obese patients who were awaiting bariatric surgery (Meule et al., 2017). In Portugal (Torres et al., 2017) it was 2.5% in the nonclinical, normal weight population, and 25.8% in a sample of obese people, waiting for bariatric intervention. A meta-analysis on the issue of the prevalence of food addiction, which took into account 25 studies with a total of 196,211 participants, of various nationalities and from both clinical and non-clinical populations, mostly overweight and obese women, showed a medium prevalence of 19.9%, with prevalence reported by investigated studies between 5.4% and 56.8% (Pursey et al., 2014). There are studies that report a prevalence of food addiction of 77.8% among patients diagnosed with eating disorders according to DSM 5 criteria (Granero et al., 2018). The same study, conducted in Spain, indicates a low prevalence among the general population, of only 3.3%. Thus, a high variability of prevalence can be observed depending on the nationality and the characteristics of the samples used, which supports the need for further investigate the issue on various populations.

Yale Food Addiction Scale 2.0

Although the YFAS scale has existed since 2009, Gearhardt, Corbin, and Brownell (2016) developed YFAS 2.0 to reflect changes in the criteria for diagnosing substance use disorders with the advent of DSM 5 (APA, 2016). Thus, the designed scale has 35 items, aiming at evaluating the eating behavior during the last 12 months, on a Likert scale from 0 to 7 for each question of the tool. Although measured on a Likert scale, in order to establish the clinical significance of the scores, a score correction is subsequently performed, the answers being finally dichotomous, based on limit values indicating clinically significant problems, determined following the study for the scale validation. These were established by the authors by examining the specificity for each response variant based on the ROC (Receiver Operator Characteristic) curves. In the absence of a gold standard for measuring food addiction, in order to measure the ROC curves, the authors created a latent variable that included constructs theoretically associated with addictive eating, such as BMI, frequency of compulsive eating, food disinhibition, persistent hunger sensation. In order to reduce the excessive pathologizing of some eating behaviors, which, if they appear sporadically, do not indicate a

disorder, cut-off scores corresponding to a specificity higher than 0.90 were chosen, these being different for each diagnostic criterion.

The scale is made up for the evaluation of each addiction diagnostic criterion according to DSM-5, with items for each dimension, and, based on the cut-off values, the presence or absence of that criterion is established. In order to determine the level of clinical significance, the calculation algorithm is a complex one. Each item has a different value for determining the presence or absence of the criterion to which it refers, being recoded with 0 (the clinically significant value is not reached) or 1 (the value is reached), but the authors provide a document that calculates these scores, once the raw scores are entered. The scale can be used without restrictions for non-profit purposes. The tool has been translated into German (Meule et al., 2017), French (Brunault et al., 2017), Italian (Aloi et al., 2017), Spanish (Granero et al., 2018), Portuguese (Torres et al., 2017), Japanese (Khine et al., 2019), all translated versions proving adequate psychometric properties. The internal consistency of the scale is adequate, with a coefficient between 0.78 and 0.96, depending on the study. A single-factor structure was identified as the best solution in all studies, although most often a 2-factor structure was studied, but the first variant was retained. However, being an area still in its infancy, we believe that exploring other factor structure would bring benefits, including understanding the construct of food addiction.

Eating habits and cardiovascular diseases

The study of the psychological aspects involved in cardiovascular diseases must also focus on those risk factors whose awareness could bring benefits in prevention. Diet is one of the important behavioral risk factors in preventing and recovering from cardiovascular diseases, and obesity and overweight are metabolic risk factors for cardiovascular diseases, as highlighted by the international guidelines developed by the World Health Organization (WHO, 2011). Obesity is associated with an increased risk of developing cardiovascular disease, especially heart failure and coronary heart disease (Carbone et al., 2019; Poirier et al., 2006; Kenchaiah et al., 2002), being a complex phenomenon, having multiple determinants that interact with each other, of genetic, environmental and behavioral nature (Nelder et al., 2018).

