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Food Addiction and Impulsivity in Clinical Populations by Gender: a Systematic Review

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Abstract

Purpose of Review Food addiction (FA) has been found to be associated with impulsivity, mainly urgency (negative and positive) and lack of perseverance. The present systematic review aimed to identify differences in impulsivity by gender and current implications of treatment regarding FA and impulsivity in clinical populations. The search was conducted in PubMed, Scopus, and Web of Science (WOS) databases, using the following search terms: "food addiction" and "impuls*." Studies were included if they were written in English, had an observational design (e.g., cross-sectional, longitudinal, case-control), and used a quantitative methodology, without a limited search period to avoid selection bias.

Recent Findings We included twenty-nine articles that aimed to examine whether there is a relationship between FA and impulsivity in clinical populations. Looking at gender differences, attentional and motor impulsivity were found to be related to FA in samples of women with obesity, whereas in the only study in a sample of men with obesity, cognitive and non-planning impulsivity appeared to be more associated with FA. Moreover, we identified three studies on the effects of interventions which included motivational, psychosocial, nutritional, and mindfulness components to address impulsivity and FA in cohorts with overweight/obesity and with substance use disorder (SUD). While some studies reported decreased levels of impulsivity, in other studies only FA decreased, and only one study showed significant changes in both FA and impulsivity after treatment.

Summary Further research is needed to better understand the association between impulsivity and FA. Specifically, more studies with male populations could provide further evidence on how to better tailor treatment designs.

Keywords Food addiction · Impulsivity · Systematic review · Clinical population · Gender differences · Treatment

Introduction

Impulsivity is a multidimensional construct which describes how an individual reacts to urges and stimuli present in their environment [1], the primary focus being on obtaining a positive reward without adequate deliberation of any potential negative consequences [2, 3]. There are two prevailing models relating to trait impulsivity in the literature: Barratt (1959, 1995) [4, 5] and Whiteside and Lynam (2001) [6]. The former can be assessed by means of a self-report scale with various adaptations: the BIS-11 and BIS-15 [4, 7] assess three traits of impulsivity: (1) motor impulsivity, characterized by acting without thinking (including lack of perseverance as the tendency to give up a task, especially when it appears difficult or boring) [4, 8]; (2) attentional/cognitive impulsivity, linked to an inability to maintain focused attention and associated with rapid decision making [9••, 10]; and (3) non-planning impulsivity, characterized by a lack of planning for the future (including dimensions of self-control and cognitive complexity) [4, 10]. Both scales also include a total score. The BIS-brief scale or BIS-8 [11] includes 8 of the original BIS-11 items. The second model (UPPS-P) entails a multidimensional measure addressing five impulsive dispositions consisting of (1) urgency, a predisposition to strong impulses which may come along with negative affect, (2) lack of premeditation, the trouble recognizing potential consequences of a situation

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or action prior to proceeding to it, (3) lack of perseverance, the incapacity of staying focused on an arduous task, (4) sensation seeking, i.e., participating in precarious novel or stimulating activities, and lastly (5) positive urgency, a dimension that was added later and relates to having strong responses in highly positive emotional settings [12]. When examining the literature, higher rates of impulsivity have been linked to obesity and eating disorders (EDs) such as bulimia nervosa (BN) and binge-eating disorder (BED) [13], which, in turn, have a higher likelihood of comorbidity with substance use disorders (SUDs) as well as behavioral addictions [14•, 15•].

Additionally, over the years, one concept which has been viewed as rather similar to both EDs and addictive patterns, is that of food addiction (FA) [16, 17]. Until now, FA has not been labeled as a formal clinical diagnosis according to the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5). However, the SUD criteria from the DSM-5 are implemented to determine whether or not an individual has FA [18, 19]. FA is marked by excessive overeating of high caloric foods with a loss of control and intense food cravings [20]. The self-report instrument which is used to determine FA using the DSM-5 criteria is the Yale Food Addiction Scale 2.0 (YFAS), which was created to offer a validated questionnaire for addictive-like eating behaviors [21]. Studies have shown that individuals with higher YFAS scores are also more impulsive, especially in terms of negative urgency, motor impulsivity, and a lack of perseverance [13, 22]; these traits are also found in individuals with obesity [23–25]. Additionally, there are also other adaptations of this scale, the mYFAS 2.0 (short version), and YFAS-C (version for children) [26, 27]. However, due to the fact that FA is mainly based on how individuals identify themselves and is assessed by the YFAS in mostly cross-sectional studies, there is growing concern about how this may limit the understanding of causality inferences between FA and other constructs such as impulsivity [28]. Perhaps longitudinal studies could help to further clarify the concept of FA and its associations with other parameters.

FA has been found to be present in both ED and SUD groups and might represent more than solely intense food and substance cravings in these individuals; studies have demonstrated the involvement of the mesolimbic dopamine pathway, the reward circuit of the brain, leading to the inability to suppress impulses to consume high fat, high refined sugar foods [16, 29–34]. Furthermore, animal models have associated the excessive consumption of sugar to tolerance, withdrawal, and continued use despite negative consequences [35–39]. Given these phenotypical similarities between SUD and FA, it has been hypothesized that personality traits like impulsivity–often described as an underlying mechanism of addictive patterns–may also be linked to FA. Impulsivity has been examined in various studies along with FA [1, 9••, 13].

The concepts of "urgency" (negative and positive, i.e., emotional impulsivity, tendency to act suddenly when experiencing extreme emotions) [40] and "lack of perseverance" (i.e., cognitive impulsivity, inability to sustain attention and motivation to complete tasks) [1, 22, 41, 42] have been described as relevant in the context of FA in several studies. Thus, individuals with FA may be more likely to act instantaneously by choosing immediate gratification with food rather than waiting, especially in situations of inconsistency between their personal needs and the present condition [1, 13, 32, 43, 44]. Difficulties in regulating negative (or positive) emotional states cause food intake, with impulsivity being the mediator of this link in individuals with FA [13]. This facet of trait impulsivity in individuals with FA could be related to low inhibitory control, which refers to the incapacity to suppress inadequate or undesirable behaviors [45]. However, studies have yielded mixed results regarding trait impulsivity and inhibitory control, especially in terms of concurrent FA [46].

Moreover, some studies have recognized gender differences regarding FA. For example, a study investigating FA in adults reported that women were significantly more likely to show FA traits than men (24.4% vs. 13.3%) and 3.65 times more likely to have severe FA [47]. Gender differences have also been related to impulsivity. A meta-analysis reported that men are more impulsive than women and more likely to present psychopathologies characterized by impulsive behaviors [48]. This meta-analysis also found differences between cognitive impulsivity in men and women using the BIS-11 scale, indicating that men had greater difficulty concentrating and focusing their attention. On the non-planning subscale of the BIS-11, men also reported a lower tendency to engage in future planning. Similarly, the same analysis found that men tend to experience greater sensation seeking and take more risks compared to women. Given these findings, it might be expected that such gender differences in impulsivity may also reflect onto the relationship between impulsivity and FA. In Parkinson's disease, e.g., women who exhibit greater attentional impulsivity are more likely to also have FA compared to men [49••].

