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Food addiction and its associations with mental and physical health comorbidities and with quality of life in the general population

Valeria Lima da Cruz¹, Jose Carlos Appolinario^{2*}, Rosely Sichieri¹, Phillipa Hay^{3,4} and Claudia de Souza Lopes¹

Abstract

Background and aims There is limited information on the prevalence and characteristics of Food Addiction (FA) in representative samples of the general population, and particularly in low- and middle-income countries. This study aimed to estimate the prevalence of FA and its associations with mental and physical health comorbidities, and with quality of life in Brazil.

Methods A population-based household survey of 2297 individuals aged 18 to 60 years with 3-staged sampling was conducted in the city of Rio de Janeiro, Brazil from 2019 to 2020. FA was assessed with the modified Yale Food Addiction Scale 2.0 (mYFAS 2.0). Psychiatric comorbidity was evaluated with validated instruments and physical health conditions with close-ended questions. The prevalence of FA and all analyses were adjusted with sample weights. Multivariate logistic regression was used to assess associations between psychiatric and physical comorbidities and FA.

Results The prevalence of FA was 2.78% (95% CI: 1.40 to 4.17) and was significantly higher in women than men [4.08% vs. 1.39% respectively, $p < .001$] and in younger compared to older individuals. Individuals with FA were significantly more likely to have depression (75.4%), anxiety (77.0%), attention deficit hyperactivity disorder (32.7%) and alcohol use disorder (19.7%) symptoms compared to those without FA. Eating disorders (binge eating disorder and bulimia nervosa) were more than 10 more likely to occur in individuals with FA compared to those without FA. Furthermore, FA was significantly associated with all eating disorder, mental and physical health comorbidities, such as diabetes, stroke, asthma, chronic asthma, headaches, muscle problems, and gastroesophageal reflux, adjusting for Body Mass Index (BMI), sex and race, and poorer quality of life.

Conclusions The prevalence of FA in the general population of a metropolitan city of Brazil lower than reported in other populations. However, FA was associated with notable mental and physical health comorbidity and a lower quality of life.

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Plain language summary

There is limited information on the prevalence and characteristics of Food Addiction (FA) in representative samples of the general population, especially in low- and middle-income countries. Therefore, this study aimed to assess the occurrence of FA and its associations with mental and physical health conditions, and quality of life in a representative sample of the city of Rio de Janeiro/ Brazil. From 2297 respondents the rate of occurrence of food addiction was 2.78%. The associations between FA and various mental/physical comorbidities and higher body weight denote the importance of studying this topic and evaluating the impact on quality of life. The results provide valuable public health information regarding the prevalence and associations of FA with eating and general mental and physical health problems providing new insights into this phenomenon in a major urban center in a developing country.

Keywords Food addiction modified yale food addiction scale 2.0, Psychiatric disorders, Physical comorbidity, Eating disorder, Survey

Background

The syndrome of Food Addiction (FA) was initially defined by Theron Randolph in 1956 as “a specific adaptation to one or more regularly consumed foods to which a person is highly sensitive [which] produces a common pattern of symptoms descriptively similar to those of other addictive processes” [1]. It is characterized by addiction-like eating behaviors (e.g., cravings, loss of control over eating, and abstinence) triggered primarily by foods with high palatability. Despite many and an increasing number of studies [1, 2] FA remains controversial and is not currently recognized by the DSM-5 or ICD-11 [3, 4]. Critics also argue it may pathologize normal eating behaviors, especially in environments with widespread access to ultra-processed foods [2]. Additionally, food lacks a clearly identified addictive substance, and FA symptoms often overlap with those of binge eating disorder, raising concerns about its distinctiveness as a clinical entity [5–8]. However, despite these criticisms, a growing body of evidence, including neuroimaging and behavioral data, suggests that some individuals do exhibit addiction-like responses to certain foods, particularly those high in sugar and fat [6].

The development of a validated instrument for the assessment of FA (the Yale Food Addiction Scale (YFAS) by Gearhardt et al. in 2009 has facilitated research. The YFAS was based on DSM-IV-TR substance use disorders criteria and has been updated using the DSM-5 criteria, resulting in the current version, the YFAS 2.0 [9]. A brief version, the Modified YFAS 2.0 (mYFAS 2.0) with thirteen items [10] has since been validated across different contexts and countries including Brazil [11].

A recent meta-analysis ($k=272$, $n=269,050$) has reported prevalences of FA from as low as 1.11% to as high as 94.7 with a pooled prevalence of 20% (95% Confidence Interval (CI): 18 to 21%) [12]. The wide dispersion of the prevalences found in this review is likely due to methodological issues, particularly the variability in the populations investigated and the type of assessment

instruments employed [12]. For example, studies using YFAS 2.0 found prevalence figures three times higher [24% (95% CI: 21%; 28%)] than those that used mYFAS [7% (95%CI 6 to 8%)]. Furthermore, the highest prevalence was seen in studies in individuals with binge eating spectrum conditions [55% (95% CI: 35 to 75%)] and the lowest in studies with non-clinical samples [14% (95% CI: 13 to 15%)]. The few studies of FA in representative general population samples [13–16] have reported prevalences ranging from 7.9% in Germany to 15.2% in the US.