In overweight and obese people, overeating and a sedentary lifestyle seem to be particularly important factors, so intervention is needed to help understand overeating, and food addiction could be a construct to help not only explaining these behaviors, but also identifying more effective ways to intervene in those affected. Although not all people with obesity have food addiction, as, for example, in a study of obese adolescents only 38% of them exceeded the limit values to be diagnosed with food addiction (Meule, 2015), it is still frequently associated with obesity and more common in people with this problem. A number of studies support the association of food addiction measured with YFAS 2.0 with obesity and eating disorders, and patients with obesity, bulimia nervosa, or compulsive eating disorder have a higher risk of meeting the criteria for food addiction (Meule et al., 2017; Brunault et al., 2017; Granero et al., 2018). Unlike obese people without food addiction, those with this pathology tend to have different eating habits, consuming more often foods rich in sugar, fats, but also in various minerals and vitamins (Pedram & Sun, 2015). Therefore, the study of food addiction is important, as it can be the basis of behaviors that lead to cardiovascular risk factors and it is a possible psychological factor associated with cardiovascular disease.

II. Objectives and hypotheses

The paper consists of two sub-studies with different objectives, but with the same participants and a similar methodology. Given the scientific interest related to the subject of food addiction, but also the fact that the scale was not translated into Romanian, the need to start such a process was identified, along with assessing the psychometric properties of this tool.

Hypothesis 1: We assume that YFAS 2.0 is a good tool for measuring food addiction with appropriate psychometric properties.

A second sub-study aimed at the analysis of the usefulness of the concept of food addiction in patients with cardiovascular diseases, as it may underlie obesity and metabolic syndrome, important risk factors for cardiovascular disease. Thus, the analysis of differences in food addiction, BMI, frequency of addictive foods consumption between people with and without cardiovascular diseases, and the analysis of predictors of body mass index in people with and without cardiovascular diseases were considered.

Hypothesis 2. We assume that there are statistically significant differences between people with cardiovascular diseases and those without diseases, in terms of food addiction level, body mass index and frequency of consumption of potentially addictive foods.

Hypothesis 3. We assume that there are different predictors of BMI in people with cardiovascular diseases compared to those without diseases.

III. Methods

Research design

The research had a cross-sectional design, with the following variables: food addiction level, bulimia/ compulsive eating level, number of addictive foods, frequency of addictive food consumption, age, BMI category.

Participants

The research group consisted of 375 adult participants, aged between 20 and 65 years, with an average age of 44 years, 187 men and 188 women. Of these, 100 had cardiovascular diseases (61 men and 39 women), and 275 had no disease (126 men and 149 women). 200 of the participants were employees of a company with an industrial profile, who received the questionnaires through the medical staff of the unit, and to ensure greater heterogeneity of data, online questionnaires were distributed in social networks groups, 175 responses being received in this way.

Research procedures

Participation was on a voluntary basis, and participants who completed the pencil-paper version signed an informed consent and had the opportunity to have a meeting with the research psychologist, if they wanted to know the results or if they wanted to ask other questions, but then the anonymization of data for all participants was provided.

Informed consents were collected separately to ensure that participants who wished to remain anonymous to the researcher had the opportunity to do so.

The participants who filled in the questionnaires electronically received the informed consent at the beginning of the form, its completion being conditioned by its acceptance, and they filled it in anonymously.

In the case of participants recruited by the unit doctor, the diagnosis of cardiovascular diseases could be verified through his records, but in the case of those recruited online it was established only based on participants' self-reporting.

Statistical analysis procedures were performed with SPSS 24 and included: descriptive statistics, internal consistency analysis, Pearson correlation, t test for independent samples, unifactorial ANOVA, exploratory factorial analysis, multiple regression analysis, Mann-Whitney test.

Research instruments

YFAS 2.0 (Gearhardt, Corbin & Brownell, 2016)

In this study, the full version of the scale, with 35 items, was used, which was presented in the introductory section of this study. In this study, the analysis of the psychometric properties of the scale was performed using its raw scores, because we considered it necessary to use this scoring variant in the non-clinical population. It would be important that the analysis for clinical scoring be performed with a clinical sample, equivalent in volume to the non-clinical one, with people with grade I, II obesity and morbid obesity, who may be previously diagnosed with eating disorders. according to DSM, because we would expect people in the non-clinical population to frequently have scores of 0 in the clinical scoring mode, as the level of their eating behaviors most likely does not exceed the clinical threshold, which would affect the variability of distribution and data analysis. The raw score, however, also indicates the intensity of the tendency towards food addiction, even if it is a subclinical one.

