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Exploring sub-threshold Food Addiction in adult patients with severe obesity: a cross-sectional analysis

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Short title: sub clinical food addiction in severe obesity

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Abstract

Background: Most studies on Food Addiction (FA) used the strict classical diagnosis approach without quantifying sub-threshold symptoms (i.e. uncontrolled/excessive food intake, negative affect, craving, tolerance, withdrawal, and continued use despite harm) nor indicating where they stand on the “three-stage addiction cycle” modelling the transition from substance use to addiction. **Objectives** 1) to estimate the proportion of clinically significant episodes of distress/impairment in severely obese patients without FA, and 2) to assess their associations with FA symptoms at the subthreshold level. **Methods:** The modified Yale Food Addiction Scale 2.0 (mYFAS 2.0) assesses 11 symptoms (diagnostic criteria) plus clinically significant impairment and distress (clinical significance criterion). We used this tool to diagnose FA (≥ 2 criteria plus clinical significance) in adult patients with severe obesity, but included only those below the threshold in the analyses. Demographics, clinical features, and obesity complications were collected. **Results:** Only 18% of the 192 participants (women $n=148$, 77.1%; mean age: 43.0 ± 13.2) reported a total absence of FA symptoms, while one in four reported recurrent episodes of clinically significant distress (24%) or impairment (25%) in social, occupational, or other important areas of functioning. The most common recurrent symptoms were first-stage symptoms (binge/intoxication), while second- (withdrawal/negative affect) and third-stage (preoccupation/anticipation) symptoms affected nearly one patient in five for tolerance and craving, and one in ten for withdrawal. In multivariate analysis, impairment was positively related to withdrawal and tolerance, while distress was positively related to failure in role obligations. **Conclusion:** Many patients with severe obesity experience recurrent episodes of FA symptoms at the subthreshold level. Prospective studies will examine whether these symptoms may play a causal role in symptoms progression towards a full-blown FA and obesity outcomes.

Keywords: obesity; eating disorders; food addiction; craving; binge eating.

Introduction

Some foods, particularly hyper-palatable and ultra-processed foods with added sweeteners, salt and fats have the greatest addictive potential ^{1, 2}. Patients who exhibit eating patterns and symptoms similar to addictive disorders are labelled as having a Food Addiction (FA), a construct that applies the Diagnosis and Statistic Manual (DSM)-5 criteria for Substance Use Disorders to food ³. Typically, these diagnostic criteria include addictive-like symptoms such as uncontrolled/excessive food intake, negative affect, craving, tolerance, withdrawal, and continued use despite harm. In response to concerns that the DSM criteria are overly inclusive, a “clinical significance criterion” must be additionally present to endorse addiction diagnosis. This criterion includes clinically significant episodes of distress or impairment in social, occupational, or other important areas of functioning, which serves at adequately distinguishing mental disorder from sub-threshold symptom variations ⁴.

Investigating sub-threshold FA could nevertheless be of interest for prevention and medical care, since many mental health problems exist in clinical forms that do not meet the minimum number of criteria required for full-blown disorder⁵. These sub-threshold conditions can interfere with social and occupational activities, cause distress, and impair general functioning in affected individuals ^{5, 6}. They may also constitute potential targets for preventive strategies ⁷, as affected individuals are at a greater risk to develop psychiatric disorders ^{8, 9}. However, FA studies used the strict classical diagnosis approach by dividing the patients into “cases” and “non-cases”, without quantifying sub-threshold symptoms, nor indicating where they stand on the “three-stage addiction cycle” ¹⁰. Yet, this model provides a comprehensive framework for understanding the development, maintenance, and treatment of addictive behaviours, and starts with the binge/intoxication phase (first stage), followed by withdrawal/negative affect (second stage) and ends with preoccupation/anticipation/craving ^{11, 12}.

