Self-perceived food addiction:

Meadows, Angela; Nolan, Laurence J; Higgs, Suzanne

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ABSTRACT

Food addiction is controversial within the scientific community. However many lay people consider themselves addicted to certain foods. We assessed the prevalence and characteristics of self-perceived "food addiction" and its relationship to a diagnostic measure of "clinical food addiction" in two samples: (1) 658 university students, and (2) 614 adults from an international online crowdsourcing platform. Participants indicated whether they considered themselves to be addicted to food, and then completed the Yale Food Addiction Scale, measures of eating behavior, body image, and explicit and internalized weight stigma. Participants in the community sample additionally completed measures of impulsivity, food cravings, binge eating, and depressive symptomatology. Follow-up data were collected from a subset of 305 students (mean follow-up 280 ± 30 days). Self-perceived "food addiction" was prevalent, and was associated with elevated levels of problematic eating behavior, body image concerns, and psychopathology compared with "non-addicts", although individuals who also received a positive "diagnosis" on the Yale Food Addiction Scale experienced the most severe symptoms. A clear continuum was evident for all measures despite no differences in body mass index between the three groups. Multinomial logistic regression analyses indicated that perceived lack of self-control around food was the main factor distinguishing between those who did and did not consider themselves addicted to food, whereas severity of food cravings and depressive symptoms were the main discriminating variables between self-classifiers and those receiving a positive "diagnosis" on the Yale Food Addiction Scale. Self-perceived "food addiction" was moderately stable

across time, but did not appear predictive of worsening eating pathology. Self-classification as a “food addict” may be of use in identifying individuals in need of assistance with food misuse, loss-of-control eating, and body image issues.

Keywords

Food addiction; Food use disorder; Disordered eating; Eating self-efficacy; Body Image.

Introduction

The concept of "food addiction" has attracted great interest within the scientific community, particularly in terms of implications for public policy on obesity prevention and management (Gearhardt, Grilo, DiLeone, Brownell, & Potenza, 2011). The Yale Food Addiction Scale (YFAS) was developed to identify individuals exhibiting addictive-like behaviours with respect to foods, and is based on the DSM-IV-TR criteria for diagnosis of substance dependence (Gearhardt, Corbin, & Brownell, 2009). These criteria identify seven potential symptoms of addiction syndromes, namely: taking the substance in larger amounts or over a longer period than intended; persistent desire or unsuccessful attempts to reduce or stop use; continued use of the substance despite negative consequences; excessive time or money spent obtaining the substance; important social, occupational, or leisure activities reduced because of use of the substance; withdrawal symptoms when the substance is discontinued; and requiring larger amounts of the substance to achieve the same effects, i.e. tolerance. Endorsement of three or more of these criteria in the previous year, along with clinically significant distress or impairment, is required to receive a positive "diagnosis" (YFAS+). Based on these criteria, the prevalence of "food addiction" in student and non-clinical populations is generally between approximately 5% and 15%[1], although significantly higher rates have been observed in obese or eating disorder samples (for a review, see Pursey, Stanwell, Gearhardt, Collins, & Burrows, 2014).

[1] One study in a student sample reported much higher rates of YFAS+ diagnoses (24%; Murphy, Stojek, & MacKillop, 2014).

Positive diagnosis on the YFAS has been linked to a range of other problem eating behaviors, including binge eating, emotional eating, elevated food cravings, impaired self-control around food, night eating syndrome, and eating disorder psychopathology in both community and clinical samples, with similar findings reported when using the a continuous symptom score, i.e. the number of symptoms endorsed (Burmeister, Hinman, Koball, Hoffmann, & Carels, 2013; Davis, Curtis, Levitan, Carter, Kaplan, & Kennedy, 2011; Gearhardt et al., 2009; Koball, Clark, Collazo-Clavell, Kellogg, Ames, Ebbert, & Grothe, 2016; Meule, Hermann, & Kübler, 2015; Nolan & Geliebter, 2016). Scores on the YFAS have also been associated with depression, anxiety, and attentional deficit hyperactivity disorder, weight and shape concern, and reduced quality of life (Brunault, Ducluzeau, Bourbao-Tournois, Delbachian, Couet, Réveillère, & Ballon,, 2016; Burmeister et al., 2013; Davis et al., 2011; Eichen, Lent, Goldbacher, & Foster, 2013; Koball et al., 2016; Meule, Lutz, Vögele, & Kübler, 2012). However, the existence of "food addiction" remains highly contentious among the scientific community, with some authors questioning whether the mechanisms underlying "food addiction" are equivalent to those seen in more traditional substance use disorders (Long, Blundell, & Finlayson, 2015; Ziauddeen, Farooqi, & Fletcher, 2012).

In contrast, the concept of "food addiction" is widely accepted within the lay population. In a series of studies in students and staff of a UK university, only 6 of 364 recruited participants did not believe in the existence of "food addiction" (Ruddock, Christiansen, Jones, Robinson, Field, & Hardman, 2016; Ruddock, Dickson, Field, & Hardman, 2015). A qualitative study in a low-income, ethnically

diverse US sample also found the concept of "food addiction" was almost universally accepted (Malika, Hayman, Miller, Lee, & Lumeng, 2015), supporting the generalizability of these findings.

Lay conceptualization of "food addiction"

Few studies have explored what the concept of "food addiction" means to those who self-diagnose as such and to the lay population in general. Hetherington and Macdiarmid (1993) reported that self-confessed "chocolate addicts" scored highly on items that would map onto DSM-IV criteria for substance dependence. However, when asked what made them feel they were addicted to chocolate, 76% responded that it was their inability to control consumption. No other criteria were widely endorsed. More recently, an online qualitative study reported that understanding of "food addiction" was similar in those who did and did not consider themselves to be addicted to food, with the most frequently mentioned characteristics being reward-driven eating, preoccupation with food, and a perceived lack of self-control around food (Ruddock et al., 2015). This result suggests that lay understanding of the term "food addiction" may be driven predominantly by perceptions of control around food, or eating self-efficacy. However, other characteristics emerging from qualitative studies include non-physiological eating, e.g. in the absence of hunger, frequent and uncontrollable food cravings, usually for specific, energy-dense foods, eating despite negative health consequences, and devoting time and effort to obtain the craved food (Malika et al., 2015; Ruddock et al., 2015), which are similar to the conceptualization of substance use disorders used in clinical diagnosis,

particularly since the addition of "cravings" to the diagnostic criteria in the DSM-5 (American Psychiatric Association, 2013).