The scale was translated by a certified translator and by a psychologist independently, and then the retroversion of the items was performed by an independent person, a sociologist with experience in developing psychometric tests, who was not familiar with the variant in English, and then the elements of differences were discussed and the best expression by consensus was chosen. Prior to their division, the forms were handed to a group of 5 participants, who gave positive feedback on understanding the questions. The items did not pose problems of interpretation, because the questions are simple, with a language from the basic lexical background.

PDSQ Bulimia/ Compulsive Eating Scale (Zimmerman, 2010)

The scale assesses compulsive eating disorder and bulimia, being part of the PDSQ psychiatric screening and diagnosis questionnaire, which is validated and calibrated on the Romanian population, requiring a license to use. The value of the internal consistency index for the Romanian version of the scale is 0.88, the section point given by the test manual for this scale is 5, with a sensitivity of 92% and a specificity of 88%, this value indicating an increased probability of positive diagnosis for an eating disorder. In order to establish the diagnosis, however, the clinical interview is also necessary, the decision cannot be made only based on this scale. In this study, the recommended section point was used to

separate study participants based on the absence or presence of a significant clinical score, no in-depth diagnostic interviews were performed.

Checklist – food patterns

Based on the information identified in the literature on potentially addictive foods, a number of such foods were identified, being grouped according to their affiliation, the checklist developed having two components. One of these asks the respondent to choose from the list presented all those foods in connection with which he has experienced difficulties in refraining from consuming during the last year, these being: ice cream, chocolate, donuts, cakes, candies, cookies, white bread, pasta, rice, pastries, chips, pretzels, savory biscuits, puff pastry, fatty steak, bacon/ ham, burgers, pizza, French fries, sweet and fizzy drinks (Cola, Fanta, Sprite, etc.), non-carbonated sweet drinks, energy drinks. The second part of the checklist divides these foods into 5 categories (sweets, starchy foods, salty snacks, fatty foods, sweet drinks) and the participant chooses their frequency of consumption in the last year: not at all, less than monthly, once a month, 2-3 times a month, once a week, 2-3 times a week, 4-6 times a week, every day. The identification data (gender, age, height, weight, health) were also collected in the checklist.

IV. Results

Sub-study I. Psychometric properties of the Romanian translation of the Yale Food Addiction Scale 2.0

YFAS 2.0 fidelity

To evaluate the fidelity of the test, an analysis of the internal consistency in the SPSS program was performed and the value of the resulting Cronbach-Alpha index is 0.95, which indicates an increased fidelity, the scale thus proving to be well homogenized regarding the content of items.

YFAS 2.0 validity

The content validity of the scale is supported by the way it was developed, its items being formulated by the authors taking into account the criteria for addictions present in the DSM-5. Thus, it is observed that the items fully reflect the theoretical model on addictions, as it is described in the most important classification of mental disorders at this date. The structure of the test follows the field to which it is addressed, all diagnostic criteria being targeted by its items.

The convergent validity of the tool was analyzed by correlating it with a scale of bulimia/ compulsive eating validated and calibrated on the Romanian population, but also with the reported number of addictive foods in our checklist.

The research data indicate a statistically significant positive correlation between the constructs of bulimia and food addiction ($r = 0.653$, $p < 0.001$, $N = 375$), the correlation having a moderately-increased intensity. Thus, it is observed that the two constructs are correlated, but they do not overlap, because the correlation does not exceed 0.9, which supports the convergent validity of the YFAS scale. The convergent validity of the scale is also supported by the statistically significant positive correlation between food addiction and the reported number of addictive foods ($r = 0.286$, $p < 0.001$, $N = 375$), although the intensity of this correlation is low.

The criterion validity of the tool was analyzed by:

- Its ability to differentiate between normal, overweight and obese people.
- Its ability to differentiate between people with clinically significant bulimic symptoms and those without such symptoms.

Thus, we assumed that there are statistically significant differences between normal, overweight and obese individuals with respect to food addiction, but also that there are statistically significant differences between people with and without clinically significant bulimic symptomatology with respect to food addiction.

For the division on the normal weight, overweight, obese categories, the standard cut-off values for BMI were used, in the research sample there were 144 (38.4%) normal-weight people, 153 overweight people (40.8%) and 78 obese people (20.8%). To establish the existence or non-existence of clinically significant symptoms for bulimia/ compulsive eating, the section point presented in the test manual (5) was used, out of a total of 375 participants 304 (81.1%) not having clinically significant symptoms of bulimia/ compulsive eating, and 71 (18.9%) showing such symptoms.