An important aspect of FA is its association with other psychiatric and physical comorbidity. FA has been reported to be associated with eating disorders characterized by overeating such as binge eating disorder (BED) [17–20] and bulimia nervosa (BN) [21]. In this regard, there is a growing body of evidence of a higher prevalence of FA in BED participants compared to those without this diagnosis [22, 23]. Piccinni et al. (2021) have argued that although FA is distinct from BN or BED it could be considered a transdiagnostic construct [24]. In addition, FA has been associated with other mental health problems such as depression, anxiety, impulsivity, attention-deficit hyperactivity disorder, and substance use disorders [25, 26]. In terms of physical comorbidity, FA has been reported to be associated with lifetime high body mass index (BMI; kg/m^2) levels and weight cycling [27, 28]. Whilst the impact of FA on Quality of Life (QoL), especially the Health-Related Quality of Life (HRQoL) has been insufficiently explored, a cross-sectional survey of 1,432 Canadian adults found significantly lower levels of QoL among individuals with FA compared to those without it [29].

Among Brazilian people, the prevalence of FA has been investigated in a large ($n=7639$) non-clinical sample from a web-based research platform. Participants completed an online questionnaire containing the mYFAS 2.0 and questions related to sociodemographic characteristics and psychopathological correlates of FA as well as QoL. The authors found a FA prevalence of 4.32% (95% CI: 3.89 to 4.80%). Furthermore, participants with FA compared

to those without FA had a significantly increased risk of a major depressive episode and a bipolar spectrum disorder. FA was also independently associated with exposure to early life psychological and sexual abuse as well as with reduced QoL [11].

In summary, most of the epidemiology research about FA comes from studies with clinical populations or non-clinical convenience samples. Notably, there is limited information on the prevalence and characteristics of FA in representative samples of the general population, especially in low- and middle-income countries. Therefore, this study aimed to assess the prevalence of general psychiatric/eating psychopathology, physical comorbidities, and quality of life among individuals meeting the criteria for FA within a representative sample of the adult population of Rio de Janeiro, a major metropolitan city in Brazil.

Methods

Participants

This study is based on a population-based household survey conducted in the city of Rio de Janeiro, which is the capital of the state of Rio de Janeiro, located in the Southeast Region of Brazil. The survey was conducted between September 2019 and February 2020. A probabilistic sample of the population was interviewed face-to-face by trained lay interviewers and included 2,297 individuals aged 18 to 60 years. A three-stage 'cluster' probability sampling design was used for selection based on the data from the Brazilian Demographic Census [30]. Pregnant and breastfeeding women, as well as individuals with disabilities, were excluded from the study. Participants were randomly selected from each household where there was more than one individual in the specified age group. More information about the methodology of Binge Eating in Rio Study can be found in Appolinario et al. [31]. The study was approved by the Research Ethics Committee of the Federal University of Rio de Janeiro (protocol number CAAE: 03814818.7.0000). All participants provided written informed consent before enrolling in the study.

Data collection

Data collection was carried out by trained interviewers. They visited the selected household up to three times in different shifts of the day to ensure maximum participation. From that moment on, the randomization of the eligible individual from the household was carried out and data were obtained by face-to-face interview. Data was directly entered into a Mobile Collection Device (MCD) that was loaded with a multimodule questionnaire.

Outcomes

Demographic and socioeconomic characteristics

Participants reported their sex, age, self-reported race/ethnicity, marital status, schooling, employment status, and income.

Food addiction (FA)

FA was assessed by The Modified Yale Food Addiction Scale 2.0 (mYFAS 2.0), a self-administered instrument designed to identify FA symptoms, with 13 questions, two of which indicate clinical distress or impairment in significant psychosocial functioning [10]. Each question is scored as present/absent based on a threshold established in the mYFAS 2.0 validation study [32]. The categorical interpretation required a minimum of two symptoms and the presence of psychosocial distress or impairment related to food consumption. For the diagnostic scoring option, a participant was evaluated as having mild (2 or 3 symptoms and clinical significance), moderate (4 or 5 symptoms and clinical significance), or severe food addiction (6 or more symptoms and clinical importance). The validation of the Brazilian translation of the mYFAS 2.0 demonstrated good internal consistency and factor structure, as well as adequate convergent validity [11].

Binge eating spectrum conditions

Binge eating spectrum conditions were defined as a group of disorders/conditions characterized by the presence of binge eating as a core symptom such as BED, BN and recurrent binge eating (RBE), a condition defined when an individual reported the occurrence of objective binge eating episodes at least once a week in the last three months, but they did not fulfill the full criteria for BED or BN. The assessment of binge eating spectrum conditions was performed in two steps. In the first wave of the survey, participants completed the Questionnaire on Eating and Weight Patterns-5 (QEWP-5) for the screening of BED, BN, and RBE. QEWP-5 is a self-report instrument developed to screen BED and BN according to Diagnostic and Statistical Manual of Mental Disorders-5 criteria (DSM-5) [33]. The Brazilian version of the questionnaire was validated in a sample from the general population and showed satisfactory psychometric properties [34]. In the second wave, the cases were interviewed by telephone to confirm diagnoses using the structured clinical interview for DSM-IV (SCID-P) [35] adapted to assess DSM-5 criteria.

Psychiatric comorbidity

Depressive symptoms were evaluated with the Patient Health Questionnaire-9 (PHQ-9) [36], using the validated Brazilian version [37]. The instrument is composed of nine self-administered questions, with scores assigned

based on the frequency of symptoms over the past two weeks. Using a 4-point Likert scale, ranging from 0 to 3, scores range from 0 to 27, and a cut-off point of 10 or higher was used to identify the presence of moderate depression symptoms. Total PHQ-9 scores within specific ranges indicate varying levels of depression severity, from mild to severe [38].