Prevalence of self-perceived food addiction

Limited evidence from studies of lay appreciation of "food addiction" suggests that self-perceived food addiction (SPFA) is more prevalent than food addiction measured using the YFAS (Corwin & Grigson, 2009). A website poll of overweight adolescents provided a definition of addiction as "feeling driven to a behaviour even though the person knows that it will damage her/his health or social life". Based on this description, approximately one-third of the participants believed they were addicted to food (Pretlow, 2011). In contrast, another study simply asked children and adolescents, "Do you think you are addicted to food?" Approximately one-third of the sample answered positively to this question (Merlo, Klingman, Malasanos, & Silverstein, 2009). However, this item was placed at the end of the questionnaire following a number of questions based on DSM-IV criteria for substance dependence, which may have influenced responses. Consequently, these studies might not have fully captured self-attribution of food addiction. Nevertheless, the previously cited study by Ruddock and colleagues (2015) reported a similar proportion of adults (29%) self-classified as food addicted, and this number was unaffected by the *a priori* presence or absence of a definition of "food addiction".

Characterization of SPFA

Although SPFA appears to be prevalent in the general population, little is known about the characteristics of this "condition", whether particular constructs can uniquely predict SPFA, or what distinguishes it from YFAS-diagnosed food addiction. It has been suggested that SPFA is not reflective of any addictive-like processes but rather may be a way in which individuals with low eating self-efficacy can explain, to themselves and others, their "failure" to control their intake, whilst attributing the problem to a biological mechanism rather than a personal weakness (Rogers & Smit, 2000).

Some support for the attribution hypothesis comes from an experimental study that randomly allocated 60 students to either a condition in which they read a sham newspaper article explaining that "food addiction" was "real" or one in which they were told that it was a myth, and, in effect, an excuse for lack of self-control (Hardman, Rogers, Dallas, Scott, Ruddock, & Robinson, 2015). Students were then asked if they thought they were addicted to foods. Subsequently, students in the "myth" condition were less likely to self-classify as food addicts than students in the "real" condition, although over a quarter nevertheless did so (27% versus 57%, respectively). The authors concluded that SPFA is simply a convenient external attribution to explain "problematic" eating behavior, whose use is abrogated by receiving disaffirming information about the existence of the construct. However, an alternative explanation is that participants may be unwilling to admit to a researcher that they may have a condition that they have just been told does not exist; this possibility is supported by the fact that the manipulation check regarding the belief that foods can be addictive indicated

only neutrality rather than disagreement in the "myth" group, consistent with demand characteristics or embarrassment as much as with success of the manipulation.

Whether SPFA is indeed simply an attribution response to dysregulated eating behaviors or a construct that is related to YFAS-diagnosed food addiction, it is likely to be characterized by a range of cognitions and behaviors associated with disordered eating that distinguish it from the experience of individuals who do not self-classify as food addicted. Nevertheless, we would expect these cognitions and behaviors to be less severe than those reported by YFAS+ individuals, who, by definition, experience clinically significant distress or impairment associated with their condition.

Eating cognitions and behaviors

In terms of eating behavior, self-perceived food addicts are likely to report more dietary restraint, less reliance on internal signals to trigger eating, more eating in response to affective or situational cues, and lower eating self-efficacy, that is, low perceived self-control around food (Berman, 2006; Lowe, 1993; Tylka, 2006), compared with individuals who do not consider themselves addicted to food. In contrast, SPFA is unlikely to be characterized by clinically significant eating pathology, and this is likely to be a key distinguishing factor between SPFA and YFAS-diagnosed "food addiction".

Body image

Elevated weight and shape concerns have been reported in community and clinical samples of adults and adolescents who receive a YFAS+ diagnosis compared with those who do not meet the diagnostic criteria for "food addiction" (YFAS-; Gearhardt, White, Masheb, & Grilo, 2013; Gearhardt, Boswell, & White, 2014; Meule et al., 2015), although body image has received less attention than other constructs as a factor associated with food addiction. Nevertheless, the role of body dissatisfaction in the development and maintenance of eating pathology is well established (Stice, 2002), and we would expect self-perceived food addicts to be more concerned about their appearance, have worse body image, and greater weight concern than "non-addicts".

Weight stigma

Endorsement of negative stereotypes about higher-weight individuals and weight-related self-stigma have been consistently linked to disordered eating behaviors (Durso & Latner, 2008; Puhl, Moss-Racusin, & Schwartz, 2007; Schvey, Roberto, & White, 2013), including YFAS-diagnosed "food addiction" (Burmeister et al., 2013). Thus, we would expect elevated scores on measures of anti-fat attitudes and weight self-stigma in SPFA+ individuals compared with those who do not self-classify as addicted to food.

Validation seeking

Self-worth that is contingent on external factors, such as appearance or the need for others' approval, has been linked to a range of disordered eating behaviours

(Clabaugh, Karpinski, & Griffin, 2008; Crocker, 2002). More specifically, high need for approval and fear of social rejection is associated with greater dietary restraint, body shape, eating, and weight concerns, emotional eating, bulimic symptoms, and global eating pathology in both community and eating-disordered populations (Hayaki, Friedman, Whisman, Delinsky, & Brownell, 2003; Teal Pedlow & Niemeier, 2013). Indeed, mediation analyses suggest that need for the approval of others may be an important predictor of body shape dissatisfaction and disordered eating in non-clinical samples (Teal Pedlow & Niemeier, 2013); however, this construct has yet to be explored in the context of "food addiction".

Study 1a

The purpose of the present research was to explore the prevalence and characterization of self-perceived food addiction, and to determine whether SPFA+ individuals can be identified by a level of the cognitions and behaviors generally associated with problem eating that distinguish it from both clinical "food addiction" (YFAS+) and from the experiences of individuals who do not self-classify as food addicts (non-food addicts, NFA). Note, in the present study, we assign the status SPFA+ to individuals who *do* self-classify as food addicts, but who do not experience clinically significant distress or impairment and who therefore *do not* receive a YFAS+ diagnosis. We proffered the following hypotheses:

H1: SPFA+ would be significantly more prevalent than YFAS+ "food addiction".

H2: Compared with NFA individuals, SPFA+ individuals would report more dietary restraint, eat less in response to internal hunger cues, experience lower eating self-efficacy, and more disordered eating behaviour overall, greater investment in appearance-based domains of self-worth, poorer body image, higher anti-fat attitudes and weight-related self-stigma, and greater need for external validation. However, we also predicted that scores on these measures would indicate less severity than found in YFAS+ participants.

H3: In terms of discrimination between the groups, we predicted that perceived self-control around food would be the main discriminating factor between SPFA+ and NFA participants, whereas clinically significant eating pathology would be the main discriminating factor between YFAS+ and SPFA+ participants, being present in the former but not the latter.

Methods

Participants

Data were collected from 658 psychology students at the University of Birmingham, who participated in an online study entitled "Easy online eating survey" for course credit between January 2013 and December 2014. The majority of the sample identified as female (90%; 9% male, 1% declined to answer), and White (76%; 3% Asian – Chinese, 6% Asian – Indian, 3% Asian – Pakistani, 2% Asian – Other, 2% Black – African, 1% Black – Caribbean, 1% White/Black Caribbean, 2% White/Asian, 1% Other – Mixed, 1% Other, and 2% declined to answer). The mean age of the sample was 18.7 years (SD 1.3, range

17–36). BMI was calculated from self-reported heights and weights, with a mean value of 22.0 kg/m^2 (SD 3.9, range 14.0–44.5; 10.2% underweight, 55.6% normal weight, 9.9% overweight, and 2.7% obese; data were not available for the remaining 21.6% of the sample). The study was approved by the University of Birmingham Ethical Review Committee, and informed consent was obtained from all participants.