The variance of food addiction was studied according to three categories of BMI, using the unifactorial ANOVA test, the participants being divided into: normal weight ($N = 144$, $M = 21.00$, $SD = 24.588$), overweight ($N = 153$, $M = 21.68$, $SD = 23.757$), and obese ($N = 78$, $M = 45.21$, $SD = 35.247$). The Levene test for variance homogeneity indicates a statistically significant value ($p < 0.05$), which cannot lead to the conclusion that the dispersions between the three groups

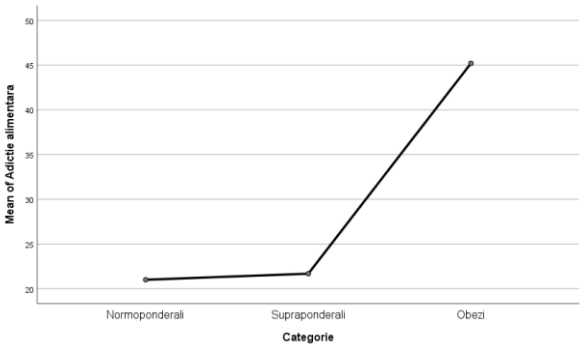
are homogeneous, thus supporting the use of the Welch test, and not the F test. We found it to be statistically significant with a value of 15.860 ($df_{intergroup}$ = 2, $df_{intergroup}$ = 183.962, $p < 0.001$, $\eta^2_{partial}$ = 0.147), which indicates a statistically significant overall difference between groups, but with a small effect size.

Post-hoc analysis with the Tamhane test revealed statistically significant differences between:

- the group of obese people and that of normal-weight people ($M_{normalweight} - M_{obese}$ = -24.205, $p < 0.01$, 95% CI: -35.07, -13.34).
- the group of obese and overweight people ($M_{overweight} - M_{obese}$ = -23.525, $p < 0.01$, 95% CI: -34.2, -12.79)

There were no statistically significant differences between overweight and normal weight people ($p > 0.05$).

Graph 1. Average food addiction according to BMI



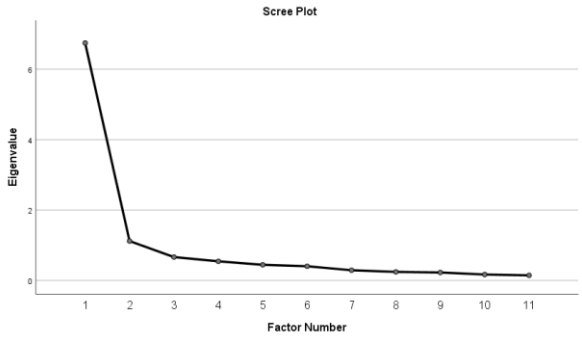
Graph 1 shows the difference between the means of food addiction, on the three groups. We can thus observe how weight gain, and especially in obese people, is associated with increased levels of food addiction.

Another aspect studied for the analysis of the validity of the criterion was represented by the difference in food addiction between participants who do not show clinically significant bulimic symptoms (N = 304, M = 18.96, SD = 21.821) and those who show such symptoms (N = 71, M = 57.79, SD = 32.082), using the t test for independent samples. The Levene test is statistically significant, indicating that the homogeneity of the variances is not observed, which determines the use of the Welch t test. The research data support the existence of statistically significant differences between the two groups (t = -9.688, df = 85.712, $p < 0.01$, 95% CI: -46.796, - 30.861), the effect size being increased (Hedge's g = -1.609, 95% CI Cohen d: -1.895, -1.328). People with clinically significant symptoms thus have a higher level of food addiction, which once again supports the criterion validity of the tool, as it manages to distinguish between the groups.