Since FA is common in morbidly obese patients¹³⁻¹⁵, using this model to characterize subthreshold symptoms in these high-risk individuals could constitute a remarkable opportunity to increase knowledge on FA developmental origins and early detection. We hypothesize that morbidly obese patients not meeting the full diagnostic criteria for FA nevertheless experience recurrent episodes of clinically significant distress or impairment in social, occupational, or other important areas of functioning, in association with FA symptoms. The aim of the present study was to investigate subthreshold FA in morbidly obese patients consulting for the first time in the regional obesity referral centre of a university hospital. Specific objectives were: 1) to estimate the proportion of clinically significant episodes of distress/impairment in severely obese patients without FA, and 2) to assess their association with others FA symptoms at the subthreshold level.

Methods

Patients and procedure

We used routine of care data previously collected from the patient medical record in consecutive severely obese patients consulting for the first time in the nutrition department of a University Hospital between December 2016 and March 2019¹³. All were obese patients with a body mass index (BMI) equal to or higher than 35. These data were used for selecting the patients included in a study approved by an independent national research ethics committee on June 18, 2018 (Comité de Protection des Personnes “Ouest II”, Angers, France, N°2017/44,; N°ID-RCB/EUDRACT 2017-A01269-44).

Impairment/distress and FA symptoms

We assessed FA with the modified Yale Food Addiction Scale 2.0^{16, 17} (mYFAS 2.0), a shortened version of the 35-item YFAS 2.0 questionnaire, developed to measure the frequency of addictive-like eating behavior and identify individuals who may be experiencing symptoms akin to substance dependence in relation to certain foods. The mYFAS 2.0 comprises two questions assessing the clinical significance criterion (i.e. clinically significant impairment or distress) and eleven questions assessing diagnostic criteria (i.e. FA symptoms), as follows: loss of control (food taken in larger amount and for a longer period than intended); inability to cut down (persistent desire or repeated unsuccessful attempt to quit); much time spent (much time/activity to obtain, use, and recover); impact on activities (important social, occupational, or recreational activities given up or reduced); withdrawal (development of physiological and/or psychological symptoms in response to abstinence or decreased use of these foods); tolerance (marked increase in amount to experience the same effects); craving (strong, urgent, desire for a certain food); use despite social/interpersonal and physical/psychological consequences (use continues despite knowledge of adverse consequences); failure in role

obligations (school, work, home); and use in physically hazardous situations (*e.g.*, driving, *etc.*). Each item asks participants about their symptoms' frequency in the past year, using an eight-point Likert scale ranging from a total absence of symptoms to experiencing them every day (0 = never; 1 = less than monthly; 2 = once a month; 3 = 2–3 times a month; 4 = once a week; 5 = 2–3 times a week; 6 = 4–6 times a week; 7 = every day). For each symptom, a threshold indicates whether the corresponding DSM-5 criteria is endorsed (yes/no). Participants can be categorized into mild (two or three symptoms and clinical impairment/distress), moderate (four or five symptoms and clinical impairment/distress) or severe (six or more symptoms and clinical impairment/distress) FA. In the present study though, we included patients below the threshold (*i.e.* less than two symptoms and/or no clinically significant impairment/distress) and considered a symptom “recurrent” when experienced at least once a month.

Socio-demographic and clinical data

Socio-demographic (age, gender, occupation, marital status) and clinical data were extracted from the computerized medical record (DxCare, Dedalus, France). Occupation was sorted as active, unemployed and retired categories, and marital status as single or in a relationship. Clinical data included anthropometry (weight and height, to calculate body mass index), physical disability status (yes/no), obesity complications (type-2 diabetes, arterial hypertension, metabolic syndrome, obstructive sleep apnoea syndrome (OSAS), joint pain, fatty liver disease), tobacco (yes/no) and alcohol consumption (regular, occasional, none).

Statistical analyses

Categorical data were expressed as numbers (N) and percentages (%). Numerical data were expressed as means and standard deviations (\pm SD), or as median value and Interquartile Range

[IQR]. Since our study outcomes were ordered categorical variables (frequency of clinically significant impairment/distress), we used ordinal regressions to estimate the strength of the association between each outcome and covariate (univariate analysis). In order to determine variables independently associated with outcomes, all variables that demonstrated an association with $p < 0.05$ in the univariate analysis were considered as covariates in the multiple ordinal regression model. Statistical analyses were performed using the SPSS statistical package, version 19 (SPSS, Chicago, Illinois, United States).