Measures

Food Addiction

Participants were initially asked a simple yes/no question: "Do you feel that you are addicted to some foods?" Participants then completed the Yale Food Addiction Scale (YFAS), a 25-item self-report scale measuring addictive behaviours with respect to certain foods (Gearhardt et al., 2009). The YFAS can produce a continuous symptom count score as well as a clinical diagnosis of food addiction. In line with the DSM-IV-TR scoring criteria for substance dependence, upon which the YFAS was based, participants must endorse a minimum of three of the seven symptoms plus experience clinically significant distress or impairment in order to receive a positive diagnosis. Kuder-Richardson's α was .82 in this sample. Participants who received a positive "diagnosis" on the YFAS were classified as YFAS+, independent of their response to the question of self-perceived food addiction. Those who did not receive a YFAS+ "diagnosis" but who nevertheless considered themselves addicted to foods were classified SPFA+. The remainder, who were both YFAS- and SPFA- , were classified NFA.

Eating Behavior

Current dieting status was assessed with a single item asking participants to self-designate as either currently dieting to lose weight, currently dieting or watching food intake so as not to gain weight, or not currently dieting (Massey & Hill, 2012).

Dietary restraint was assessed using the 10-item Restraint Scale (RS) (Herman & Polivy, 1980). The scale is made up of two subscales: concern for dieting and weight fluctuation. The scale appears to capture a history of chronic dieting, and does not necessarily represent current calorie restriction (Lowe, 1993). Item scoring varies but items are summed to create a total scale score, with a possible range of 0 to 35. Higher scores are indicative of more restrained eating. Cronbach's α was .84 in the present sample.

Perceived self-control over eating was assessed using the Eating Self-Efficacy Scale (ESES) (Glynn & Ruderman, 1986). The ESES is a 25-item measure that assesses perceived ability to control eating under a range of situational and emotional conditions. Responses are graded on a 7-point Likert scale ranging from 1 (No difficulty controlling eating) to 7 (Most difficulty controlling eating), and items are averaged to provide a total scale score. Higher scores represent more perceived difficulty in controlling eating, and are therefore indicative of *reduced* eating self-efficacy. The ESES has previously been shown to correlate with YFAS symptom count (Burmeister et al., 2013). Cronbach's α was .91 in the present sample.

Eating in response to non-physiological cues was assessed using the Intuitive Eating Scale (IES) (Tylka, 2006), a 21-item questionnaire that measures the extent to which an individual responds to internal rather external eating cues. Participants record to what extent they disagree with a range of statements such as "I stop eating when I feel full (not overstuffed)" and "I trust my body to tell me what to eat", using a 5-point Likert scale ranging from 1 (Strongly disagree) to 5 (Strongly agree), and items averaged to provide a total scale score. Higher scores indicate more intuitive eating, therefore, lower scores are equated with more non-physiological eating. Intuitive eating is negatively associated with chronic dieting, general eating pathology, unhealthy weight control practices, binge eating frequency, and food preoccupation (Denny, Loth, Eisenberg, & Neumark-Sztainer, 2013; Madden, Leong, Gray, Horwath, Jeffrey, Epstein, et al., 2012; Tylka, Calogero, & Daníelsdóttir, 2015). Cronbach's α was .82 in the present sample.

Finally, general eating pathology was assessed using the Eating Attitudes Test (EAT-26) (Garner, Olmsted, Bohr, & Garfinkle, 1982), a widely used 26-item measure assessing the extent of symptoms and concerns characteristic of eating disorders. Possible scores can range from 0 to 78, and scores of 20 or greater suggest increased risk of clinical eating disorders (Anderson, De Young, & Walker, 2009). Scores on the EAT-26 are highly correlated with both a YFAS diagnosis and the symptom count (Gearhardt et al., 2009). Cronbach's α was .89 in the present sample.

Body Image

Body image was assessed using four subscales of the Multidimensional Body Self-Relations Questionnaire – Appearance Scales (MBSRQ-AS; Brown, Cash, & Mikulka, 1990; Cash, 2000). The Appearance Orientation subscale (Cronbach's α = .89) assesses how important appearance is to the participant and includes 12 items, for example, "It is important that I always look good," and "I check my appearance in a mirror whenever I can." The Appearance Evaluation subscale (α = .90) includes seven items, such as "I like my looks just the way they are," and "Most people would consider me good-looking." The Overweight Preoccupation subscale (α = .83) includes four items, e.g. "I constantly worry about being or becoming fat." The Self-Classified Weight subscale (α = .88) is made up of two items where respondents classify their body weight on a scale from "Very Underweight" to "Very Overweight", and also how they think others would classify them. All items are scored 1 to 5 and mean scores calculated for each subscale.

334 *Weight Stigma*

335 Explicit weight stigma was tested using two subscales from the Anti-Fat
336 Attitudes Questionnaire-Revised (AFAQ-R) (Quinn & Crocker, 1999). The Dislike
337 subscale (α = .92) comprises 10 items, such as, "I have a hard time taking fat
338 people too seriously," and "I have an immediate negative reaction when I meet a
339 fat person." The Willpower subscale (α = .90) assesses beliefs about the
340 controllability of body weight, and includes eight items, such as, "Fat people can
341 lose weight if they really want to," and "The medical problems that overweight
342 people have are their own fault." Both subscale are scored on a 10-point Likert
343 scale from 0 (Very strongly disagree) to 9 (Very strongly agree), and mean scores
344 are calculated for each subscale. Higher scores indicate more negative attitudes.
345 Scores on the Dislike subscale have previously been linked with more addictive-
346 like eating behaviors in a treatment-seeking weight-loss population, although no
347 association was found for weight-controllability beliefs (Burmeister et al., 2013).
348
349 Weight self-stigma was assessed using the 12-item Weight Self-Stigma
350 Questionnaire (WSSQ; Lillis, Luoma, Levin, & Hayes, 2010). Most of the previous
351 work on weight self-stigma and eating behavior has utilized a global measure of
352 internalized weight stigma; in contrast, the WSSQ comprises two subscales that
353 distinguish between self-devaluation and fear of stigma from others. Some
354 evidence suggests that these aspects of weight self-stigma may be differentially
355 related to eating behavior and psychological wellbeing (Farhangi, Emam-
356 Alizadeh, Hamedi, & Jahangiry, 2016; Lillis et al., 2010). The Self-Devaluation
357 subscale (α = .93) assesses shame and self-blame with respect to body weight,
358 and includes items such as, "I feel guilty because of my weight problems," and "I