Although research has begun to investigate the relationship between FA and impulsivity, studies that include gender aspects are lacking. The predominantly female samples in most studies may hinder observations regarding gender differences. These differences are important to better understand the underlying potential causes of FA, how it may manifest differently between genders, and how these factors are linked to impulsivity. Likewise, additional evidence is missing regarding non-planning and motor impulsivity. Some scales of impulsivity (e.g., BIS-11) include these aspects, but no associations have been made with FA so

far. Considering the various phenotypes of impulsivity, it is important to delineate their distinct impact, especially in co-occurrence with FA.

Previous studies [50, 51•] have reported possible mechanisms related to FA, impulsivity, and reward sensitivity. This review not only extends the work of Loxton (2018) and Maxwell et al. (2020) but also focuses on the clinical implications of impulsivity and FA. Additionally, this review aimed to identify differences in impulsivity and FA by gender.

Methods

Search Parameters

The methodology employed in this review adheres to principles of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) [52]. The bibliographic search was carried out through the databases PubMed, Scopus, and Web of Science (WOS), using the following search terms: "food addiction" AND "impuls*" and filtered by title and abstract (food addiction [Title/Abstract]) AND (impuls*[Title/Abstract]). The bibliographic search was carried out between February 13 and 14, 2023.

Study Selection

The only studies considered for inclusion were the ones written in English with an observational design (e.g., cross-sectional, longitudinal, case-control) and a quantitative methodology, without a limited search period to avoid selection bias. Articles with no abstract, as well as publications that were not full articles, that had a qualitative design, or were literature reviews, books, dissertations, case reports or series, editorials, commentaries, systematic reviews, and narrative reviews were excluded. Special interest was given to those studies that used any version of the Yale Food Addiction Scale (YFAS) for the assessment of FA in clinical populations and the administration of at least one psychometric instrument to assess the presence of impulsivity. Only articles that aimed to search for a relationship between FA and impulsivity in a clinical population were included.

Once duplicate results were excluded, all abstracts were screened for inclusion and exclusion criteria. For all studies identified for inclusion, a full text version was retrieved, and all studies were reviewed regarding their quality and eligibility for this review. The exclusion criteria for these studies were documented. Subsequently, included studies were read thoroughly, and the former defined measures were extracted in tables.

Study Assessment and Data Extraction

The complete screening process was carried out using the COVIDENCE software, based on the PRISMA standards and recommended by Cochrane Reviews [53]. The article selection process was carried out in two steps. First, two reviewers (CBR and AGP) screened titles and abstracts of all potential studies individually. In the second phase of the screening and in accordance with the eligibility criteria, two different authors (AS and AGP) performed a detailed review of the full text of the identified articles. Differences in ratings between both reviewers were resolved through consensus, with the assistance of a third reviewer (LMG).

A total of 274 original articles were identified from the selected databases. A total of 119 duplicate articles were eliminated. Then, 110 articles were excluded based on title and abstract. In the next step, the full text of 45 articles was examined, 16 of which were excluded based on the following criteria: no reported associations between FA and impulsivity, not relevant to FA, non-clinical samples. Finally, 29 articles were included in this review (Fig. 1).

Risk of Bias Assessment

The risk of bias and the quality of the articles included in this review were assessed using the Newcastle-Ottawa Scale (NOS) [54], developed by the Cochrane Collaboration [55]. The face/content validity of the NOS has been established based on a critical review of the items by several experts in the field who evaluated its clarity and completeness for the specific task of assessing the quality of studies to be used in a meta-analysis [54].

This scale assigns up to a maximum of nine points for the least risk of bias in three domains: (1) selection of study groups (four points); (2) comparability of groups (two points); and (3) ascertainment of exposure and outcomes (three points) for case-control and cohort studies, respectively [54].

Results

Study Characteristics

The 29 studies included had a cross-sectional design, and two studies [56••, 57••] additionally included a longitudinal design. One study included men only [58], five studies included women only [19, 59, 60, 61••, 62••], and the rest had varying percentages of men and women, with the percentage of women being higher in most cases. Studies were primarily from developed countries, with most conducted in Germany (n = 7, 24.1%) [19, 63–67, 68••] and Spain (n = 4, 13.9%) [13, 56••, 58, 69••, 70]. Only eleven articles

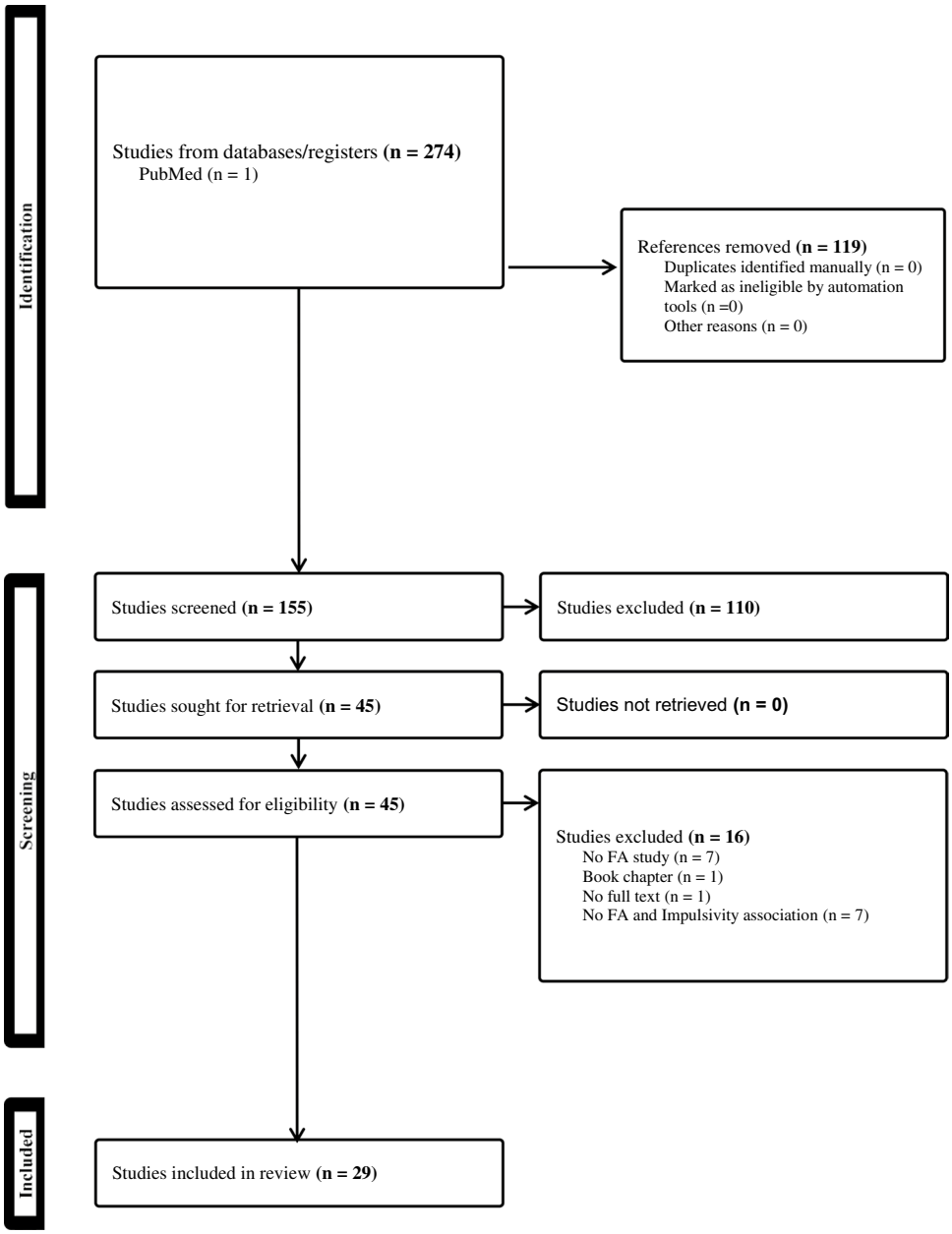

Fig. 1 The PRISMA flow diagram of the selection process

(37.93 %) included a control group [19, 49••, 56••, 57••, 58–60, 63, 71, 72, 73••].