Anxiety symptoms were evaluated with the Generalized Anxiety Disorder-7 (GAD-7) [39, 40]. The Portuguese translation was done by Pfizer (Copyright © 2005 Pfizer Inc., New York, NY), with evidence of validity in Brazil (Mapi Research Institute, 2006). The instrument is composed of seven self-administered questions with scores assigned based on the frequency of symptoms over the past two weeks. Using a 4-point Likert scale ranging from 0 to 3, scores range from 0 to 21, and a cut-off point of 10 or higher was used to identify the presence of symptoms of anxiety disorders [39].

Attention-Deficit Hyperactivity Disorder (ADHD) symptoms were assessed with the Adult ADHD Self-Report Scale (ASRS-Screening Scale) [41, 42]. This 6-item screening scale uses a 5-point Likert scale that runs from never (scored 0) to very often (scored 4) to enquire about inattention and hyperactivity in the previous 6 months, according to DSM-5 criteria. The total score can range from 0 to 24 with higher scores indicating more severe ADHD symptoms of ADHD were defined with cut-off point ≥ 14 . The Portuguese translation was performed by [43].

Alcohol Use Disorders were evaluated through the Alcohol Use Disorder Identification Test (AUDIT), a widely used instrument developed by the World Health Organization (WHO) to identify risky or harmful alcohol consumption, as well as alcohol dependence and abuse [44]. The AUDIT consists of 10 items and evaluates the participant's drinking habits in the previous twelve months. Scores range from 0 to 40, with a generally accepted cut-off point of more than 8 for females and more than 9 for males to identify potentially hazardous drinking [45, 46].

Physical comorbidity

Physical comorbidity (lifetime) was assessed using close-ended questions about chronic diseases and injuries included in the Brazilian Health Survey [47]. The following conditions were assessed: hypertension, diabetes mellitus, heart disease (myocardial infarction, angina, heart failure or others), cerebrovascular accident (stroke)/stroke, asthma, arthritis and work-related musculoskeletal diseases (WRMSDs), headache, cervical and lumbar pain (such as chronic back or neck pain, lumbago, sciatic pain, vertebra or disc trouble), arthritis, myalgias and arthralgias, fibromyalgia, gastroesophageal reflux disease and irritable colon syndrome. For each condition

we employed the following question, based on the self-report of a medical diagnosis: (a) "Has any doctor ever given you a diagnosis of (disease X)?"

Body mass index and weight status

Body Mass Index (BMI kg/m^2) was calculated based on current weight and height, measured by previously trained interviewers. Weight was measured with a digital scale with a maximum capacity of 150 kg and precision of 100 g (Plenna®, São Paulo, Brazil). The individuals were weighed at home, barefoot, wearing light clothing, and standing in the center of the scale, with arms hanging freely along the body. Two measurements were taken, and the average of the values obtained was calculated. Height was measured using a portable stadiometer to a maximum of 200 cm and a precision of 0.1 cm (model 206; Seca®, Hamburg, Germany). Participants were classified into three groups as follows: Eutrophic (BMI 18.5 to $<25 \text{ kg/m}^2$), overweight (BMI 25 to $<30 \text{ kg/m}^2$), and obesity (BMI $\geq 30 \text{ kg/m}^2$) [48].

Health related quality of life (HRQoL)

The short version of the Medical Outcomes Survey (SF-12) was used to assess HRQoL, categorized into Physical health (PHRQoL) and Mental health (MHRQoL) [49]. In the Brazilian population a studied of psychometric properties presented a Cronbach's alpha coefficient ($\alpha = 0.836$) and a high degree of reliability [50].

Statistical analysis

Descriptive analyses were conducted to estimate weighted prevalences and respective 95% confidence intervals (95% CI) of FA, adjusting for demographic and socioeconomic characteristics, quality of life and weight status. The chi-square test of linear tendency was used to verify proportional trends between the ordered categorical variables in the groups and the outcome. To evaluate the unadjusted and adjusted odds ratios (OR) and their respective 95% CIs for the association between FA and psychiatric and clinical morbidities, logistic regression was used, by survey procedure, which incorporates weights and study design. The crude and adjusted models were built with psychiatric and clinical morbidities variables as the outcomes and FA as the exposure variable. In addition, potential confounders included in the adjusted models were gender, age, and BMI. In the adjusted models with clinical morbidities as the outcomes, it was also considered as covariates those with $p\text{-value} < 0.01$. All statistical analyses were conducted using Stata® version 14.0 (StataCorp/College Station, United States).

Results

From the initial 2985 eligible households 688 refused to participate, thus the attrition rate was 23%.

Prevalence

In the 2297 participants the prevalence of FA was 2.78% (95%CI: 1.40 to 4.17). Of those with FA, 17.42% (95%CI: 16.50 to 39.01) were classified as mild, 36.49% (95%CI: 15.18 to 37.26) as moderate, and 46.09% (95%CI: 36.60 to 61.86) as severe. Most participants with FA were women (75.85–95%CI: 49.37 to 90.99). Furthermore, the prevalence of FA was higher in women than in men, (4.08% vs. 1.39% respectively, $p = .001$), and FA was more prevalent among younger individuals (18 to 30 years, $p = .017$). No other demographic and socioeconomic variables were associated with FA (Table 1).