359 became overweight because I'm a weak person." The Fear of Enacted Stigma
360 subscale (α = .85) assesses worries about being stigmatized by others because of
361 weight, for example, "Others are ashamed to be around me because of my weight."
362 Items are scored on a five-point Likert scale from 1 (Completely Disagree) to 5
363 (Completely Agree). Sum scores were calculated with a possible range from 0 to
364 30 for each subscale. Higher scores are indicative of increased self-stigma.
365 As some of the items on this scale are mainly applicable to participants who
366 believe they have a weight problem, this section did not initially have a forced
367 response requirement. However, an interim quality check after the first week of
368 data collection identified a large amount of missing data on this instrument. Of
369 the 157 participants completing the survey in the first week, 132 (84%) did not
370 complete this measure. Given the prevalence of weight dissatisfaction even
371 among lean individuals, it appeared that many students were skipping these
372 questions simply because they could, and a decision was made to make this
373 section non-optional. Individuals who did not consider themselves to have a
374 weight problem could simply disagree with the relevant statements. See below
375 for details of missing data handling.
376

Validation Seeking

The extent to which participants' behavior was driven by the need for external validation was assessed using the 18-item Validation-Seeking subscale of the Goal Orientation Inventory (Dykman, 1998). This scale assesses personality in terms of goal motivation, specifically, the extent to which an individual is driven by the need to receive external validation of their self-worth. A typical item is, "Whether it be in sports, social interactions, or job/school activities, I feel like I'm still trying to prove that I'm a worthwhile, competent, or likeable person." Items are scored on a seven-point Likert scale ranging from 1 (Strongly disagree) to 7 (Strongly agree), with a sum score calculated for the scale. Scores can range from 18 to 126, with higher scores indicating greater need for external validation. Cronbach's α was .97 in the present sample.

Demographics and anthropometrics

Finally, participants were asked to provide age, gender, and ethnicity, and to report height and weight measurements, which were used to calculate BMI. The option to decline to answer any of these questions was provided. As with the Weight Self Stigma Questionnaire, 84% of the first 157 participants chose not to provide height and/or weight information. Thus, these two items were made non-optional at the same times as the WSSQ. However, responses were entered into a text box, so students were able to type, "I don't know", or "I'd rather not answer", etc., if they so wished, and a small number did so.

Handling of missing values

In order to determine the impact of missing data for weight self-stigma and BMI, the relationship between these measures and key study outcome variables was explored for the participants completing the study before and after these questions became mandatory. There were no differences in proportion of respondents classified in each food addiction category between the two groups. Additionally, there were no statistically significant differences in continuous study variables between the two groups. Missing values analysis confirmed that the data were missing completely at random (Little's MCAR test χ^2 (57) = 28.2, p = 1.0). Thus, missing data on these variables were imputed using the expectation maximization (EM) method. The EM method is an iterative procedure that estimates the means, covariance matrix, and correlation of scale variables with missing values based on the likelihood under the distribution of the variable – in this case, a normal distribution, and which is suitable for data that are missing completely at random. Each iteration is conducted in two steps: first, an E step uses log-likelihood to produce a conditional expectation of the missing data given the observed values and current estimate of the parameters, e.g. correlations; the second M step performs full information maximum likelihood estimation as though the missing data had been filled in, to compute parameters that maximise the expected log-likelihood from the E step. These parameter estimates are used in the subsequent E step, and the process repeats until convergence is achieved. Missing values on demographic variables (gender and ethnicity) were not imputed and were deleted pairwise; consequently, sample size varied slightly by analysis.

Statistical analysis

Gender differences were tested using independent *t*-tests and ethnicity differences using χ^2 tests. Given the small sample sizes for most of the non-White ethnic groups, ethnicity was dichotomized into White and Other Ethnicities for subsequent analyses, unless otherwise stated. Statistical significance was indicated by p values < .05, unless otherwise stated.

Descriptive statistics are provided for prevalence of each food addiction category (H1). Inter-group differences by food addiction status were assessed using χ^2 tests for categorical outcomes and univariate ANOVA for continuous outcomes with Welch's robust F as the omnibus test of significance. In line with our hypothesis that SPFA+ would be characterized by scores between those of YFAS+ and NFA (H1 and H2), significant ANOVAs were probed with planned contrasts, first comparing YFAS+ with SPFA+, and then SPFA+ with NFA. As these contrasts are non-orthogonal, a conservative alpha criterion was set at .01. Zero-order bivariate correlations were calculated between YFAS symptom count and all study outcomes. To explore the predictors hypothesized to differentiate between those who did and did not consider themselves addicted to food (SPFA+ and NFA) and between self-perceived and YFAS-diagnosed food addicts (SPFA+ and YFAS+) (H3), multinomial logistic regression was conducted, using SPFA+ as the reference group.

Analyses in all studies were conducted using SPSS for Mac, Version 23.

Results

Preliminary analyses

Men and women did not differ on YFAS symptom count, food addiction category, dieting status, eating self-efficacy, eating attitudes, appearance evaluation and orientation, or validation-seeking goal orientation (all $p > .05$); however, women scored significantly higher than men on dietary restraint scale, internalized weight stigma, overweight preoccupation, and self-classified weight, and lower on intuitive eating, and anti-fat attitudes. Additionally, although YFAS+ classification prevalence did not differ by ethnicity, Whites were less likely to self-classify as food addicted than other ethnicities (39.9% versus 55.7%, respectively; $\chi^2_{(2)} = 12.8$, $p = .002$[2]. Sex and ethnicity were therefore included as covariates in subsequent regression analyses. Food addiction status did not differ by age.

H1: Prevalence and symptom endorsement in YFAS+, SPFA+, and NFA

As predicted, SPFA was more prevalent than "food addiction" based on YFAS criteria. Over half of the participants (342/658) considered themselves to be addicted to some foods. Of these, however, only 56 (16%; 8.5% of total sample) met the YFAS diagnostic criteria. Thus, 286 individuals (43.5%) believed

[2] This effect was largely driven by participants identifying as of South Asian ethnicity (i.e., Asian – Indian or Asian – Pakistani; n = 64; 64.1% SPFA+). Other ethnicities had prevalence rates between those identifying as White and South Asian. No differences in any other measure of eating behaviour, body image, weight stigma, or BMI were found between participants of South Asian and White ethnicity. Exploratory analyses were conducted using an alternative coding scheme with three groups: White, South Asian, and Other Ethnicities. This did not alter findings; thus we report results using dichotomous coding (1 = White, 0 = Other Ethnicities) for simplicity.

themselves to be addicted to foods but did not receive a YFAS+ diagnosis and were designated SPFA+. The remaining 316 participants (48.0%) were categorized as NFA.