The majority of studies enlisted samples with obesity (n = 12, 41.3%) [29, 56••, 57••, 58–60, 62••, 63, 68••, 72, 74, 75]. Furthermore, five studies (17.24%) included cohorts with ED [9••, 13, 61••, 69••, 70], only one study (3.4%) included individuals with obesity and ED [63], 6 studies (20.6%) included patients undergoing bariatric surgery [64, 65, 67, 73••, 75, 76], and two studies (7.4%) included adolescents with obesity [66, 77]. There was one study (3.7%) in patients with type 2 diabetes [78] and one study (3.4%) that included individuals with Parkinson's disease [49••]. With regard to substance use, three studies (10.3%) were identified [57••, 69••, 70] (Table 1).

Assessment of Impulsivity and FA and Their Associations

Trait Impulsivity

In this review, the instruments most commonly used to quantify impulsive personality traits and study their association with FA were the Barratt Impulsivity Scale (BIS) [4] and the UPPS-P Impulsive Behavior Scale [6].

Most of the studies in this review (n = 12, 41.3%) assessed impulsivity using the BIS-11 [9••, 29, 49••, 58–60, 71, 72, 73••, 74, 75, 78]; six studies (20.6%) used the short version with 15 items (BIS-15) [19, 64–67, 68••], and only one study used the BIS-8 scale [76]. The results showed

Table 1 Description of the selected studies

Author	Type of study	Sample	Country	Participant characteristics	Impulsivity/FA measures	Results	Gender differences
ElNasser et al. (2016) [59]	Cross sectional	200 females with obesity (108 females with FA and 92 females no FA)	Egypt	Age: 18-40. Gender: 100% female	YFAS + BIS-11	The FA group used more calming distracting strategies together with externalizing strategies to control their negative emotions, whereas the group without FA used more cognitive and behavioral strategies. The FA group were more, novelty seekers harm avoidant, self-transcendent, impulsive also less self-directed, and cooperative than the group without FA.	No gender differences mentioned.
de Chazeron et al. (2021) [49••]	Cross sectional	400 participants: patients with Parkinson (n = 200) and patients without (n = 200)	France	Age: 67.5 ± 9.9. Gender: 60% male.	2 items from the DSM-5 criteria for FA symptoms + BIS-11	FA was associated with female gender and greater attentional impulsiveness. A high non-planning impulsiveness score was protective.	In PD patients, FA was associated with female gender and impulsivity (higher attentional non-planning factor). Being a female or having a high attentional impulsiveness score increases the risk of having an FA.
Babaei et al. (2017) [58]	Cross sectional	60 participants with obesity (30 male with FA and 30 males no FA)	Iran	Gender: 100% male	YFAS+ BIS-11 + DERS	The FA patients have cognitive impulsivity, higher no-movement, wider no-planning and weaker performance on impulse control compared to the control group.	100% male sample. The sample have cognitive impulsivity.
Blume el al. (2018) [63]	Cross sectional	88 participants with obesity: obesity and FA (n = 23), obesity and BED (n = 19), obesity and FA plus BED (n = 23), and control group with obesity (n = 23)	Germany	Age: 40.06 ± 10.19. Gender: 73.9% female	YFAS 2.0 + IGT + DDT + GNG	No differences in executive functioning among individuals with FA, FA/BED, and obesity only. FA and BED were not associated with altered attention, cognitive flexibility, and inhibition in obesity.	No gender differences mentioned.
Brunault et al. (2018) [71]	Cross sectional	188 bariatric surgery candidates; 31 patients with FA and 157 patients without FA	France	Age: 40.8 ± 12.6 years. Gender: 84% female	YFAS + BIS-11	Bariatric surgery patients with FA (vs. without) exhibited higher motor impulsivity, cognitive impulsivity, non-planning impulsivity.	No gender differences mentioned.

Table 1 (continued)

Author	Type of study	Sample	Country	Participant characteristics	Impulsivity/FA measures	Results	Gender differences
Ceccarini et al. (2015) [74]	Cross sectional	88 patients with obesity: 25 male and 63 female	Italy	Age: 40.8 ± 7.1 Gender: 71.6% female	YFAS + BIS-11 + DERS	Patients with FA had significantly higher binge eating levels, greater emotional dysregulation, and nonacceptance of negative feelings; they lacked goal-oriented behavior, had little impulse control, had difficulty in emotion recognition, and attentional impulsivity; and they were unable to concentrate and lacked inhibitory control behavior.	No gender differences mentioned.
Davis et al. (2011) [29]	Cross sectional	72 obese adults: female ($n = 49$) and male ($n = 23$)	Canada	Age: 25–46. Gender: 68.1% female	YFAS + BIS-11 + DDT + Delay of Gratification Task	Participants with FA reported more impulsivity and showed poorer performance on the delay of gratification and delay discounting tasks. They also had significantly higher scores on the measure of addictive personality traits.	No gender differences mentioned
Hsu et al. (2017) [60]	Cross sectional	40 participants (20 females with obesity and sweet food addiction (O&SFA) and 20 controls female)	Taiwan	Age: 24.5 ± 3. Gender: 100% female	YFAS + BIS-11 + GNG	The O&SFA group had signifi- cantly higher BMI, body fat percentage, impulsivity, uncontrolled eating, and emotional eating and lower cognitive restraint than did the control group. In the behavior task, the O&FA group had a trend to make more incorrect Nogo response than control group and perceived higher difficulty in task than the control group.	100% female sample

Table 1 (continued)