Results

During the study period, 474 patients accepted to participate in the study, but only 292 completed the questionnaire without missing data. Briefly, 100 patients (34.5%) met the mYFAS 2.0 criteria for FA, and were removed from analyses. Of the 192 included patients (**Table 1**), the majority were women (n=148, 77.1%), aged 43.0 ± 13.2 years on average, living in couple (n=116, 60.4%) and professionally active (n=105, 54.7%) with a mean (\pm SD) BMI of 42.8 ± 6.6 . Half of them reported alcohol use (occasional: 46.4%; regular: 3.6%), eight in ten (n=164, 84.4%) had at least one comorbid condition but only 25 (13%) had a physical disability status.

While 62 patients endorsed ≥ 2 FA diagnostic criteria without clinically significant impairment/distress, a minority of them endorsed the clinical significance criterion (impairment: n= 6; distress n=10) with less than two diagnostic criteria. Overall, the median number [IQR] of diagnostic criteria endorsed was 1 [0-2], but data-driven analysis showed that only 18% of participants (N=35) reported a total absence of FA symptom, and that one in four reported clinically significant episodes of impairment (N=48) and distress (23.9%) at least once a month (**Table 2**). Recurrent FA symptoms most commonly reported were: “Being unable to cut down food intake” (52.0%), “spending a great deal of time” (37.5%), “tolerance” (28.6%), “use despite interpersonal consequences” (25.0%) and “use despite emotional consequences” (22.4%). Nearly one in five patients reported “withdrawal” (N=34; 17.7%) and “craving” (N=30; 15.7%) while less than one in ten reported “failure in role obligations” (N=16; 8.3%), “important activities given up” (4.1%) and “use in hazardous situations” (2.1%). Non-parametric correlations between the eleven scales ranged from non-significance ($p > 0.05$) to moderate relationships (between craving and tolerance; $r = 0.37$; $p < 0.001$), indicating an absence of collinearity.

In the univariate analysis (**Table 3**), impairment was related to all symptoms listed in the mYFAS 2.0 except for “important activities given up” and “use in physically hazardous situations”. In the multivariate analysis, impairment was related to “withdrawal” and “tolerance”. In the univariate analysis, distress was related to “withdrawal”, “failure in role obligations”, “unable to cut down”, “being professionally active”, and “alcohol use”. In the multivariate analysis, “distress” was only related to “failure in role obligations” (**Table 4**).

Discussion

Findings showed that only 18% of severely obese participants without FA reported a total absence of FA symptoms, while one in four reported clinically significant episodes of “impairment” and “distress” at least once a month. Recurrent FA symptoms commonly reported were: “Being unable to cut down” (52.0%), “spending a great deal of time” (37.5%), “tolerance” (28.6%), “use despite interpersonal consequences” (25.0%) and “use despite emotional consequences” (22.4%). Nearly one in five patients reported “consumed more than planned” (18.7%), “withdrawal” (17.7%) and “craving” (15.7%) while less than one in ten reported “failure in role obligations” (8.3%), “important activities given up” (4.1%) and “use in hazardous situations” (2.1%). In the multivariate analysis, clinically significant impairment was positively related to “withdrawal” and “tolerance”, while clinically significant distress was positively related to “failure in role obligations”.

Our findings suggest that recurrent episodes of clinically significant distress/impairment in relation to eating are common in obese patients without FA, affecting one patient in five at least once a month. The relationship between excess weight and psychological well-being is complex, encompassing physical, social and psychological factors¹⁸. Living with obesity increases the risk of affective disorders, and patients with psychological problems may gain weight by overeating in response to stress^{19,20}. In addition, many obese individuals experience

social stigma as well as self-blame and low self-esteem²¹. Because of their increased weight, they are also more likely to be limited in walking, bending, kneeling, and stooping^{22, 23}. Altogether, these adverse consequences of obesity have the potential to induce recurring clinically significant distress and impairment episodes, even at the subthreshold level.