Interestingly, thirteen of the fifty-six individuals meeting the criteria for YFAS+ diagnosis did not consider themselves to be addicted to any foods. Independent *t*-tests and χ^2 tests indicated no significant differences between these two sub-types of YFAS+ participants on study outcomes, with the exception of one YFAS symptom and eating self-efficacy. Only 23.1% of YFAS+ participants who did not consider themselves addicted to food endorsed the symptom "Substance taken in larger amount and for longer period than intended", compared with 60.5% who self-classified as food addicted ($\chi^2_{(1)} = 5.6$, $p = .027$, OR = 0.2). Additionally, those who did not self-classify as addicted had a mean ESES score of 3.5, compared with 4.3 for those who also rated themselves as food addicts ($t_{(54)} = 2.8$, $p = .008$, $d = 0.76$). Given the relatively minor differences between the two subtypes, and the small size of the YFAS+ category, all data were retained and grouped together into a single YFAS+ category. However, all subsequent analyses were conducted with and without these cases, and any differences reported.

Mean YFAS symptom count differed significantly between the three food addiction groups (Welch's $F_{(2,144)} = 183.6$, $p < .001$, estimated $\omega^2 = .36$), with higher symptom endorsement in the YFAS+ than in the SPFA+ group, and in the SPFA+ than the NFA group (Table 1; all pairwise comparisons $p < .001$). Nevertheless, 40% of SPFA+ participants endorsed three or more symptoms, the minimum required for a diagnosis of substance dependence, but because these

individuals reported no clinically significant distress or impairment as a result of their symptoms, they did not receive a YFAS+ diagnosis. Consistent with previous findings, the symptom "Persistent desire or repeated unsuccessful attempts to quit" was endorsed highly by all three groups.

Table 1. YFAS symptom endorsement by food addiction status

	YFAS+ (n=56)*	SPFA+ (n=286)	NFA (n=316)	Total (n=658)
Mean symptom count	4.8	2.4	1.3	2.1
Range	3 – 7	0 – 7	0 – 7	
% endorsing 3 or more symptoms	100	40	9	30
% endorsing each symptom*				
Taken in larger amounts than intended	52[a]	17[b]	6[b]	14
Persistent desire/unsuccessful attempts to quit	98[a]	95[a]	87[b]	91
Effort to obtain/use	68[a]	28[b]	8[c]	22
Important activities reduced	68[a]	22[b]	8[c]	19
Continued use despite negative consequences	63[a]	23[b]	8[c]	19
Tolerance	57[a]	35[b]	9[c]	25
Withdrawal	71[a]	19[b]	4[c]	16

[a,b,c] For each symptom, groups that do not share a superscript differ at the .05 level. Other differences were non-significant.
Abbreviations: YFAS+, positive diagnosis on Yale Food Addiction Scale; SPFA+, self-perceived food addiction without positive diagnosis on the YFAS; NFA, no food addiction.
* With YFAS minor subtype (individuals who received a YFAS+ diagnosis but who did not consider themselves to be addicted to food) excluded, N = 43; Endorsement for each symptom: 61%, 98%, 67%, 65%, 65%, 58%, 79%.

H2: Characteristics of SPFA+ versus YFAS+ and NFA

Participant characteristics by "food addiction" classification are shown in Table 2. With the exception of weight controllability beliefs, which did not differ across the three groups, the hypothesized gradient was apparent for all measures, with the scores in the SPFA+ group falling between those in the YFAS+ and NFA groups. Additionally, although mean BMI was not significantly different between

the three groups, the three food addiction groups were significantly different on all measures of eating behaviour, internalized weight stigma, appearance evaluation, overweight preoccupation, and validation-seeking behaviour. The YFAS+ participants had a mean score on the EAT-26 slightly above the cut-off of 20, suggesting clinically relevant eating pathology. Additionally, YFAS+ participants were significantly more likely to be weight-loss dieting than the other two groups (OR 3.9, 95% CI 2.2 to 6.9, $p < .001$), and this relationship held when controlling for BMI. YFAS symptom count was significantly correlated with all outcomes measured, with the exception of weight-controllability beliefs.

Table 2. Group differences by food addiction status and correlation with YFAS symptom count

	Possible range	YFAS+ (n=56)	SPFA+ (n=286)	No FA (n=316)	Test Statistic†	*p*	Effect size†	*r*‡
BMI		23.2 (5.5)	22.1 (3.5)	21.7 (3.2)	2.8	.06	.01	.15***
Eating behavior								
RS	0–35	18.7 (6.5)[a]	12.7 (5.7)[b]	10.7 (5.8)[c]	39.9	< .001	.11	.42***
ESES	1–7	4.1 (1.0)[a]	3.4 (1.1)[b]	2.6 (1.1)[c]	70.1	< .001	.17	.55***
IES	1–5	2.6 (0.5)[a]	3.1 (0.5)[b]	3.4 (0.5)[c]	76.2	< .001	.19	-.47***
EAT-26	0–78	22.5 (14.7)[a]	10.4 (10.0)[b]	8.6 (10.0)[b]	23.4	< .001	.06	.35**
Dieting status§					26.4	< .001	3.9§	-.20***
WL Dieting		41.1%[a]	16.8%[b]	13.9%[b]				
Watching		26.8%	32.2%	29.4%				
Not Dieting		32.1%[a]	51.0%[b]	56.6%[b]				
Body Image								
Appearance orientation	1–5	3.8 (0.6)[a]	3.7 (0.6)[a]	3.5 (0.6)[b]	6.3	.002	.02	.10*
Appearance evaluation	1–5	2.3 (0.9)[a]	2.9 (0.8)[b]	3.1 (0.8)[c]	26.4	< .001	.07	-.33***
Overweight preoccupation	1–5	3.5 (0.9)[a]	2.8 (0.9)[b]	2.6 (1.0)[c]	27.5	< .001	.07	.32***
Self-classified weight	1–5	3.5 (0.9)[a]	3.2 (0.7)[a]	3.0 (0.6)[b]	10.3	< .001	.03	.24***
Weight stigma								
WSSQ								
WSSQ-Self	6–30	19.4 (5.7)[a]	13.5 (6.0)[b]	11.0 (5.3)[c]	56.9	<.001	.15	.45***
WSSQ-Fear	6–30	17.0 (5.7)[a]	12.9 (5.0)[b]	10.7 (4.2)[c]	40.3	<.001	.11	.38***
AFA Dislike	0–9	2.4 (1.8)[a]	2.0 (1.7)[a]	1.7 (1.3)[b]	6.4	.002	.02	.14***
AFA Willpower	0–9	4.9 (1.7)	5.1 (1.8)	5.0 (1.7)	0.4	.65	.00	.01
Other								
Validation seeking	18–126	84.8 (20.5)[a]	71.9 (23.3)[b]	62.1 (26.0)[c]	29.6	< .001	.08	.30***

Unless otherwise stated, data are means (standard deviation).
[a,b,c] Planned contrasts for continuous variables: *consecutive* food addiction categories that do not share a superscript differ at .01 level.
* $p < .05$, ** $p < .01$, $p < .001$