Author	Type of study	Sample	Country	Participant characteristics	Impulsivity/FA measures	Results	Gender differences
Ivezaj et al (2016) [72]	Cross sectional	502 participants with overweight/obesity: BED ($n = 43$), FA ($n = 84$), BED + FA ($n = 51$) and 328 controls)	USA	Age: 38.0 ± 13.1. Gender: 83.2% female	YFAS+ BIS-11 + BSCS	The three groups with eating pathology (BED, FA, and BED + FA) had significantly greater disturbances on eating-disorder psychopathology, impulsivity, and self-control than the Control group. All eating groups reported higher levels of attentional impulsivity, while the BED and FA groups reported significantly higher levels of motor impulsivity and non-planning impulsivity.	No gender differences mentioned.
Meule et al. (2017) [64]	Cross sectional	133 pre-operative bariatric surgery	Germany	Age: 39.5 ± 10.7. Gender: 77.4% female	YFAS 2.0 + BIS-15	Scores on attentional and motor impulsivity interactively predicted FA status: higher attentional impulsivity was associated with a higher likelihood of receiving a YFAS 2.0 diagnosis only at high (+ 1 SD), but not at low (− 1 SD) levels of motor impulsivity.	No gender differences mentioned.
Meule et al. (2014) [65]	Cross sectional	96 obese individuals seeking bariatric surgery	Germany	Age: 39.92 ± 11.51. Gender: 65.60% female.	YFAS + BIS-15	The FA group had higher attentional but similar motor and non-planning impulsivity, compared with the non-addicted group (on the BIS-15). FA and impulsivity interactively predicted alcohol use.	No gender differences mentioned.
Meule et al. (2015) [66]	Cross sectional	50 adolescents with overweigth and obesity	Germany	Age: 16.50 ± 1.84. Gender: 62% female.	YFAS + BIS-15	Those with FA reported more binge days, more frequent food cravings, higher eating, weight and shape concerns, more symptoms of depression and higher attentional and motor impulsivity than individuals without a food addiction diagnosis.	No gender differences mentioned.

Table 1 (continued)

Author	Type of study	Sample	Country	Participant characteristics	Impulsivity/FA measures	Results	Gender differences
Ouellette et al. (2017) [76]	Cross sectional	146 bariatric surgery patients (112 female and 34 male)	Canada	Age: 39.8 ± 7.1. Gender: 76.7% female.	YFAS + BIS-8 + DERS	Findings showed that bariatric candidates with FA presented more emotion dysregulation, more harm avoidance, and less self-directedness. The association between harm avoidance and the number of FA criteria endorsed was mediated by emotion dysregulation, while the association between self-directedness and the number of FA criteria endorsed was mediated by reward sensitivity.	No gender differences mentioned.
Pape et al. (2021) [68••]	Cross sectional	213 participants with obesity or overweight	Germany	Age: 46.45 ± 12.13. Gender: 67.1% female.	YFAS 2.0 + BIS-15 + FRIS + FEV_In	An impulsive and emotional eating behaviour as well as weight bias (WBI) was positively associated with FA. There were negative correlations between FA symptom severity and the subscales action withdrawal, action cancellation, reward sensitivity and delay discounting of the FRIS (Food Related Inhibitory Control).	The prevalence of Food Addiction was 15% (N = 32), with higher, although not statistically significant, prevalence rates in female (18.2%, N=26) compared to male (8.6%, N=6) participants.
Raymond et al. (2015) [78]	Cross sectional	334 patients with type 2 diabetes	Australia	Age: 41 ± 9.5, Gender: 66% female.	YFAS + BIS-11	FA and impulsivity (non-planning) are more salient cross-sectional predictors of BMI, in people with t2d, than indices of depression, anxiety, stress and impulsivity (motor and attentional).	No gender differences mentioned.
Rodrigue et al. (2018) [75]	Cross sectional	86 patients with severe obesity (20 male and 66 female)	Canada	Age: 40.21 ± 7.1. Gender: 76.7% female	YFAS + BIS-11	No difference between groups (low FA vs high FA) was observed regarding impulsivity scores.	No gender differences mentioned.

Table 1 (continued)

Author	Type of study	Sample	Country	Participant characteristics	Impulsivity/FA measures	Results	Gender differences
Rose et al. (2018) [77]	Cross sectional	69 adolescents with severe obesity	USA	Age: 16.5 ± 1.5. Gender: 71% female.	YFAS-C + UPPS-P	Negative urgency was significantly associated with poorer weight-related QoL (quality of life), and this relationship was mediated by an association with emotional eating and FA.	No gender differences mentioned.
Schulte et al. (2021) [62••]	Cross sectional	46 females with overweigth and obesity	USA	Age: 31 ± 4.1. Gender: 100% female	YFAS 2.0 + UPPS-P	Individuals with FA exhibited significantly higher scores on the Palatable Eating Motives Scale overall score and subscales for coping and enhancement of emotions, UPPS-P Impulsivity Scale negative urgency and lack of perseverance subscales, and the Food Craving Inventory overall.	100% female sample
Sönmez Güngör et al. (2021) [73••]	Cross sectional	155 patients: 40 with pre-operative bariatric surgery, 35 with overweight, 40 in the control group and 40 with normal weight)	Turkey	Age: 35.1 ± 7.15. Gender: 79.4% female	YFAS + BIS-11	FA was significantly associated with more serious eating pathologies, more frequent weight-cycling and earlier onset of dieting, higher impulsivity, and higher BMI. Motor and total impulsivity scores showed a positive albeit week correlation with the severity of FA but no significant correlation with BMI.	Women were 6.7 times more likely to exhibit FA than men.
de Vries and Meule (2016) [19]	Cross sectional	115 individuals with BN and 341 undergraduates	Germany	Age: 26.35 ± 8.09. Gender: 100% female	YFAS2.0 + BIS-15	A higher number of FA symptoms was associated with lower interoceptive awareness, higher depressiveness, and higher impulsivity in both groups (BN group, control group).	No gender differences mentioned.

Table 1 (continued)

Author	Type of study	Sample	Country	Participant characteristics	Impulsivity/FA measures	Results	Gender differences
Fauconnier et al. (2020) [61••]	Cross sectional	195 patients: AN-R, (n = 65), AN-BP (n = 33), BN (n = 82), and TPA (n = 15)	France	Age: 23.1 ± 7.4. Gender: 100% female	YFAS + UPPS-P	They found significant difference in UPPS-Urgeny and difference in Impulse Regulation subscale (ED-2) between FA group and no-FA group. Participants with FA presented greater negative urgency.	100% female sample. No gender differences mentioned.
Meule et al. (2017) [67]	Cross sectional	Study1: 455 university students. Study 2:138 obese patients presenting for bariatric surgery	Germany, Austria, Switzerland, Luxembourg	Study 1: Age: 25.57 ± 6.97. Gender: 89% female. Study 2: Age: 39.52 ± 10.71. Gender: 78.3% female.	YFAS 2.0 + BIS-15	Study 1: FA was associated with higher body mass, binge eating frequency, trait food craving, and attentional impulsivity as well as with lower perceived self-regulatory success in dieting. Study 2: FA symptomatology was associated with higher binge eating frequency and attentional impulsivity.	No gender differences mentioned.
Miranda-Olivos et al. (2022) [69••]	Cross sectional	527 patients (176 BN, 115 BED, and 236 OSFED)	Spain	Age: 32.1 ± 12.6. Gender: 92.8% female	YFAS 2.0 + UPPS-P	The comorbid condition of FA+ and SU+ obtained higher mean scores on the EDI-2 impulse regulation subscale, on the UPPS-P scales (except for lack of premeditation and positive urgency), and on the TCI-R novelty seeking, as well as lower scores on the TCI-R self- directedness and cooperativeness scales. Increased impulsivity (such as high lack of premeditation, sensation seeking, and positive urgency) and low self-directedness were differentiating factors for presenting one or two addictive behaviors.	No gender differences mentioned.
Tran et al. (2020) [9••]	Cross sectional	73 patients with AN	France	Age: 28 ± 10.5. Gender: 97.2% female	YFAS 2.0 + BIS-11	FA was not associated with level of impulsivity.	No gender differences mentioned.