Table 1 Prevalence of food addiction (%), and confidence interval (CI) according to demographic and socioeconomic characteristics in BINGE-Rio survey ($n = 2,297$). 2020

Variables	FA		95%CI	p-value*
	n	%		
Total	61	2.78	1.40–4.17	
Gender				0.001
Man	11	1.39	0.51–3.74	
Woman	50	4.08	2.27–7.22	
Race/skin color				0.496
White	21	2.09	1.09–3.97	
Black/ Brown	38	3.13	1.65–5.86	
Age#				0.017**
18 to 30 years	21	3.15	1.46–6.67	
31 to 45 years	24	2.73	1.56–4.74	
46 to 60 years	16	2.46	1.14–5.24	
Marital status				0.385
Married	26	2.73	1.33–5.55	
Single/ others ^a	35	2.84	1.78–4.50	
Education (Completed to date)				0.821
0–10 years	23	3.32	1.47–7.32	
11–14 years	28	2.53	1.54–4.13	
>15 years	10	2.32	1.15–4.59	
Employment				0.073
Employed	32	2.19	1.32–3.62	
Unemployed	16	3.55	1.03–11.48	
Others ^b	8	4.02	1.83–8.63	
Retired	5	5.18	1.76–14.29	
Income ^{§§}				0.860**
Up to R\$1.000.00	12	2.75	1.07–6.91	
R\$1.001.00–3.000.00	30	3.27	1.68–6.29	
>R\$3.000.00	9	2.00	1.06–3.76	
Missing	10	2.60	1.23–5.41	

Values in bold indicate statistically significant at p -value < 0.05

*Chi squared test; and **Chi squared test of linear trend. For income missing were excluded

^a Window. separated or divorced, ^b Student or recovering from illness and not applicable. §§ Revenue – R\$1000.00 is approximately one minimum wage in Brazil

#post hoc test 18–30 years < 31–46 and < 46–60 years

Psychiatric comorbidity

Among those with food addiction, the prevalence of psychiatric symptoms was significantly greater compared to those without FA. FA was associated with an increased chance of all psychiatric morbidities in both the crude and adjusted models. Among those with FA, 75.4% had symptoms of depression, and 77.0% had symptoms of anxiety values approximately three times higher than the prevalence among those without FA. Eating disorders were also more than 10 times as prevalent among individuals with FA, compared to those without FA. Additionally, attention deficit hyperactivity disorder and alcohol use disorder were also significantly more frequent among those with FA (Tables 2 and 3).

Physical comorbidities

Physical comorbidities were significantly more prevalent in participants with FA compared to those without. The odds for having a comorbid medical condition were more than twice as high in those with FA compared to their counterparts. In unadjusted models, we observed an association between FA and an increased chance of having arterial hypertension diabetes, stroke, asthma, spine problems, chronic headaches, muscle problems, and gastroesophageal reflux. However, this association became non-significant after adjusting for confounders (BMI, gender, age and psychiatric comorbidities) in a multivariate regression analysis (Table 3).

Weight status

Overweight/Obesity was more than five times frequent among those with FA, compared to those without FA. Considering the prevalence of FA by BMI category, FA was more prevalent among those with obesity (6.8–95% CI: 4.19 to 10.70) compared with those with overweight (1.9–95% CI: 0.77 to 4.59) and those in the adequate BMI range (0.7–95% CI: 0.31 to 1.53). In addition, only BMI was associated with FA in the crude analysis and remained significant after controlling confounders in the adjusted analysis (Table 3).

Quality of life

Physical Health Quality of Life was significantly ($p < .0001$) poorer in individuals with FA (mean 44.7; 95%CI: 41.7 to 47.7) compared to those without FA (mean 54.0; 95%CI 53.6–54.3). Mental Health Quality of Life was also significantly ($p < .0001$) poorer in individuals with FA (mean 30.2; 95%CI 27.6–33.0) compared to those without FA (mean 46.8; 95%CI 46.2–47.3) (Fig. 1).

Discussion

To our knowledge, this is the first household survey on FA conducted with a representative sample from the population of a major city in a developing country. Using

Table 2 Number of the case, and crude and adjusted odds ratios and 95% confidence intervals of psychiatric comorbidities according to the presence of food addiction

Variables	Outcome		Model 1 Crude		Model 2 Adjusted	
Exposure	n (%)	n (%)	OR	95% CI	OR	95% CI
	<i>Binge eating disorder</i>					
Food addiction	No	Yes				
No	2219 (99.24)	17 (0.76)				
Yes	49 (80.33)	12 (19.67)	36.36	16.72–79.08	31.18	9.30–104.66
	<i>Bulimia nervosa</i>					
No	2229 (99.69)	7 (0.31)				
Yes	51 (83.61)	10 (16.39)	106.15	32.60–345.64	52.84	12.09–230.92
	<i>RBE*</i>					
No	2162 (96.69)	74 (3.31)				
Yes	45 (73.77)	16 (26.23)	10.22	4.38–23.86	6.65	2.77–15.92
	<i>Depressive symptoms</i>					
No	2003 (89.58)	233 (10.42)				
Yes	15 (24.59)	46 (75.41)	33.30	17.43–63.62	33.10	16.36–66.93
	<i>Anxiety symptoms</i>					
No	1990 (89.00)	246 (11.00)				
Yes	14 (22.95)	47 (77.05)	27.61	12.69–60.09	23.03	10.35–51.22
	<i>ADHD* symptoms</i>					
No	2155 (96.38)	81 (3.62)				
Yes	41 (67.21)	20 (32.79)	12.24	6.14–24.39	11.94	5.97–23.90
	<i>Alcohol use</i>					
No use	2087 (93.34)	149 (6.66)				
Use	49 (80.33)	12 (19.67)	3.73	1.39–9.98	5.88	2.13–16.25