Factorial structure of the scale

Because the scale was translated into Romanian for the first time, an exploratory factorial analysis was performed, using as components the 11 diagnostic criteria, by dividing the items into the 11 criteria to which they are addressed, as the factorial structure of this scale is generally studied in other studies. The factor extraction method was the *Principal axis factoring* method, with *Varimax* rotation, the choice of the number of factors initially made by the Kaiser method, keeping in the factorial solution only the eigenvalue factors with the value at least equal to 1. Initially, the KMO index was analyzed, which has a value of 0.922, as well as the Bartlett test of sphericity, which is statistically significant (χ^2 = 3400.787, df = 55, $p < 0.001$), thus justifying the use of the exploratory factor analysis on the research data. By this method, two factors were extracted, which together explain 68.369% of the total variance, the first factor explaining 60.946% of the variance, and the second factor 7.423%. After applying the rotation procedure, a redistribution of the variance explained by each factor is observed, in the context of the same total variance, the first factor explaining 38.830% of the variance and the second 29.538%.

Graph 2. Scree Plot



Graph 2 expresses the eigenvalue values for all the main components resulting from the analysis, and by its visual inspection, a marked decrease of the eigenvalue values can be observed from the first to the second factor, which, based on the method proposed by Cattel (apud Popa, 2010), justifies the choice of a single factor in the analysis, especially since this is the factorial solution identified by previous studies in the field of food addiction. Therefore, we performed a new exploratory factor analysis, this time with the number of

factors chosen according to the method proposed by Cattel. Performing such an analysis with a fixed number of factors (1 factor), the resulting solution explains 60.230% of the entire variance. Communality values are adequate, generally with values above 0.4. The saturations for each diagnostic criterion are adequate, and none of them has a factor load of less than 0.5. Given these results, it can be seen that, similar to other studies, the single-factor variant, in which the food addiction factor is composed of all DSM criteria for addictions applied to eating behaviors, can be kept as an explanatory model.

Sub-study 2. Psychological aspects of nutrition in people with and without cardiovascular diseases

Descriptive statistical analysis

The table below presents the descriptive statistical analysis for the research variables.

Table 1. Descriptive statistical indicators

	M	SD	Skewness		Kurtosis	
			Value	SE	Value	SE
Food addiction	26.31	28.468	1.512	.126	2.375	.251
BMI	26.65	4.780	1.031	.126	2.655	.251
Compulsive eating	2.11	2.452	1.004	.126	.002	.251
Frequency of sweets consumption	4.37	1.495	-.096	.126	-.714	.251
Frequency of salty snacks consumption	3.15	1.455	.424	.126	-.458	.251
Frequency of starchy foods consumption	5.46	1.688	-.869	.126	-.325	.251
Frequency of fat consumption	3.47	1.410	.463	.126	-.325	.251
Frequency of sweet drinks consumption	3.58	1.742	.256	.126	-.873	.251
Age	44.71	11.067	-.148	.126	-1.034	.251

Inferential statistical analysis

The aim was to observe the difference in food addiction between participants who do not have cardiovascular diseases (N = 275, M = 25.67, SD = 27.688) and those who have cardiovascular diseases (N = 100, M = 28.08, SD = 30.584), by using the t test for independent samples. The Levene test is not statistically significant ($p > 0.05$), indicating that the homogeneity of the variances is observed. The research data do not support the existence of statistically significant differences between the two groups ($t = -0.725$, $df = 373$, $p > 0.05$, 95% CI: -8.952, 4.130).

The analysis of the difference in BMI between participants who did not have cardiovascular diseases (N = 275, M = 25.51, SD = 4.043) and those with cardiovascular diseases (N = 100, M = 29.77, SD = 5.255) was also considered, by using the t test for independent samples. The Levene test is not statistically significant ($p > 0.05$), indicating that the homogeneity of the variances is observed. The research data support the existence of statistically significant differences between the two groups ($t = -8.301$, $df = 373$, $p < 0.01$, 95% CI: -5.272, - 3.253).

For the analysis of differences in the frequency of consumption of different foods with addictive potential, the Mann-Whitney U test was used. Research data support the existence of statistically significant differences between people without cardiovascular diseases and those with diseases only in terms of frequency of consumption of sweets ($U = 11630$, $p < 0.05$), as it can be seen in Table 2.

Table 2. Differences in frequency of consumption

	Persons without diseases		Persons with diseases		U	p
	N	M ranks	N	M ranks		
Frequency of sweets consumption	275	195.71	100	166.80	11630	p<0.05
Frequency of starchy foods consumption	275	185.04	100	196.14	14564	p>0.05
Frequency of salty snacks consumption	275	190.98	100	179.80	12930	p>0.05
Frequency of fat consumption	275	188.19	100	187.48	13698	p>0.05
Frequency of sweet drinks consumption	275	192.30	100	176.17	12567	p>0.05

To test the second hypothesis, the regression analysis was used, previously studying the matrix of correlations between research variables.