Table 1 (continued)

Author	Type of study	Sample	Country	Participant characteristics	Impulsivity/FA measures	Results	Gender differences
Wolz et al. (2017) [13]	Cross sectional	315 patients: BN (n = 176) or BED (n = 61) diagnostic criteria, and OSFED patients with binge-eating symptomatology (n = 78)	Spain	Age: 30.5 ± 10.79. Gender: 92.7% female	YFAS-S + UPPS-P + DERS	Results indicate that, ED severity mediated the relationship between negative urgency and FA, and the relationship between difficulties in emotion regulation and FA: high negative urgency levels and high difficulties in emotion regulation predicted high ED levels, which are also a significant and positive predictor of high FA levels. A direct effect was found for negative urgency to FA, but not for emotion regulation and self-directedness to FA levels.	No gender differences mentioned.
Wolz et al. (2016) [70]	Cross sectional	278 patients: AN (n = 68), BN (n = 110), BED (n = 39), and OSFED (n = 61)	Spain	Age: 29.1 ± 10.4. Gender: 92.8% female	YFAS + UPPS-P	There were significant differences on the UPPS-P subscales lack of perseverance and negative urgency, with higher values in FA patients compared to patients without "positive YFAS".	No gender differences mentioned.

YFAS, Yale Food Addiction Scale; *YFAS 2.0*, Yale Food Addiction Scale version 2.0; *Myfas*, Modified Yale Food Addiction Scale; *YFAS-C*, Yale Food Addiction Scale for Children; *DSM-5*, Diagnostic and Statistical Manual of Mental Disorders, fifth edition; *BIS-11*, Barratt Impulsiveness Scale; *BIS-15*, Barratt Impulsiveness Scale Short Form; *BIS-11-SF*, Barratt Impulsiveness Scale Short Form; *BIS-8*, BIS-Brief; TRIS, Trait-Related Impulsivity Scale; *DERS*, Difficulties in Emotion Regulation Scale; *UPPS-P*, Impulsive Behavior Scale; *GNG*, Go/no-go' task; ED50, effective delay 50; *DDT*, delay discounting task; *IGT*, Iowa gambling task, delay of gratification task; *FRIS*, food-related inhibitory control; *SURPS*, personality and risk profiles; *CPT*, Conner's continuous performance test, stroop color, and word test; BSCS, Brief Self-Control Scale; *BIS-Brief*, FRIS Food Related Inhibitory Control, FEV_In Impulsive Eating Behaviour Interference subscale.

that four of the studies recorded significant positive associations between BIS total score and FA [19, 29, 60, 73••], while two studies, using the BIS-11 scale, did not find associations between FA and impulsivity levels [9••, 75]. The motor impulsivity subscale and the subscale of attentional impulsivity were the measures most frequently associated with FA [65–67, 71, 72, 74]. A study reported that FA and cognitive/attentional impulsivity interactively predicted alcohol use [65]. Non-planning impulsivity was associated with FA in patients with Parkinson's disease, and was also identified as a cross-sectional predictor of BMI in patients with type 2 diabetes [78]. In another study which applied the Brief Self-Control Scale (BSCS) [72], the group with FA reported significantly greater disturbances with regard to impulsivity and self-control compared to the control group.

Eight studies (27.5%) used the UPPS-P scale [13, 56••, 61••, 62••, 69••, 70, 77]. Negative urgency and lack of perseverance showed significant associations with FA [13, 56••, 62••, 69••, 70]. One study reported that lack of premeditation, sensation seeking, and positive urgency may be predictors for developing one or two addictive behaviors [69••]. Another study found that high scores in negative urgency and reward dependency but low scores in lack of premeditation may increase the likelihood of FA [70].

Another scale used to evaluate personality profiles was the Personality and Risk Profiles Scale (SURPS), with the least frequent personality profile being the impulsive one. This instrument was applied in one of the three treatment studies included in this review. However, no changes in impulsivity scores were reported after the three-session intervention (brief motivational interview) [57••].

Neurocognitive Measures of Impulsivity

Based on cognitive and behavioral models of impulsivity, objective tests have been developed to measure inhibitory control processes using tasks that assess performance in terms of accuracy and reaction time data. These neurocognitive measures for assessing impulsivity are (1) measures of response inhibition. These are based on the suppression of a prepotent or dominant automatic response. The most commonly used behavioral or laboratory tests to assess this component are the Go/No-Go (GNG) Task and the Stroop Colour and Word Test [79, 80]. In this review, two studies included the GNG [60, 63], but only one of these studies reported significant differences in the FA group, indicating that the group with obesity and sweet food addiction (O&SFA) had a tendency to make more incorrect No-Go responses compared to the control group and to have a higher perceived difficulty in the task than the control group [60]. (2) Measures of delay-discounting: in these, impulsivity is mirrored by the preference for a small reward (available immediately or after a short delay) over a larger reward available at some future point in time [79, 81]. Two studies included the delay discounting task (DDT) [29, 63] and one of these studies also included the delay of gratification task [29], but only in one study the participants with FA reported higher impulsivity and showed poorer performances in the delay of gratification and delay discounting tasks [29]. In a similar realm, another study assessed impulsivity using the Food Related Inhibitory Control (FRIS) and the Impulsive Eating Behavior Interference subscale (FEV_In) [68••] and found negative associations between FA symptom severity and the subscales action withdrawal, action cancelation, reward sensitivity, and delay discounting of the FRIS. (3) Measures of cognitive impulsivity, referring to impulsive decision making behavior: in these tasks, subjects may select between a conservative option and a riskier option that offers a gain [82]. Such measures include the Iowa Gambling Task (IGT), the Cambridge Gamble Task (CGT), the Risky Gains Task (RGT), the CPT Conner's Continuous Performance Test, and the Trail Making Test [79, 83–86]. Two studies used the IGT [56••, 63] and one of these studies also utilized the CPT [56••]; no impact in executive functioning among individuals with FA was found.

Assessment of FA

The most widely used scale to measure FA has been the Yale Food Addiction Scale (YFAS). This scale was developed in 2009 by Gearhardt, Corbin, and Brownell, showing adequate internal reliability as well as good convergent and discriminant validity [20]. This self-report questionnaire examines eating behaviors during the past 12 months. The DSM-IV criteria for substance dependence were taken as a basis for the development of the items and were adapted to the consumption of foods rich in fats and sugars. Using this measure, FA can be assessed as a continuous variable (symptom count) and as a categorical variable (presence or absence of FA), and a "diagnosis" of FA is established if a person reports three or more symptoms in the past 12 months with clinically significant distress or impairment [87]. Currently, there are several translations of the YFAS, including the newer version YFAS 2.0 adapted to consider changes in the fifth edition of the DSM (DSM-5; measures of severity and craving) [21]. The YFAS 2.0 contains 35 questions that assess the 11 criteria of SUD. Abbreviated forms of the YFAS are the mYFAS [26] and the YFAS-C (version for children) [27].