Addiction can be conceptualized as a three-stage, recurring cycle – binge/intoxication, withdrawal/negative affect, and preoccupation/anticipation (craving) – that worsens over time and involves neuroplasticity changes in the brain reward, stress, and executive function systems¹¹. In the present study, the percentage of participants reporting recurrent FA symptoms varied from 2% to 52% depending on the symptom considered, with higher rates for first-stage symptoms (binge/intoxication), such as being “unable to cut down”, “great deal of time spent” and “consumed more than planned”. This result could be expected as these symptoms overlap with overeating and binge eating disorders²⁴, which are common in patients with obesity²⁵.

More surprisingly, many patients also experienced recurrent bouts of second-stage (withdrawal/negative affect) symptoms, since one in five reported “tolerance” and one in ten reported “withdrawal” at least once a week. These symptoms may be associated to eating disorders (ED) found in obese patients, probably in relationships with an alteration of the dopaminergic system that would appear from subthreshold levels of ED^{26, 27}. For instance, in a study sample from the German general population – but comprising a majority of overweight/obese people – 13% of individuals without FA endorsed YFAS criteria for withdrawal²⁸.

Despite their medical condition, a majority of participants remained professionally active and less than 10% reported recurrent “failures in role obligation”, “important activities given up” and “use in hazardous situations”. These disturbances in social and professional life seem therefore infrequent at the subthreshold level and may be related to the last stage of the addiction cycle (preoccupation/anticipation), that involves the brain’s prefrontal cortex, the region that

controls the ability to organize thoughts and activities, prioritize tasks, manage time, make decisions, and regulate one's own actions, emotions, and impulses ¹².

Albeit marginal, “failure in role obligations” was the only symptom related to clinically significant distress in the multivariate analysis. When it comes to “impairment”, the relationships observed between this clinical criterion, eating disorders (“unable to cut off”, “consumed more than planned”, “use despite physical/emotional consequences”) and social consequences (“failure in role obligations”) become non-significant when combined with “tolerance” and “withdrawal” in the multivariate model. One possible explanation is that second-stage symptoms at the FA subthreshold level correlate with eating disorders of sufficient severity to impair social and professional life²⁹, and could therefore constitute warning signs for the development of full-blown FA.

The results of this study must be viewed in light of its main limitations. Firstly, there is a lack of consensus on subthreshold psychiatric conditions, including FA. Secondly, cross-sectional, analysis of data from single centre limits the generalization of findings to whole population. Thirdly, the use of the shortened version of the YFAS 2.0 greatly simplified the data-driven approach adopted in the study, but also precluded more in-depth analyses. In addition, the Finally, many patients willing to participate in this study did not fill the questionnaire correctly (38%), leading to missing data and the necessity to exclude these participants from the analysis. Further developments consequently include the generation of a digital questionnaire that may prevent missing data and loss of participants.

This is the first study designed to investigate subthreshold FA, and it would be premature to draw definitive conclusions. Nonetheless, our findings showed that many patients with severe obesity experience recurrent symptoms of second- and third-stage addiction at the subthreshold level, and identified some potential targets for preventing FA development. Prospective studies

are needed to examine whether these symptoms play a causal role in symptoms progression towards a full-blown FA and obesity outcomes.

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Table 1. Characteristics of the study participants (n=192). Data are expressed as number and percentages (%) except # mean (standard deviation (SD)).

Variables	N (%)
Female gender	148 (77.1)
Age [#] , years – mean (SD)	43.0 (13.2)
Living in couple	116 (60.4)
Professionally active	105 (54.7)
Disability status	25 (13.0)
Alcohol consumption	
Regular	7 (3.6)
Occasional	89 (46.4)
None	96 (50.0)
Tobacco	47 (24.5)
Body mass index [#] – mean (SD)	42.8 (6.57)
Comorbidities	
Diabetes	27 (14.1)
Arterial hypertension	62 (32.3)
Joint pains	128 (66.7)
Fat liver disease	22 (11.5)
metabolic syndrome	54 (28.1)
OSAS	72 (37.5)

Table 2. Frequency Table for mYFAS 2.0 Likert-Type Scale Items in obese patients without food addiction (n=192). Data are expressed as number and percentages (%).