Values in bold indicate statistically significant at p-value < 0.05

Model 1 Univariate Logistic Regression. Model 2 Logistic regression adjusted by Body Mass Index., gender, and age

*RBE – Recurrent Binge Eating (≥ 1 binge eating episode/week in the last 3 months), ADHD – Attention-deficit/hyperactivity disorder, n – number of the case, OR – Odds Ratios, CI – 95% Confidence Intervals

the mYFAS2.0 instrument, we found a prevalence of FA of 2.78% among people living in Rio de Janeiro, Brazil. In our study, FA was associated with younger age and was over three times as frequent in women compared to men. FA was also significantly associated with general psychopathology, binge eating spectrum conditions, a higher BMI, and cardiovascular, metabolic and other medical comorbidities. Furthermore, individuals with FA exhibited a significantly poorer quality of life.

Notably, the prevalence of FA observed in our sample was lower than those reported in other countries, such as the study of Carr et al. (2020), which found a FA prevalence of 15.2%, and Schulte and Gearhardt (2018) who reported a prevalence of 15.0%. Both studies were conducted with representative samples of US population [13, 51]. However, findings from other population-based surveys have reported slightly lower prevalences rates such as 7.9% in Germany [14] and 9.0% in Denmark [52]. More recently, a systematic review revealed a weighted mean prevalence of FA of 20.0%, with rates of 18% in studies utilizing the mYFAS 2.0 version and 14% in studies with non-clinical samples [12]. Additionally, another systematic review that included only studies from Latin

America, reported a prevalence of 15% in surveys with non-clinical populations [53].

Conversely, other studies have reported prevalences similar to our findings. Nunes-Neto et al. (2018), validating the mYFAS 2.0 in the Brazilian population, described a FA prevalence of 4.32% in a convenience sample selected through an anonymous web-based research platform [11]. Additionally, Brunault et al. (2020) conducted a study to validate the French-language version of the mYFAS 2.0 in a Canadian non-clinical population and found a prevalence of FA of 6.4% [54, 55]. In addition, our findings are consistent with the prevalence reported by Torres et al. (2017) in a study involving a non-clinical Portuguese population, which found a prevalence of FA of 2.5% [56].

The low prevalence of FA observed in our study could also be explained by dietary factors related to Brazilian cultural environment. Antunes et al. (2021) have reported that the Brazilian diet is largely composed of foods such as rice, beans and meat [57]. This eating pattern differs from that observed in North America and Europe and could, in turn, be less associated with FA. Likewise, food insecurity, a reflection of socioeconomic inequalities in the country [58], may be another factor influencing the

Table 3 Number of the case, crude and adjusted odds ratios and 95% confidence intervals of physical comorbidity (lifetime) according to the presence of food addiction

Variables	Physical comorbidity (lifetime)		Model 1 Crude		Model 2 Adjusted	
Exposure	n (%)	n (%)	OR	95% CI	OR	95% CI
	<i>Arterial hypertension</i>					
Food addiction	No	Yes				
No	1721 (77.31)	505 (22.69)				
Yes	38 (63.33)	22 (36.67)	2.09	1.10 – 3.96	1.01	0.36–2.87
	<i>Diabetes</i>					
No	2064 (92.68)	163 (7.32)				
Yes	52 (85.25)	9 (14.75)	2.91	1.36 – 6.19	2.09	0.59–7.40
	<i>Heart disease</i>					
No	2117 (94.68)	119 (5.32)				
Yes	54 (88.52)	7 (11.48)	2.42	0.77–7.60	1.05	0.30–3.68
	<i>Stroke</i>					
No	2203 (98.52)	33 (1.48)				
Yes	57 (93.44)	4(6.56)	6.14	1.89–19.97	4.08	0.65–25.66
	<i>Asthma</i>					
No	2070 (92.58)	166 (7.42)				
Yes	51 (83.61)	10 (16.39)	4.23	1.25–14.25	3.00	0.59 – 15.28
	<i>Arthritis/rheumatism</i>					
No	2111 (94.41)	125 (5.59)				
Yes	57 (93.44)	4 (6.56)	1.08	0.27–4.18	0 0.49	0.12– 2.00
	<i>Chronic spinal problems</i>					
No	1844 (82.47)	392 (17.53)				
Yes	35 (57.38)	26 (42.62)	4.04	1.88 – 8.67	2.03	0.86–4.77
	<i>Chronic headache problem</i>					
No	1953 (87.34)	283 (12.66)				
Yes	35 (57.38)	26 (42.62)	4.56	2.18 – 9.48	2.05	0.86–4.88
	<i>Chronic muscle pain</i>					
No	1881 (84.12)	355 (15.88)				
Yes	30 (49.18)	31 (50.82)	4.47	1.85–10.76	1.89	0.67–5.37
	<i>Fibromyalgia</i>					
No	2215 (99.06)	21 (0.94)				
Yes	58 (95.08)	3 (4.92)	1.94	0.45–8.44	0.19	0.02–1.71
	<i>Gastroesophageal reflux</i>					
No	2143 (95.84)	93 (4.16)				
Yes	49 (80.33)	12 (19.67)	4.95	2.01–12.19	2.41	0.80–7.21
	<i>Irritable colon syndrome</i>					
No	2216 (99.11)	20 (0.89)				
Yes	58 (95.08)	3 (4.92)	2.76	0.76 – 0.01	1.57	0.25–10.05 continued
	<i>WMSDs^a</i>					
No	2172 (97.14)	64 (2.86)				
Yes	55 (90.16)	6 (9.84)	2.12	0.65–6.84	0.98	0.28–3.43
	<i>Body Mass Index^{b,c}</i>					
Eutrophic	739 (34.83)	1383 (65.17)				
Overweight/obese	8 (13.79)	50 (86.21)	3.17	2.16–4.65	5.56	1.84–16.73