In this review, FA was assessed using the Yale Food Addiction Scale (YFAS) in most studies (n = 16, 55.1%). One study used the Yale Food Addiction Scale for Children (YFAS-C) [77], and another study in participants with Parkinson's disease used 2 items from the DSM-5 criteria to assess FA symptoms (food often consumed in larger amounts or over a longer period or more frequently than

was intended; and craving, or a strong desire or urge to eat specific foods) [49••]. The rest of the studies used the YFAS 2.0 (37.9%). One study used the Food Cravings Questionnaire-Trait (FCQ-T) as a complement to FA assessment [88]. Finally, only one study used two different instruments in the assessment of FA; mYFAS at baseline and the YFAS 2.0 at the end of treatment [57••].

Impulsivity and Gender Differences

Only one article evaluated the relationship between FA and impulsivity in a 100% male sample [58] of individuals with obesity. Three further articles were identified that included a majority of men (10.3%) [49••, 56••, 88]. The majority of the studies ($n = 12$, 41.3%) had a higher percentage of women, and five articles (17.2%) [19, 59, 60, 61••, 62••] had 100% female cohorts.

In men, associations between FA and cognitive impulsivity, greater lack of planning, and weaker impulse control performance were found [58]. In the studies that had a higher percentage of men in their sample, FA was found to play a mediating role between impulsivity and BMI [56••]. One study did not detect FA in men [49••], while in another study, FA and impulsivity were not associated with the male gender [88].

In women, FA was associated with greater attentional and motor impulsivity, especially in women with obesity undergoing bariatric surgery. One study reported that high attentional impulsivity scores increased the risk for FA [49••]. The results of a study reporting gender differences showed that women were 6.7 times more likely to exhibit FA than men [73••]. In patients with Parkinson's disease, FA was associated with the female gender and impulsivity (higher attentional non-planning factor) [49••]. In women with ED, negative urgency had a significant association with FA [13, 62••, 69••, 70].

Treatment

Three studies evaluated the effectiveness of an intervention and assessed both FA and impulsivity outcomes [56••, 57••, 88]. Two controlled studies included a cohort with overweight and obese individuals and a 3-month [57••] and 1-year follow-up [56••]. The third study conducted an intervention in participants with SUD without follow-ups [88]. Table 2 displays treatment approaches and intervention components that were different in each of the 3 studies.

The study by Mallorquí-Bagué et al. [54] aimed to investigate whether overweight/obesity was related to increased impulsivity, FA, and depressive symptoms, and whether these variables could be modified following a multimodal intervention based on a traditional Mediterranean diet (energy restricted), the promotion of physical activity and psychosocial (behavioral-motivational) support. This study was the only one of the treatment studies that performed a randomization of participants to intervention and control groups. The results showed that higher levels of impulsivity were related to higher FA. Multiple regression analysis and path analysis (a special case of structural equation modeling: SEM) revealed FA to play a mediating role between impulsivity and BMI. After 1 year of treatment, patients in both groups (intervention and control) reported a significant decrease in BMI and FA, along with significant tendencies in decreases of different characteristics of impulsivity (i.e., trait impulsivity and inhibitory control)–with further decreases in patients in the intervention group. Also, lack of perseverance and negative urgency were related to obesity/overweight through the presence of FA. Among the most important observations and conclusions of this study was the modifiable nature of FA and BMI in part through the improvement of impulsivity characteristics. The study also highlighted the usefulness of an intensive multimodal intervention (promoting a healthy dietary pattern such as the Mediterranean diet, physical activity, and behavioral-motivational support).

The FoodFix intervention in the study by Burrows et al. [68••] was designed as a brief motivational interview (of three sessions) to improve dietary profiles. This interview was developed and modeled according to a previous efficacious intervention for alcohol addiction, adapting its content to the dominant personality profile following a baseline assessment. Session content and structure were centered around the social cognitive theory (SCT) and the acceptance and commitment therapy (ACT). After the intervention, changes in individual symptoms of FA and in dietary intakes were found for both the intervention and control group; there were no changes in BMI over time. Because participants did not present an impulsive profile to begin with, no changes in impulsivity were reported. The intervention design was based on principles from the addiction research field, in which brief interventions are common.

The intervention by Koball et al. [88] was designed for participants with SUD and included group and individual therapy options with topics such as meditation, mindfulness, nutrition, and spirituality. In this study, no significant differences between pre- and post-treatment in scores measuring FA were found; however, impulsivity levels decreased following treatment. No change in the number of participants screening positive for FA emerged. A relevant finding of this study was that the BMI slightly (significantly) increased in the follow-up. The authors interpreted this result as a possible use of food as a substitute for abused substances; however, an artifact of abstinence from weight gain–promoting substances (e.g., alcohol or marijuana, the two most common substances used in this sample) could have also been a plausible explanation for the increase in BMI.

Table 2 Description of selected treatment studies

Author	Type of study	Sample	Country	Participant characteristics	Impulsivity/ FA measures	Results	Gender differences	Treatment sessions	Intervention	Treatment results	Follow-up
Mallorquí-Bagué et al. (2021) [56••]	Cross sectional and longitudinal (multicenter, randomized clinical trial)	342 adults with overweight/ obesity and metabolic syndrome (MetS). 179 participants control group and 163 participants intervention group.	Spain	Age: 65.24 ± 4.65. Gender: 51.6 % male	YFAS 2.0 + UPPS-P + IGT + CPT + Stroop	At baseline, higher impulsivity was linked to higher food addiction and depressive symptoms, but not to body mass index (BMI). After treatment, FA not only predicted higher BMI and depressive symptoms, but also achieved a mediational role between impulsivity and BMI/ depressive symptoms.	No gender differences mentioned.	Multimodal psychosocial intervention (based on an energy-restricted traditional Mediterranean diet, physical activity promotion and behavioral-motivational support).	The intervention group: received an energy restricted traditional Mediterranean diet. Dietary intervention was associated with physical activity promotion and psychosocial (behavioral-motivational) support, with specific goals of weight loss, including self-monitoring and frequent monitoring throughout the study. The participants performed individual interviews (15–30 min) and motivational group sessions (30–45 min; maximum 20 participants) three times per month during the first year of the intervention.	After 1 year, patients in both groups reported significant decreases in BMI, FA, and impulsivity. BMI reduction and impulsivity improvements were higher in the intervention group. Higher BMI decrease was achieved in individuals with lower impulsivity. Higher scores in FA were also related to greater post-treatment impulsivity.	1-year follow-up (impulsivity measures FA, and BMI)

Table 2 (continued)