Table 3. Correlations

	1	2	3	4	5	6	7	8	9
Persons without diseases									
1. BMI	1								
2. Food addiction	.228**	1							
3. Bulimia/ compulsive eating	.297**	.698**	1						
4. Age	.222**	-.040	-.028	1					
5. Frequency of sweets consumption	.099	.252**	.214**	-.101	1				
6. Frequency of starch consumption	.056	.027	.069	.153*	.312**	1			
7. Frequency of salty snacks	.113	.181**	.178**	-.251**	.446**	.271**	1		
8. Frequency of fats	.154*	.154*	.160**	-.082	.264**	.423**	.413**	1	
9. Frequency of sweet drinks	.079	-.004	-.022	-.231**	.253**	.192**	.512**	.435**	1
Persons with cardiovascular affections									
1. BMI	1								
2. Food addiction	.482**	1							
3. Bulimia/ compulsive eating	.309**	.542**	1						
4. Age	-.076	.048	.114	1					
5. Frequency of sweets consumption	.103	.257**	.025	-.083	1				
6. Frequency of starchy foods consumption	.177	.171	-.114	-.240*	.354**	1			
7. Frequency of salty snacks consumption	.142	.106	-.189	-.089	.272**	.266**	1		
8. Frequency of fat consumption	.338**	.219*	-.009	-.151	.365**	.318**	.524**	1	
9. Frequency of sweet drinks consumption	.061	.053	-.186	-.213**	.419**	.472**	.513**	.557**	1

From the correlation matrix, statistically significant correlations of BMI with food addiction, bulimia/ compulsive eating, age and frequency of fat consumption can be observed, these being the predictors

that were included in the regression analysis. Thus, a stepwise multiple regression analysis was performed, analyzing the predictor value of food addiction (N1 = 275, N2 = 100, M1 = 25.51, M2 = 28.08, SD1 = 4.043, SD2 = 30.584), of bulimia/ compulsive eating (N1 = 275, N2 = 100, M1 = 2.13, M2 = 2.06, SD1 = 2.507, SD2 = 2.30), of age (N1 = 275, N2 = 100, M1 = 41.8, M2 = 52.71, SD1 = 10.423, SD2 = 8.59) and of the frequency of fat consumption (N1 = 275, N2 = 100, M1 = 3.46, M2 = 3.52, SD1 = 1.351, SD2 = 1.567) regarding the BMI level in people without cardiovascular diseases (N1 = 275, M1 = 25.51, SD1 = 4.043), as well as in people with cardiovascular diseases (N2 = 100, M2 = 29.77, SD2 = 5.255).

Table 4. Regression models

	Model	R	R^2	R^2_{adj}	Std error	deltaR^2
Without diseases	1	.297	.088	.085	3.868	.088
	2	.375	.141	.135	3.761	.053
	3	.396	.157	.148	3.733	.016
With diseases	1	.482	.232	.225	4.627	.232
	2	.538	.289	.275	4.475	.057

Table 5. Standardized and non-standardized coefficients

	Model	Predictor	B	SE	β	t	p
Without diseases	1	Constant	24.487	.307		79.877	.000
		Bulimia	.479	.093	.297	5.136	.000
	2	Constant	20.736	.964		21.507	.000
		Bulimia	.489	.091	.303	5.395	.000
		Age	.089	.022	.230	4.091	.000
	3	Constant	19.318	1.144		16.888	.000
		Bulimia	.457	.091	.283	5.010	.000
		Age	.093	.022	.240	4.286	.000
		Frequency of fat consumption	.384	.170	.128	2.262	.024
With diseases	1	Constant	27.446	.630		43.590	.000
		Food addiction	.083	.015	.482	5.447	.000
	2	Constant	24.815	1.123		22.104	.000
		Food addiction	.074	.015	.429	4.886	.000
		Frequency of fat consumption	.821	.294	.245	2.789	.006

In the stepwise multiple regression analysis, in the first step, the bulimia predictor is introduced, in the second step, next to the bulimia, the age predictor is introduced, and in the third step, the frequency of fat consumption is introduced, food addiction being eliminated from the analysis. In the case of people with cardiovascular diseases, food addiction is introduced in the first step, and in the second step the frequency of fat consumption is introduced, bulimia and age being eliminated. The resulting models and the standardized and non-standardized coefficients can be seen in Table 4 and Table 5.