<u>mYFAS 2.0 Items</u>	Never	Less than once a month	Once a month	Once a week	2-3 times/week or more
Clinical significance criterion					
Impairment	119 (62.0)	25 (13.0)	16 (8.3)	12 (6.3)	20 (10.4)
Distress	119 (62.0)	27 (14.1)	15 (7.8)	15 (7.8)	16 (8.3)
Diagnostic criteria					
Unable to cut down	67 (34.9)	25 (13.0)	21 (10.9)	24 (12.5)	55 (28.6)
Great deal of time	73 (38.0)	47 (24.5)	14 (7.3)	12 (6.3)	46 (24.0)
Use despite social/interpersonal consequences	118 (61.5)	26 (13.5)	16 (8.3)	9 (4.7)	23 (12.0)
Consumed more than planned	117 (60.9)	39 (20.3)	15 (7.8)	10 (5.2)	11 (5.7)
Tolerance	123 (64.1)	14 (7.3)	13 (6.8)	11 (5.7)	31 (16.1)
Withdrawal	128 (66.7)	30 (15.6)	15 (7.8)	8 (4.2)	11 (5.7)
Use despite physical/emotional consequences	133 (69.3)	16 (8.3)	13 (6.8)	9 (4.7)	21 (10.9)
Craving	136 (70.8)	26 (13.5)	9 (4.7)	2 (1.0)	19 (9.9)
Failure in role obligation	163 (84.9)	13 (6.8)	5 (2.6)	2 (1.0)	9 (4.7)
Important activities given up	176 (91.7)	8 (4.2)	4 (2.1)	2 (1.0)	2 (1.0)
Use despite physically hazardous situations	181 (94.3)	7 (3.6)	1 (0.5)	0 (0)	3 (1.6)

Table 3. Factors associated with frequency of clinically significant impairment, ordinal univariate and multivariate regressions (n=192).

	Univariate		Multivariate	
	Est.	p-value	Est.	p-values
Consumed more than planned	0.37	0.001	0.04	0.753
Great deal of time	0.08	0.21		
Important activities given up	0.03	0.881		
Withdrawal	0.49	<0.001	0.32	0.009
Failure in role obligations	0.28	0.01	0.18	0.176
Use despite physical/ emotional consequence	0.28	<0.001	0.06	0.471
Tolerance	0.35	<0.001	0.21	0.006
Craving	0.39	<0.001	0.13	0.191
Unable to cut down	0.18	0.002	0.09	0.200
Use in physically hazardous situations	0.17	0.339		
Use despite social/ interpersonal consequences	0.24	0.001	-0.01	0.975
Female gender	-0.21	0.522		
Age	-0.02	0.09	-0.02	0.190
Living in couple	-0.03	0.916		
Disability status	-0.47	0.308		
Professionally active	0.41	0.164		
Tobacco	0.07	0.840		
Body Mass Index	0.01	0.820		
Comorbidities	0.19	0.510		
Alcohol use	0.31	0.275		

Table 4. Factors associated with frequency of clinically significant distress, ordinal univariate and multivariate regressions (n=192).

	Univariate		Multivariate	
	Est.	p-value	Est.	p-values
Consumed more than planned	0.15	0.164		
Great deal of time	0.07	0.277		
Important activities given up	-0.11	0.658		
Withdrawal	0.20	0.070	0.13	0.264
Failure in role obligations	0.29	0.007	0.23	0.039
Use despite physical/ emotional consequence	0.12	0.124		
Tolerance	0.11	0.104		
Craving	0.11	0.213		
Unable to cut down	0.12	0.038	0.09	0.110
Use in physically hazardous situations	0.22	0.226		
Use despite social/ interpersonal consequences	0.10	0.154		
Female gender	0.23	0.494		
Age	-0.01	0.237		
Living in couple	0.114	0.699		
Disability status	-0.19	0.663		
Professionally active	0.72	0.015	0.49	0.108
Tobacco	0.44	0.170		
Body mass index	0.01	0.762		
Comorbidities	0.09	0.805		
Alcohol use	0.61	0.036	0.57	0.062