Author	Type of study	Sample	Country	Participant characteristics	Impulsivity/ FA measures	Results	Gender differences	Treatment sessions	Intervention	Treatment results	Follow-up
Koball et al. (2019) [88]	Cross sectional and exploratory	44 participants con substance use disorders (33 male and 11 female)	UK	Gender: 75% male	YFAS 2.0 + FCQ-T + UPPS-P	FA and food craving was relatively low at baseline and did not change from pre to post.	No gender differences mentioned.	Average length the program for participants included was 30.95 days (sd = 13.76, Range = 5–86 days).	Treatment program included separate residences for men and women. It was based both 12-step based (for men) and trauma-informed/ holistic (for women). The sessions included options for group and individual therapy with topics including meditation, mindfulness, nutrition, spirituality, and recovery. Also performed morning meditation, quiet worktime, and offsite alcoholics anonymous and narcotic-sanonymous meetings.	No significant differences were pre to post treatment in scores measuring FA or craving. Impulsivity, distress tolerance, depression, and anxiety went down from post treatment. Drug and/ or alcohol use cravings decreased. BMI did slightly, although-sig-nificantly, increase from pre to post.	No follow up

Table 2 (continued)

Author	Type of study	Sample	Country	Participant characteristics	Impulsivity/ FA measures	Results	Gender differences	Treatment sessions	Intervention	Treatment results	Follow-up
Burrows et al. (2021) [57••]	Cross sectional (randomised controlled triall)	52 participats with overweight and obesity (26 in the intervention group and 26 in the control group)	Australia	Age: 43.6 ± 12.2. Gender 96% female	Myfas + YFAS 2.0 + SURPS	There were no significant changes in self-reported BMI, diet quality or coping strategies for stressful situations for either the emotion or task domain as measured. Coping strategies provided to participants were as follows; 22% depression prone, 19% anxiety prone, 8% sensation seeking and 6% impulsive.	No gender differences mentioned.	Brief intervention with a focus on Motivational Interviewing (MI).	The FoodFix intervention comprised 3 sessions over 3 months: a baseline (week 1, 45 min), second session (week 3, 25–30 min) and final session (week 7, 15–20 min). The first session explored the participants' reasons for participation, and what they believed was addictive overeating. The second session focused on key coping strategies based on the dominant. In the third session a brief troubleshooting was carried outand encourage to continue with goals and learned strategies	At three month follow up, there were significant reductions from baseline (BL) for both groups in total YFAS 2.0 symptoms, however, these changes were not significantly different between groups.	3 month follow up

YFAS 2.0, Yale Food Addiction Scale version 2.0; *Myfas*, Modified Yale Food Addiction Scale; *UPPS-P*, Impulsive Behavior Scale; *IGT* Iowa gambling task, delay of gratification task; *SURPS*, personality and risk profiles; *CPT*, Conner's continuous performance test, stroop color, and word test; *FCQ-T*, Food Cravings Questionnaire-Trait

Risk of Bias Assessment

Only one multicenter randomized clinical trial [56••] and one randomized controlled trial were identified [57••]; the rest of the studies were cross-sectional. In addition, only 37.93% (n = 11) of the studies included a control group, including two of the three treatment studies [19, 49••, 56••, 57••, 58–60, 63, 71, 72, 73••]. Samples were generally individuals who were already diagnosed with an ED in a clinical setting or were preparing to receive bariatric surgery. Lack of control groups and aspects of selection bias were features of poor quality. Only a few (31%) of the studies were cross-sectional studies which had both a clinical and a control group with samples from hospital and community settings, thus showing good quality [19, 49••, 56••, 57••, 58–60, 72, 73••]. Two studies had a longitudinal design and a cross-sectional portion (case-control and cohort studies) with a good quality [56••, 88] (Tables 3 and 4).

Discussion

The current review focused on FA and impulsivity in clinical settings. The most commonly used instruments to measure impulsivity were the Barratt Impulsivity Scale (BIS) [4] and the UPPS-P Impulsive Behavior Scale [6]. The YFAS remains the most used measure to assess the presence and severity of FA. Most of the clinical samples were mainly women, with only one cohort consisting of men only [58]. This current research found that many studies included individuals with obesity, with or without FA. Looking at patients with an ED vs. ED and co-present FA, studies found that the comorbid groups had higher attentional and motor impulsivity than the groups with only ED [66, 73••, 74]. The results affirm the presence of a significant association between impulsivity and FA in clinical samples [19, 29, 60, 73••]. Negative urgency was identified as linked to FA, and like lack of perseverance, it showed significant associations with FA. Several studies have shown that negative urgency is one of the main features of impulsivity related to the development and maintenance of FA [32, 70], while lack of perseverance has been identified as relevant in addictive behaviors [89]. Results also show that motor impulsivity and attention impulsivity subscales were the measures most frequently associated with FA.

Although one of our objectives was to identify gender differences in impulsivity and its associations with FA, we were only able to identify four studies which included a majority of men [49••, 56••, 58, 88], and even fewer studies that analyzed gender differences. While attentional and motor impulsivity was related to FA in samples of women with obesity, the only study in men with obesity [58] found that, unlike women, cognitive and non-planning impulsivity was more closely associated with FA, which may indicate a specific clinical profile in men presenting with this association between impulsivity and FA. A meta-analysis reported similar results in identifying gender differences related to impulsivity; in that meta-analysis, men showed higher scores in cognitive/attentional and non-planning impulsivity than women. However, these results were reported in samples of the general population without FA [48].

Gender differences regarding FA and impulsivity have been studied independently (gender differences in FA have not been analyzed in relation to impulsivity before, while impulsivity has been studied in individuals without FA or showing other pathologies). The results presented here indicate that although the highest prevalence of FA is in women–with the largest samples in the studies included in this review consisting of women–men are also affected by FA. Little is known about the clinical manifestations of FA in men and putative differences to clinical manifestations of women with FA. Despite the evidence of differences in impulsivity between men and women, these differences have not yet been considered in recent studies on FA. There is scarcity of evidence regarding clinical correlates related to both FA and impulsivity; not only have very few treatment studies been conducted in individuals with FA including impulsivity as one of their treatment targets, but even the existing studies either lack the adequate power to identify statistical differences or have not included control groups. These observations warrant further investigations in larger samples including men, as this might have important implications for the design of treatments.

We were able to identify 3 studies addressing the effects of interventions on impulsivity and FA. Burrows et al. (2021) implemented a brief intervention with a focus on motivational interviewing (vs. control) in individuals with overweight and obesity. Both groups showed significant reductions in food addiction traits at the 3-month follow up; however, these changes were not significantly different between the groups. Mallorqui-Bagué et al. (2021) examined the effects of a psychosocial intervention (vs. control) on metabolic parameters, weight, dietary habits, and psychological variables in individuals with obesity and metabolic syndrome. After 1 year, participants in both groups reported significant decreases in BMI, FA, and impulsivity, although BMI decrease and impulsivity improvements were higher in the intervention group. The beneficial outcome on FA and impulsivity in the control group may provide evidence for the positive effects of unspecific interventions, thus those interventions that were not designed to specifically address impulsivity and food addiction. Although the actual intervention in this study was also not designed to specifically target FA and impulsivity, it may be assumed that psychosocial interventions of the kind that typically aim at modifying behaviors related to diet, physical