The statistically significant model that best explains the variance of BMI in people without cardiovascular diseases ($F_{3.271}$ = 16.811, $p < 0.01$) consists of predictors: bulimia/ compulsive eating ($t = 5.010$, $\beta = 0.283$, $p < 0.01$), which explains 8.8% of its variance, age ($t = 4.286$, $\beta = 0.240$, $p < 0.01$), which explains, in addition, 5.3% of the variance and frequency of fat consumption ($t = 2.262$, $\beta = 0.128$, $p < 0.01$), which explains another 1.6% of the variance. The model consisting of the three predictors explains 14.8% of the BMI variance.

In the case of people with cardiovascular diseases, the statistically significant model that best explains the variance of BMI ($F_{2.97} = 19.748$, $p < 0.01$), is made up of predictors such as food addiction, which is statistically significant ($t = 4.886$, $\beta = 0.429$, $p < 0.01$), and explains 23.2% of the variance, and the frequency of fat consumption, which is also a statistically significant predictor ($t = 2.789$, $\beta = 0.245$, $p < 0.01$), which explains, in addition, 5.7% of the variance BMI, both predictors together explaining 28.9% of the BMI variance.

V. Discussions

In this study, the main objective was the research of food addiction, firstly by demonstrating the psychometric properties for the YFAS scale translated into Romanian. Secondly, were analyzed the differences in food addiction, body mass index (BMI), frequency of addictive food consumption, between people with and without cardiovascular diseases, as well as the analysis of BMI predictors in people with and without diseases. In the Romanian population, no studies have been identified to address these issues, although they have an increased practical importance in the field of clinical and health psychology. Food addiction can be the basis for the consumption of unhealthy foods, which have an increased addictive potential and which also increase the cardiovascular risk, through the content of sugar, salt or fats, and their use can lead to obesity and to the development of metabolic syndrome which aggravates cardiovascular risk.

As well as the variants translated into other languages (Meule et al., 2017; Brunault et al., 2017; Aloi et al., 2017; Granero et al., 2018; Torres et al., 2017; Khine et al., 2019), the results of this research support the use of the YFAS 2.0, translated into Romanian in the current practice, as it has adequate psychometric properties, good reliability and validity, but also a factorial structure with a single factor, similar to other studies. Although we conclude the one-factor variant as the most appropriate, we consider that the two-factor variant, which can be analyzed in future studies, on different populations should also be noted. The two-factor variant can be justified in the context of the

explanatory theory on addictions according to DSM 5 (APA, 2016), which divides the diagnostic criteria into four major groups, the first of the factors obtained by us referring to poor control and pharmacological criteria (tolerance and withdrawal), and the second to the impact of substance use on social and recreational relationships and hazardous consumption. The tool also demonstrates good validity, as it statistically significantly correlates with variables with which we would expect to have such correlations, as bulimia/ compulsive eating and the number of reported addictive foods. Also, statistically significant differences can be observed between people who exceed the clinical threshold for bulimia/ compulsive eating, as well as between normal-weight, overweight and obese people, the significant differences being between obese people and other groups. These results are consistent with the literature, which shows that people with obesity, bulimia nervosa or compulsive eating disorder are at higher risk of meeting the criteria for food addiction (Meule et al., 2017; Brunault et al., 2017; Granero et al., 2018). Gearhardt et al. (2016) obtained statistically significant differences between the categories of normal and overweight, but in this study no significant differences were highlighted, requiring further studies to clarify the issue. The results, in addition to supporting the criterion validity of the scale, also indicate the category of people who are prone to problems with food addiction, namely those who are obese.