Model 1—Univariate Logistic regression; Model 2—Logistic regression adjusted by BMI, gender, age and psychiatric comorbidities < 0.01 in crude model

Calculations of Odds Ratio and 95% confidence intervals were adjusted for survey weights. Values in bold indicate a statistically significant p-value < 0.01

^aWork-related musculoskeletal disorders (WMSDs)^bVariable with missing^cReference category was adequate weight

* n – number of the case, OR – Odds Ratios, CI – 95% Confidence Intervals

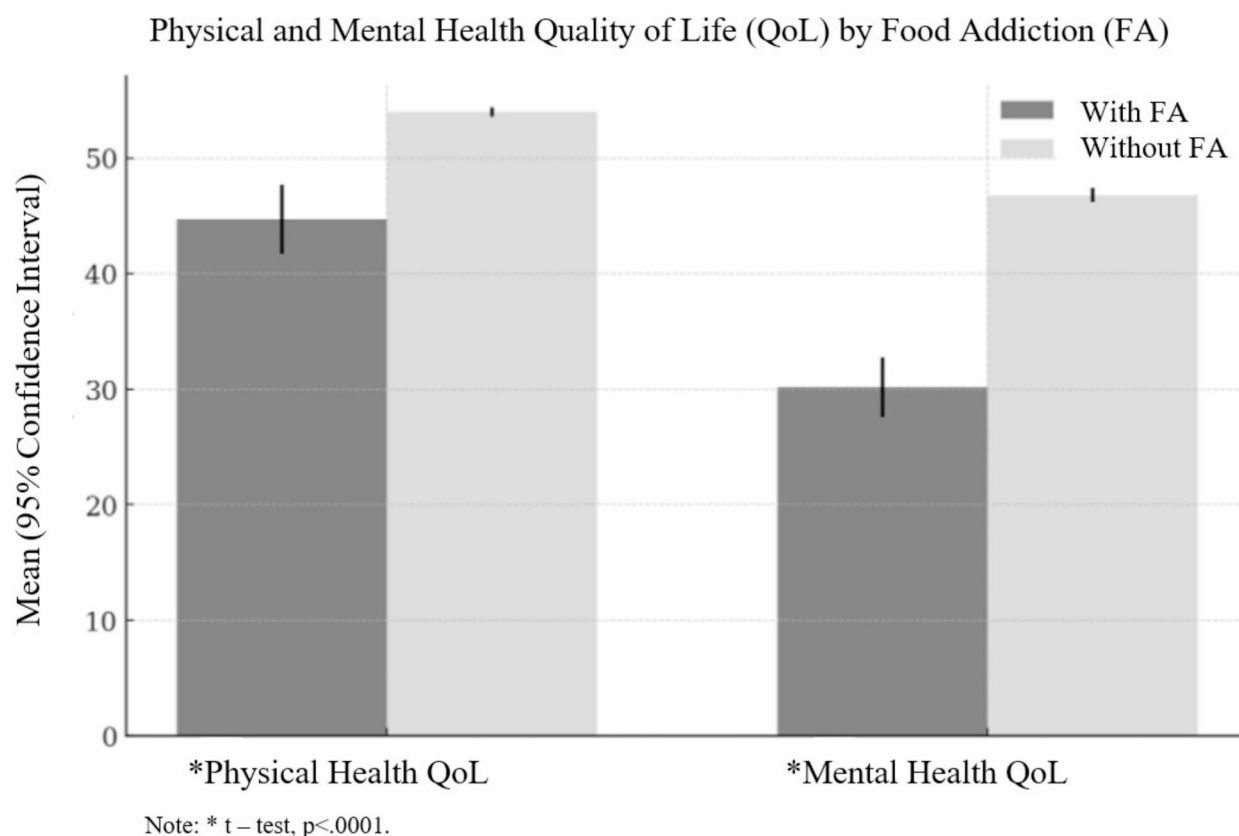


Fig. 1 Physical and mental health quality of life compared in individuals by food addiction in BINGE-Rio survey ($n = 2,297$) 2020

prevalence of FA. Although, a meta-analysis ($k = 15$) of FA prevalence studies in Latin America reported an aggregated prevalence of 15% in non-clinical samples [53] the included studies did not use representative population-based samples, which may also explain the lower prevalence observed in the current study.