Table 3 Quality and Risk bias assessment

1st author, year	Selection			Definition of controls (★)	Comparability (★★)	Exposure			Total (9★)	Quality
	Representativeness of exposed cohort (★)	Representativeness of the cases (★)	Selection of controls (★)			Ascertainment of exposure (★)	Same method of ascertainment for cases and controls (★)	Non-response rate (★)		
ElNasser et al. (2016) [19]	*	*		*	**		*	*	7	Good quality
de Chazeron et al. (2021) [49••]	*	*	*	*	**		*		7	Good quality
Babaei et al. (2017) [58]	*	*	*	*	*		*	*	7	Good quality
Blume et al. (2018) [63]	*	*		*	**		*		6	Fair quality
Brunault et al. (2018) [71]	*	*			**		*	*	6	Fair quality
Ceccarini et al. (2015) [74]	*	*						*	3	Poor quality
Davis et al. (2011) [29]	*	*						*	3	Poor quality
Hsu et al. (2017) [60]	*	*	*	*	*		*	*	7	Good quality
Ivezaj et al (2016) [72]	*	*	*		*		*	*	6	Good quality
Meule et al. (2017) [64]	*	*						*	3	Poor quality
Meule et al. (2014) [65]	*	*						*	3	Poor quality
Meule et al. (2015) [66]	*	*						*	3	Poor quality
Ouellette et al. (2017) [76]	*	*						*	3	Poor quality
Pape et al. (2021) [68••]	*	*						*	3	Poor quality
Raymond et al. (2015) [78]	*	*						*	3	Poor quality
Rodrigue et al. (2018) [75]	*	*						*	3	Poor quality
Rose et al. (2018) [77]	*	*						*	3	Poor quality
Schulte et al. (2021) [62••]	*	*	*				*	*	5	Fair quality
Sönmez Güngör et al. (2021) [73••]	*	*	*	*	**		*	*	8	Good quality
de Vries & Meule (2016) [19]	*	*	*	*	**		*	*	8	Good quality
Fauconnier et al. (2020) [61••]	*	*						*	3	Poor quality
Meule et al. (2017) [67]	*	*						*	3	Poor quality
Miranda-Olivos et al. (2022) [69••]	*	*						*	3	Poor quality
Tran et al. (2020) [9••]	*	*						*	3	Poor quality
Wolz et al. (2017) [13]	*	*						*	3	Poor quality

Table 3 (continued)

1st author, year	Selection			Definition of controls (★)	Comparability (★★)	Exposure			Total (9★)	Quality
	Representativeness of exposed cohort (★)	Representativeness of the cases (★)	Selection of controls (★)			Ascertainment of exposure (★)	Same method of ascertainment for cases and controls (★)	Non-response rate (★)		
Wolz et al. (2016) [70]	*	*						*	3	Poor quality
Mallorquí-Bagué et al. (2021) [56••]	*	*	*	*	**		*	*	8	Good quality
Burrows et al. (2021) [57••]	*	*	*	*	**		*	*	8	Good quality
Koball et al. (2019) [88]	*	*						*	3	Poor quality

Note: Asterisks represent stars, i.e., points assigned if the studies meet the established criteria. A study can be awarded a maximum of one star for each numbered item within the Selection and Exposure categories. A maximum of two stars can be given for Comparability

Table 4 Quality and risk bias assessment in longitudinal studies

1st author, year	Selection			Demonstration that outcome of interest was not present at start of study (★)	Comparability (★★)	Exposure			Total (9★)	Quality
	Representativeness of exposed cohort (★)	Selection of non-exposed cohort (★)	Ascertainment of exposure (★)			Assessment of outcome (★)	Was follow-up long enough for outcomes to occur (★)	Adequacy of follow up of cohorts (★)		
Mallorquí-Bagué et al. (2021) [56••]	*	*	*	*	**		*	*	8	Good quality
Burrows et al. (2021) [57••]	*	*	*	*	**			*	7	Good quality

Note: Asterisks represent stars, i.e., points assigned if the studies meet the established criteria. A study can be awarded a maximum of one star for each numbered item within the Selection and Exposure categories. A maximum of two stars can be given for Comparability

activity, and stress management (e.g., by means of cognitive-behavioral approaches) most probably do address underlying psychological factors contributing to unhealthy eating behaviors and metabolic dysregulation, such as impulsivity and FA. Koball et al. (2009) aimed to investigate the phenomenon of addiction shift (which refers to the transition from substance addiction to FA) in individuals undergoing residential treatment for substance use. The results showed that scores for FA did not change following treatment–but the authors argued that scores were low at baseline to begin with. On the other hand, decreased scores in impulsivity were observed. These results are in somewhat contrast to those by Mallorqui-Bagué et al. (2021) and Burrows et al. (2021) in that they may be indicative of the fact that–despite the association and co-occurence of impulsivity and FA–the management of the two traits may need to be specifically targeted. This contrast may, hypothetically, be attributed to the different cohorts under investigation; Mallorqui-Bagué et al. (2021) and Burrows et al. (2021) examined individuals with overweight/obesity, while Koball et al. (2009) examined individuals with SUD (and low baseline scores in FA). The intervention per se (length, specific content, etc.) may also be of relevance, but this is another aspect that needs to be backed up by further evidence. For example, an integrated treatment approach that addresses both impulsivity and FA may be beneficial and could involve techniques from cognitive-behavioral therapy (CBT) and dialectical behavior therapy (DBT) for emotion regulation or impulse control as well as interventions specifically targeting FA, such as psychoeducation about addictive-like eating behaviors and skills to manage cravings and triggers related to addictive eating.

Limitations and Future Research

This review has notable limitations. First, most of the studies were cross-sectional, which does not allow for causality considerations to be inferred, and most of the studies did not include a control group to allow conclusions of specificity and comparison of results. Then, several studies had unbalanced samples, with very low representation of men. The quality of most of the studies was low, which also made it difficult to identify gender differences. Additionally, studies were conducted in hospital settings, so their results cannot be generalized to different populations (e.g., the general population).

These findings demonstrate the need for longitudinal studies designed to achieve lower risk of bias. Future studies may improve methodological quality and specifically address gender differences, which is an understudied aspect in current research. Therefore, little is known about the clinical manifestations of impulsivity in men with FA. At the clinical level, such manifestations might have relevant implications for future treatment designs.

Conclusion

Understanding the relationship between impulsivity and FA may potentially inform treatment approaches and interventions. However, conclusive empirical data on the clinical significance of the co-existence of high impulsivity and distinct FA traits with regard to treatment outcomes (e.g., for individuals with problematic eating behaviors) is lacking. Further research is needed to better understand the clinical significance of the co-presence of impulsivity and FA traits and to evaluate the effectiveness of tailored treatment approaches in affected individuals. In the same sense, gender studies on the co-existence of impulsivity and FA should provide further evidence on how the bi-directional associations between impulsivity and FA may differ by gender.

Author Contribution AGP, GP, FFA, LM, and SJM contributed to the development of the study concept and design. RMO, LCB, CB, AS, and BP aided with data collection. AGP, MR, and GP wrote the original manuscript. FFA and SJM obtained funding. GP, FFA, and SJM revised the manuscript and provided substantial comments. All authors had full access to all study data.

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Declarations

Ethics Approval The present article is a systematic review of the literature and no studies with human participants or animals were performed by any of the authors to conduct this work.

Conflict of Interest FFA and SJM received consultancy honoraria from Novo Nordisk and FFA editorial honoraria as EIC from Wiley. The rest of the authors declare no conflict of interest.

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- • Of importance
- •• Of major importance

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