† Test statistics are Welch's *F* for continuous variables and χ^2 for categorical variables. Effect sizes are ω^2 for ANOVA and odds ratios for χ^2 tests.
§All pairwise comparisons calculated; groups not sharing a superscript differ at .05 level. Effect size is odds ratio for YFAS+ currently weight-loss dieting versus other groups currently weight-loss dieting. Dieting status coded 1= Weight-loss dieting, 2 = Watching, 3 = Not dieting
Abbreviations: YFAS+, positive diagnosis on Yale Food Addiction Scale; SPFA+, self-perceived food addiction without positive diagnosis on YFAS; NFA, no food addiction; App, Appearance; BMI, Body Mass Index; RS, Restraint Scale; ESES, Eating Self-Efficacy Scale; IES, Intuitive Eating Scale; EAT-26, Eating Attitudes Test-26; OW Preocc, Overweight preoccupation; SCWt, Self-classified weight; WSSQ, Weight Self-Stigma Questionnaire; WSSQ-Self, Self-Devaluation subscale; WSSQ-Fear, Fear of Enacted Stigma subscale; AFA, Anti-fat Attitudes Questionnaire; WL, Weight loss.

H3: Unique predictors of SPFA status

In order to identify whether SPFA+ could be distinguished from YFAS+ and NFA based on specific characteristics, multinomial logistic regression analysis was conducted with food addiction status as the outcome and SPFA+ as the reference category. We included the following predictors in the regression model: dietary restraint (RS) and overweight preoccupation were included based on their strong association with disordered eating behaviors; eating self-efficacy (ESES) was included as we expected perceived lack of self-control around food to be a major discriminating factor between SPFA+ and NFA, eating pathology (EAT-26) was included as it was hypothesized to distinguish between the YFAS+ and SPFA+ groups; additionally, we included both subscales of the WSSQ. Weight self-stigma is emerging as an important predictor of disordered eating behavior, but remains relatively unexplored in the context of food addiction, and the distinct roles of self-devaluation and fear of stigma from others have yet to be elucidated. Ethnicity and sex were entered as covariates.

Self-perceived food addiction was set as the reference category; thus predictors are tested for their ability to discriminate between, first, SPFA+ and YFAS+, and second, SPFA+ and NFA. The hypothesized model was a good fit for the data ($\chi^2_{(16)} = 219.9$, $p < .001$, Nagelkerke $R^2 = .34$), and overall percentage of correct classification to food addiction groups was 63.2%. However, several of the hypothesized predictors did not significantly contribute to the model, and a number of reduced models were explored by sequential removal of predictors with non-significant likelihood ratio tests. Dietary restraint, overweight

preoccupation, and gender did not contribute to discrimination between SPFA+ and either of the other two groups. Substituting current dieting status for dietary restraint did not change these findings. Deletion of these variables resulted in a more parsimonious model with no significant reduction in model fit ($\chi^2_{(10)}$ = 208.9, $p < .001$, Nagelkerke $R^2 = .33$), or predictive power. The final model is displayed in Table 3. The model correctly classified 20.0% of YFAS+, 59.9% of SPFA+ and 73.0% of NFA participants, with overall accuracy of 62.8%.

As predicted, eating pathology, as measured by the EAT-26, successfully distinguished between YFAS+ and SPFA+, but did not distinguish between SPFA+ and NFA. The EAT-26 has a possible range of 0–78; thus, a 5-point higher score on the EAT-26 was associated with a 30% higher likelihood of being YFAS+ compared with SPFA+. Eating self-efficacy was a significant predictor for both outcomes, but had a bigger role in differentiating between SPFA+ and NFA: for every 1-point increase in ESES score, an individual would be twice as likely to be SPFA+ as NFA. Higher weight-related self-stigma increased the likelihood of being YFAS+ compared with SPFA+, whereas fear of being stigmatized by others was associated with an increased likelihood of being SPFA+ compared with NFA, in each case, a 50–60% increase with each 5-point rise in the WSSQ subscales, which are scored 6 to 30. Ethnicity distinguished between SPFA+ and NFA, with White participants nearly three times as likely to be NFA rather than SPFA+, but did not distinguish between YFAS+ and SPFA+ status.

Table 3. Multinomial logistic regression comparing predictors of SPFA+ with YFAS+ and non-food addicts

	B	SE	Sig.	OR	95% CI for OR	
					Lower	Upper
YFAS vs SPFA						
Intercept	-5.33	0.80	< .001			
EAT-26	0.06	0.01	< .001	1.06	1.03	1.09
ESES	0.36	0.16	0.03	1.43	1.04	1.97
WSSQ-Self	0.12	0.05	0.01	1.12	1.03	1.23
WSSQ-Fear	-0.03	0.05	0.55	0.97	0.88	1.07
Ethnicity	0.08	0.38	0.83	1.09	0.51	2.27
SPFA vs NFA						
Intercept	-3.10	0.35	< .001			
EAT-26	0.00	0.01	0.87	1.00	0.98	1.02
ESES	0.70	0.10	< .001	2.00	1.67	2.44
WSSQ-Self	-0.04	0.03	0.15	0.96	0.91	1.01
WSSQ-Fear	0.10	0.04	0.01	1.10	1.03	1.18
Ethnicity	-1.00	0.22	< .001	0.37	0.24	0.57

N=648
Abbreviations: YFAS+, Positive "diagnosis" on Yale Food Addiction Scale; SPFA+, self-perceived food addict only; NFA, no food addiction; EAT-26, Eating Attitudes Test-26 (range 0–78); ESES, Eating Self-Efficacy Scale (range 1–7); WSSQ, Weight Self-Stigma Questionnaire; Self-Devaluation and Fear of Enacted Stigma subscales (both range 6–30);
Ethnicity scored 1 = White, 0 = Other ethnicities.

Interim Discussion

All three hypotheses were supported. First, as predicted, the prevalence of SPFA was high, with exactly half of the 658 participants considering themselves to be addicted to some foods. Only one in eight of these also received a positive "diagnosis" on the YFAS, giving a YFAS+ rate of 8.5% for the whole sample, consistent with findings from other studies in non-clinical populations (Meule, 2011). Secondly, despite very similar BMIs across the three food groups, all of which fell within the "normal weight" range, a clear continuum existed for all measures of eating behavior, body image, weight self-stigma, and validation seeking, with SPFA+ individuals having scores intermediate to the YFAS+ and NFA groups. However, only small differences in anti-fat attitudes were seen