People with cardiovascular diseases have a significantly higher BMI, but, nevertheless, there is no decrease in the level of food addiction to them, compared to people without diseases. There is also no difference in the consumption of foods with addictive potential, with the exception of sweets, which people with diseases consume less often. Higher blood glucose levels are frequently associated with cardiovascular diseases, as diabetes and hyperglycemia are known risk factors presented in the guidelines (WHO, 2011), and it is possible that people with the disease have received such medical indications. However, fats, also known as risk factors, do not appear to be consumed less frequently. This may be one of the areas that would require attention in the education of the population and may be an element that could be better supported in information and awareness campaigns, especially since it is important to emphasize that there are differences between types of fat, which can create confusion among the general public if the messages are not conveyed clearly and concisely (Liu et al., 2017). Thus, saturated and trans fats are those that increase cardiovascular risk, while polyunsaturated fats have a protective role and may be more useful than certain types of carbohydrates, such as simple ones (op. cit., 2017), and fats that are targeted as potentially addictive are exactly the harmful ones, so once again, acknowledging food addiction can contribute to adopting a healthy eating behavior that prevents cardiovascular risk. It can be seen that, without help, spontaneously, these people, although they know that they have a disease, do not have a significantly modified behavior, compared to those without diseases. Such help must be primarily informational, through a doctor or a nutritionist, but, as the addictive process can interfere with the difficulty in the adherence to a certain diet, the guidance towards a psychological intervention of those who have difficulties should be achieved.

In people without diseases, compulsive eating appears to better explain the increase in BMI, as well as older age and frequency of fat consumption. Food addiction, along with the frequency of fat consumption, appear to be the best predictors of body mass index in people with cardiovascular diseases, food addiction probably better explaining the increase in body mass index in these people because, with cardiovascular diseases and with weight gain, metabolic imbalances occur, and the body finds it harder to consume the caloric energy brought by addictive foods, which have a high caloric content. Foods that contain fats are hyper-caloric, among macro nutrients, fats having the highest caloric concentration (Youdim, 2019), and age appears as explaining the body mass index, because the metabolic rate at rest tends to decrease with age, but also with weight gain (McMurray et al., 2014), but only in people without diseases. Cardiovascular disease often involves metabolic imbalances, and thus, an impossible factor to change, such as aging, no longer appears as a predictor of BMI because it can no longer compensate for the increased caloric intake of addictive foods consumed, but rather factors such as food addiction and the frequency of fat consumption are more relevant. This is of interest for psychological practice, because, being aspects that are in the person's control, psychological interventions for behavioral change can be performed and we would expect them to have effects in lowering the BMI. Although in the study of BMI predictors, compulsive eating was identified as a better predictor in people without diseases and food addiction in those with diseases, given the increased correlation between these two constructs, we can say that they overlap to a moderate towards increased extent, and therefore, in practice, they must be approached together, so as not to omit important directions in the intervention.

VI. Conclusions

Screening for cardiovascular diseases, but also for eating disorders and food addiction, would be of real benefit to people with obesity, because they may be at risk without realizing it, and its awareness can be a first step towards the ultimate lifestyle change. Patients who notice that they have difficulties can be referred to a psychologist, and thus, behavioral changes can be supported through psychological interventions to reduce food addiction, further studies on the Romanian population being needed to address such intervention programs. Also, a future direction of research is that of studying the issue in children, as a scale for evaluating children also exists.

The limitations of the study are primarily due to the fact that it had participants from the general population, thus being few people with obesity, as well as people who cross the clinical threshold for bulimia/ compulsive eating and, even if some of these people had been diagnosed with cardiovascular diseases, those involved in this research did not suffer from serious illnesses that would require hospitalization. Future studies should focus on a clinical population of patients with obesity and diagnosed eating disorders, especially since, even on small samples in this study, they showed more intense symptoms. Also, the clinical scoring of the scale was not utilized, the raw score, for research purposes, being used and only the frequency of consumption of addictive foods was taken into account, not the measurement of the exact quantity of addictive foods consumed, which would be difficult to assess only by self-reporting – issues that could be addressed in future experimental studies on the clinical population.

To conclude, the present study supports the usefulness of the concept of food addiction and the Yale Food Addiction Scale 2.0 in psychological assessment and counseling for the purpose of preventing and managing cardiovascular risk and obesity. In people who are obese and who have difficulties in changing their lifestyle, whether or not they have cardiovascular diseases, in the evaluation and psychological intervention it is recommended to consider the possibility that this eating behavior is based on a mechanism of addictive type. It is important to act in the direction of patients' psycho-education, but also to adapt the objectives and methods of intervention, so as to target the addictive behavior.

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