Thus, the wide variation in the prevalence of FA might be explained by various methodological factors, such as differences in the populations studied, instruments used for the assessment, and sample sizes. It is worth noting that most FA prevalence studies involving “non-clinical” samples are not household-based surveys and did not employ face-to-face interviews. Instead, they often rely on convenience samples from clusters or are conducted in clinical populations, which could result in divergent findings compared to those studies. An additional explanation is related to specific cultural, genetic, and eating habits that could also play an important role in eating behavior. These factors, among others, may contribute to the disparities in the prevalence of FA across different populations and regions of the world. According to Lawson et al. (2020), constructs related to FA, such as food cravings and subjective experiences with food, vary according to cultural contexts [59]. This may help explain the higher rates observed in developed countries.

In the current study, the prevalence of FA among women was approximately three times higher than that among men, consistent with findings from other studies. Schulte and Gearhardt (2018) and Hauck et al. (2017) found a higher prevalence of FA in women, Caucasians and in participants from lower income strata. This difference may be attributed to a combination of biological, social, and psychological factors. The co-occurrence of mental health disorders such as depression and anxiety in women may also be a contributing factor [60–63]. Corroborating our findings, research based on a representative sample of the German population found that people aged 18 to 29 had the highest prevalence of FA [14]. These results may be due to the fact that young people are heavily influenced by social context when choosing unhealthy foods and tend to prefer hyperpalatable options as they are tastier than healthier alternatives [64, 65].

Furthermore, FA was significantly and strongly associated with all psychiatric morbidities investigated in our study. Individuals with FA exhibited approximately ten-fold higher rates of BED or BN, reinforcing the robust association between these constructs. This finding is consistent with meta-analytic data showing that FA is markedly more prevalent in BED, yet not entirely overlapping, as some individuals meet FA criteria without fulfilling

BED or BN diagnostic criteria [66, 67]. Conceptual models describe FA as a transdiagnostic construct reflecting a spectrum of compulsive overeating severity, which can manifest within but also beyond binge-type eating disorders [68, 69]. The substantially lower prevalence of FA among non-binge eaters likely accounts for the reduced rates observed in our community-based subsample [66, 68]. Together, these findings support the view that FA may index both binge-eating severity and broader phenotypes of dysregulated eating, warranting further longitudinal research to clarify its prognostic and therapeutic significance. Understanding the nuances and overlapping characteristics between binge eating spectrum conditions and FA is essential for providing effective interventions and treatment strategies.

In the current study, the association of symptoms of depression and anxiety among those with FA was strong. The observed link between FA and elevated rates of depressive and anxiety symptoms aligns with existing literature, highlighting the intricate relationship between addictive eating behaviors and mental health [26, 70–72]. These findings suggest putative shared pathways or triggers for FA and the psychological distress of mood disorders. Additionally, the observation of significant and higher odds of ADHD symptoms among individuals with FA, as observed in other studies [73] suggests possible commonalities between addictive eating and the neurobehavioral features of both problems. These characteristics may be associated with a lack of or a loss of control over decisions and an inability to delay actions, key aspects of impulsiveness in ADHD. Similarly, in our study, individuals with FA had a higher chance of having alcohol use disorder, consistent with the findings of Minhas et al. (2021).

FA was strongly associated with participants with a high BMI compared to those with adequate or lower weight in our sample. Previous studies are aligned with our results [27, 74]. Similarly, Hauck et al. (2017) reported a significant association of FA across all obesity category in a German sample [14]. Considering the relationship between binge eating behavior and body weight status, this relationship between FA and obesity is an important issue. Some researchers suggest that the increase in obesity rates may be partly explained by the addictive properties of certain types of foods, particularly in individuals with FA [75–77]. Notably, although we acknowledge the potential criticisms about the use of BMI and the growing interest in complementary measures such as waist circumference, BMI remains a widely used and accepted indicator of body composition in epidemiological research in line with the Brazilian Health Survey [78].

Interestingly and less explored previously, we found a significant association of a range of physical conditions and FA in the unadjusted model. Subjects in our sample

with FA had significantly higher rates of hypertension, diabetes, stroke, asthma, gastroesophageal reflux, and chronic pain syndromes (chronic spinal problems, chronic headache, chronic muscle pain) compared those without FA. Of note, these associations between FA and physical comorbid conditions were not more significant after adjustments. Thus, our data extend the observations of other authors regarding the link between FA and certain clinical conditions, such as diabetes, asthma and stroke [79–81], by adding other conditions not previously reported, such as pain syndromes and gastroesophageal problems. These findings underscore the potential impact of FA on the physical health of individuals. However, it's important to mention that obesity and psychiatric disorders are likely to mediate FA's impact on physical health in our sample. Thus, there is a need for future research to explore this mediation effect. Given the higher prevalence of FA in individuals with BED, BN, obesity, and certain psychiatric disorders, targeted screening in these high-risk groups may improve early identification and treatment. As above, evidence suggests that FA overlaps with binge-type eating disorders but should be viewed as a transdiagnostic construct. Clinically, FA can be addressed in existing BED treatments, like cognitive-behavioral therapy, while recognizing potential differences in mechanisms that may need tailored strategies. Policy initiatives should integrate FA assessments into eating disorder and obesity care. Future research should explore the effectiveness of FA-specific interventions and its impact on dietary behaviors and long-term health outcomes.