602 across the three groups, and negative attitudes toward higher-weight individuals
603 were low overall. Finally, as expected, SPFA+ did not display the same degree of
604 eating pathology, as measured by the EAT-26, as did participants classified as
605 YFAS+, and the two groups could be distinguished based on this measure. Also in
606 line with hypotheses, self-perceived difficulty controlling eating significantly
607 discriminated between SPFA+ and NFA; however, eating self-efficacy also
608 significantly discriminated between SPFA+ and YFAS+, indicating that scores in
609 the YFAS+ group were sufficiently higher than those in the SPFA+ group to make
610 this possible, even when controlling for eating pathology. Interestingly, weight-
611 related self-devaluation significantly discriminated between YFAS+ and SPFA+
612 but not SPFA+ and NFA, whereas the opposite was true for fear of enacted
613 weight stigma. The divergent roles of self-devaluation and fear of enacted stigma
614 could be indicative of a multi-staged effect of weight stigma, with fear of stigma
615 being an early driver of disordered eating behavior. The process by which weight
616 stigma develops in an individual has yet to be explored; however, evidence from
617 a study of mental illness stigma suggests that anticipation of stigma and
618 discrimination from others is a predictor of self-devaluation (Quinn, Williams, &
619 Weisz, 2015).
620
621 However, while the model accurately predicted over half of SPFA+ cases, the
622 accuracy in classifying YFAS+ status was relatively low, correctly identifying only
623 one in five participants with a YFAS+ "diagnosis", suggesting that other
624 constructs may be more important in differentiating between these two
625 "conditions".
626

627 Within the SPFA+ group – that is, those without a YFAS+ diagnosis – 40% of
628 participants endorsed 3 or more YFAS symptoms, compared with only 9% in the
629 NFA group, supporting the concept that SPFA does involve some addictive-like
630 behavior and may be a milder form of YFAS+. A significant proportion of
631 participants in studies using the YFAS endorse three or more symptoms in the
632 absence of a positive diagnosis, with frequencies between 33% and 57%
633 reported (Eichen et al., 2013; Gearhardt, White, Masheb, Morgan, Crosby, & Grilo,
634 2012; Gearhardt, Yokum, Orr, Stice, Corbin, & Brownell, 2011). Three symptoms
635 is the minimum requirement for a diagnosis of substance dependence according
636 to the DSM-IV-TR criteria on which the YFAS was based, but in the absence of
637 clinically significant distress or impairment resulting from their symptoms, a
638 positive diagnosis is not made. In a previous study, Ruddock, Field, & Hardman
639 (in press) confirmed that self-perceived food addicts endorse significantly more
640 food addiction "symptoms" as defined by the YFAS than do those who do not
641 consider themselves addicts (mean 3.2 versus 1.5) but that over 85% do not
642 experience clinically significant distress.
643
644 It is not yet known whether individuals who present with elevated YFAS
645 symptom count but who do not endorse the items relating to clinically significant
646 distress are at an "intermediate" stage that might subsequently progress to a
647 YFAS+ diagnosis. Little attention has yet been paid to the developmental
648 progression of clinically significant "food addiction"; however, Ziauddeen and
649 Fletcher (2013), proposed the existence of a "food abuse syndrome",
650 representing a potential early stage in the natural history of "food addiction". If
651 SPFA represents such an intermediate stage on the developmental pathway,

individuals who self-classify as food addicted may be at increased risk of developing clinically significant distress or impairment and qualifying for a YFAS+ diagnosis and its associated psychopathology.

Study 1b

Study 1b involved the collection of follow-up data from the sample used in Study 1a. This allowed us to examine the stability of food addiction status over time and to explore whether SPFA+ at baseline was predictive of worsening eating pathology or body image issues at follow-up. A small number of longitudinal studies have documented the progression and remission of disordered eating, sub-threshold, and threshold eating disorders in community samples. Across all eating disorder diagnoses, diagnostic stability is generally low; reported figures for remission rates for BED and sub-threshold BED, specifically, range from 35% to 100% within one to five years (Allen, Byrne, Oddy, & Crosby, 2013; Goldschmidt, Wall, Zhang, Loth, & Neumark-Sztainer, 2016; Stice, Marti, & Rohde, 2013). The majority (85–90%) of participants without disordered eating at baseline appear to remain free of problematic eating behaviors over medium-term follow up (Goldschmidt et al., 2016). Cohort studies looking at the trajectory of disordered eating behavior in community samples report between 3% and 12% of participants follow a symptom-escalation trajectory across a range of disordered eating behaviors (Fairweather-Schmidt & Wade, 2016). Thus, we made the following hypotheses:

H4: Both YFAS+ and SPFA+ would be relatively unstable, with at least half of participants in each category remitting to a less severe status at follow-up. In

contrast, NFA would be a highly stable classification. Approximately 5–10% of participants classified as SPFA+ at baseline would "progress" to a YFAS+ diagnosis at follow-up.

H5: SPFA+ at baseline would be predictive of worsening scores on measures of disordered eating, body image, and weight self-stigma at follow-up.

Method

Participants

A subset of participants from Study 1a was invited to participate in a follow-up study between October 2013 and December 2014. Due to the nature of the university's research participation scheme, which is a course requisite for only 1st and 2nd year undergraduates, and the timing of survey availability, only 308 students who completed Study 1a were able to participate in the follow-up study, and all did so. Three students filled out the follow-up questionnaire less than seven days after completing the baseline questionnaire and their data were excluded from the analyses, giving a final follow-up sample of 305 (92% female, 80% Caucasian, age 19.6 (1.5) years). After deletion of implausible values, mean BMI was 21.9 (3.7) kg/m^2, with 11.1% of the sample categorised as underweight, 70.5% normal weight, 12.1% overweight, and 3.9% obese; 2.6% missing.

Measures

Measures collected in Study 1b were the same as in Study 1a, with two exceptions. As explicit anti-fat attitudes were generally low in Study 1a, with little difference observed between food addiction groups, the AFAQ was omitted.

Additionally, the Goal Orientation Inventory was omitted as it was not critical to the hypotheses being explored in this follow-up study. All scales had good internal reliability, with Cronbach's alphas ranging from .76 to .97.

Statistical analysis

Agreement of food addiction status at baseline and follow-up (H4) was tested using Cohen's κ. Following Landis and Koch (1977), a κ value between .21 and .40 was considered fair, .41 and .60 moderate, .61 and .80 substantial, and .81 to 1 "almost perfect". Additionally, Goodman and Kruskal's λ was used as a directional measure of agreement. That is, λ measures reduction in error in predictive accuracy for follow-up classification when baseline classification is taken into account. A value of 1 would indicate that baseline classification perfectly predicts follow-up classification, whereas a value of 0 would suggest no predictive value (Field, 2013). Analysis of study outcomes by food addiction status was conducted as in Study 1a. Repeated measures *t*-tests were conducted to ascertain whether SPFA+ status at baseline was predictive of significantly worsening scores on measures of disordered eating, body image, or weight stigma (H5).