The cross-sectional design of our study precludes making causal inferences between our variables of interest and FA. A longitudinal study is needed to test causal relationships and construct a comprehensive model for interpreting the likely bidirectional associations between mental health conditions and FA. In addition, the small numbers of men with FA in the final sample is a factor limiting some more comprehensive analyses. Furthermore, although we observed a certain similarity between the demographic data of our sample and those reported in the 2022 Brazilian Census (Instituto Brasileiro de Geografia e Estatística) [82] our findings are limited to only one metropolitan area (Rio de Janeiro) and are not representative of the entire population of the country. Thus, future research should examine FA prevalence in a more diverse geographic and cultural settings in Brazil. It might also be interesting to examine whether participant characteristics vary according to the severity of FA in future studies.

We acknowledge the possibility of bias related to the sampling and data collection methods, especially since the cases were interviewed by telephone to confirm psychiatric diagnoses as well as self-report of

medical diagnoses and predefined medical conditions under investigation. However, it is important to note that telephone interviews were employed only to confirm diagnostic criteria for eating disorders [83], thereby improving diagnostic validity and reducing the risk of misclassification. Regarding the choice of predefined medical conditions and the use of self-reported medical diagnosis in life, we acknowledge this is a limitation of the study. However, we decided to include those predefined medical conditions as they were included in the Brazilian National Survey and are known medical comorbidities of eating disorders [84]. In addition, to minimize respondent burden we included only alcohol as the most commonly used substance in Brazil [47], but future studies may include medications and illicit substance use.

A notable strength of our study is the leveraging of a robust sample size that provided substantial statistical power for conducting rigorous analyses. Furthermore, our research employed standardized face-to-face interviews, a methodological approach recognized for enhancing data quality. Additionally, all instruments used were previously validated within the Brazilian population, supporting the reliability of our findings.

Conclusion

To conclude, our study conducted in the city of Rio de Janeiro, Brazil, found a prevalence of FA of 2.78% in the general population and provides new insights into FA in a major urban center in a developing country. The associations between FA and various psychopathologies, including symptoms of depression, anxiety, ADHD, and alcohol use, along with its relationship to binge eating spectrum conditions and elevated BMI, highlights the complex interplay between addictive eating behavior and mental and physical health. Notably, the significant negative impact of FA on quality of life emphasizes the need for holistic interventions addressing both the physical and psychological dimensions of individuals affected by FA. These findings carry substantial clinical implications, suggesting the need for integrated approaches that consider the multifaceted nature of FA. Future research should focus on refining intervention strategies, exploring potential causal relationships, and tailoring treatments to address the specific needs of diverse demographic groups affected by FA.

Abbreviations

ADHD	Attention-Deficit Hyperactivity Disorder
ASRS-Screening Scale	Attention-Deficit Hyperactivity Disorder Self-Report Scale
AUDIT	Alcohol Use Disorder Identification Test
BED	Binge eating disorder
BMI	Body Mass Index
BN	Bulimia nervosa
CI	Confidence interval
DSM-5	Diagnostic and Statistical Manual of Mental Disorders-5
FA	Food Addiction

GAD-7	Generalized Anxiety Disorder-7
HRQoL	Health-Related Quality of Life
MCD	Mobile collection device
MHRQoL	Mental Health Quality of Life
mYFAS 2	Modified Yale Food Addiction Scale 2.0
OR	Odds ratio
PHQ-9	Patient Health Questionnaire-9
PHRQoL	Physical Health Quality of Life
QEW-5	Questionnaire on Eating and Weight Patterns-5
QoL	Quality of life
RBE	Recurrent binge eating
WHO	World Health Organization
WRMSDS	Work-related musculoskeletal diseases
YFAS	The Yale Food Addiction Scale

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Author contributions

Valeria Lima da Cruz: Formal analysis, Investigation, Writing—Original Draft, Project administration; Jose Carlos Appolinario: Conceptualization, Methodology, Writing—Review & Editing, Supervision; Rosely Sichieri: Conceptualization, Formal analysis, Writing—Review & Editing; Phillipa Hay: Conceptualization, Methodology, Writing—Review & Editing; Claudia Souza Lopes: Conceptualization, Methodology, Formal analysis, Writing—Review & Editing, Supervision.

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Data availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author upon reasonable request.

Declarations

Ethical approval and consent to participate

To carry out the research, approval was obtained from the Ethics Committee of the Federal University of Rio de Janeiro (protocol number CAAE: 03814818.7.0000). The study was conducted by the principles of the Declaration of Helsinki. All participants were informed about the study, and consent was provided written informed consent before enrolling in the study. Also, the chance to withdraw from study at any point was given for the participants.

Competing interests

Jose C. Appolinario has received research grants, consultancy fees, and advisory board fees from Takeda Pharmaceuticals. He receives/has received royalties/honoraria from Artmed Panamericana Editora. He also received a research grant from the Brazilian National Research Council (CNPq). Phillipa Hay has received sessional fees and lecture fees from the Australian Medical Council, Therapeutic Guidelines publication, and New South Wales Institute of Psychiatry and royalties from Hogrefe and Huber, McGraw Hill Education, and Blackwell Scientific Publications, and she has received research support from CAPES, NHMRC, and ARC. She is Chair of the National Eating Disorders Collaboration in Australia (2019-). She is a consultant for Tryptamine Therapeutics Pharmaceuticals.

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