Results

Preliminary analyses

Length of follow-up ranged from 155 to 474 days (mean 280, SD 30 days), and did not differ by food addiction status (Kruskall-Wallis $H_{(2)} = 4.03$, $p = .13$). At

723 follow-up, 7.5% of participants received a positive YFAS diagnosis, 34.4% were
724 self-perceived food addicts in the absence of a YFAS+ diagnosis, and 58.8% were
725 classed as non-addicts. No differences from baseline were observed in the
726 pattern or magnitude of outcome variables between the food addiction groups
727 (data not shown), with one exception: there were no longer any differences
728 between the three groups on appearance orientation (means 3.6, 3.6, and 3.5,
729 respectively; Welch's $F_{(2,58)} = 0.9$, $p = .40$).
730

731 *H4: Stability of food addiction status*
732 Food addiction classification at baseline (T1) and follow-up (T2) is shown in
733 Table 4. Overall, food addiction status was moderately stable over the follow-up
734 period ($\kappa = .474$, $p < .001$), although YFAS+ status was less stable than SPFA+ or
735 NFA. Only 42% of YFAS+ respondents at T1 retained the same classification at T2,
736 compared with 59% for SPFA+ and 84% for NFA. Looking at the predictive
737 power of baseline food addiction status, prediction accuracy for classification at
738 follow-up was significantly improved when using baseline group membership (λ
739 = .305, p < .001); however, baseline SPFA+ status was not a significant predictor
740 of YFAS+ status at follow-up ($Z = 0.2$, *ns*).
741

742 **Table 4. Comparison of food addiction status at baseline and follow-up**

	N	%	*Z*	*p*	Odds[a]
YFAS+ at T1	24				
T2 YFAS+	10	42%	6.1	< .001	0.7
T2 SPFA+	10	42%	0.6	ns	-
T2 NFA	4	17%	-2.7	< .01	-

SPFA+ at T1	123				
T2 YFAS+	10	8%	0.2	ns	-
T2 SPFA+	73	59%	4.7	< .001	1.2
T2 NFA	40	33%	-3.7	< .001	-
NoFA at T1	158				
T2 YFAS+	3	2%	-2.6	< .01	-
T2 SPFA+	22	14%	-4.4	< .001	-
T2 NFA	133	84%	4.3	< .001	5.3

[a] Odds of staying in the same group from baseline to follow-up.

H5: SPFA+ as a predictor of worsening eating behavior, body image, and weight stigma

Baseline SPFA+ was not associated with increases in problem eating or worsening body image at follow-up: repeated measures *t*-tests indicated no change between T1 and T2 in any measure of eating behavior, overweight preoccupation, self-classified weight, self-reported BMI, or weight-related self-stigma or fear of stigma in this group. Conversely, appearance evaluation improved slightly (2.9 to 3.0, $t_{(122)} = 3.0$, $p = .004$, d = .54) and appearance orientation decreased slightly (3.7 to 3.6, $t_{(122)} = -2.2$ $p = .03$, d = .40) at follow-up.

Interim Discussion

Self-perceived food addiction appears to be a moderately stable condition over time, at least on a par with YFAS+; thus, H4 was supported. However, the data do not support H5; that is, SPFA+ does not appear to be a marker for worsening pathology, at least over the time period tested here.

761 Overall, these findings confirm that SPFA represents a relatively stable condition
762 that distinguishes self-perceived food addicts from YFAS+ and NFA individuals in
763 a number of meaningful constructs related to eating, body image, and weight-
764 related self-stigma, not simply their sense of self-control around food. However,
765 in logistic regression models, these constructs alone resulted in low specificity
766 for YFAS+ status, correctly classifying only 20% of YFAS+ individuals in Study 1a.
767
768 Our focus in Study 1 was on measures of disordered eating and body image
769 whereas other research on food addiction has explored the roles of broader
770 constructs such as cravings, clinical comorbidities – in particular, depressive
771 symptoms, and trait impulsivity (Davis et al., 2011; Imperatori, Innamorati,
772 Contardi, Continisio, Tamburello, Lamis, et al., 2014; Ivezaj, White, & Grilo, 2016;
773 Meule & Kübler, 2012; Meule, Heckel, Jurowich, Vögele, & Kübler, 2014; Meule et
774 al., 2015; Nolan & Geliebter, 2016). It is possible that inclusion of these
775 constructs would improve the specificity of the predictive model and the ability
776 to discriminate between YFAS+ and SPFA+ individuals. Impulsivity reflects rapid,
777 disinhibited responses to internal or external cues irrespective of potential
778 negative consequences, and has been associated with a variety of addiction
779 disorders (de Wit, 2009; Morris & Voon, 2016). Impulsivity has also been linked
780 to a range of pathological eating behaviors, including food addiction (Davis,
781 2013; Gearhardt et al., 2009; Meule, 2013). Additionally, it may be possible to
782 distinguish SPFA from YFAS-diagnosed food addiction on the construct of binge
783 behavior. Notable similarities exist between binge eating disorder (BED) and
784 YFAS-diagnosed food addiction in terms of diagnostic criteria, symptoms,
785 comorbid psychopathology, and neurobiological pathways (Davis, Loxton,

Levitan, Kaplan, Carter, & Kennedy, 2013; Gearhardt, White, & Potenza, 2011), and co-occurrence is common. Thus severity of binge behavior may differentiate between YFAS+ and SPFA+ individuals.

Study 2

The purpose of study 2 was three-fold. First, we aimed to replicate findings from Study 1 in a non-student population. Second, we aimed to determine whether addition of constructs related more broadly to behavioral control improved the predictive accuracy of "food addiction" category beyond that achieved with only traditional measures of eating-related problems. The final aim of study 2 was to explore the utility of the food addiction categories in predicting psychopathology, beyond that attained by simply utilizing a continuous measure of symptom endorsement. In a review of studies utilizing the YFAS, Long et al. (2015) note that the majority of studies report findings in terms of the continuous YFAS symptom count, rather than exploring the utility of a YFAS+ diagnosis involving the requisite endorsement of clinically significant impairment or distress. The authors contend that the clinical utility of a YFAS+ "diagnosis" has yet to be firmly established, and can only be achieved if the "condition" itself is linked with specific clinical symptoms independently of the continuous symptom count. Given the continuum of symptom counts for each food addiction category observed in Studies 1a and 1b, and the previously described strong association between symptom count and psychopathology, we explored whether classification as either YFAS+ or SPFA+ explained additional variance in

psychopathology beyond that accounted for by their respective elevated symptom counts. We made the following hypotheses:

H6: The high prevalence of SPFA, and the continuum of scores on all measures would be replicated in this sample.

H7: Scores on the Binge Eating Scale and depressive symptoms would significantly differential between SPFA+ and YFAS+ in logistic regression models, and would increase the predictive accuracy of the models in correctly classifying YFAS+ participants. We expected that cravings, binge eating, and attentional impulsivity would differentiate between SPFA+ and NFA, but would not be sufficiently different to differentially predict SPFA+ and YFAS+.

H8: A YFAS+ diagnosis would explain additional variance in depressive symptoms, eating pathology in general, and binge eating specifically beyond that attributable to symptom count scores alone. We did not expect SPFA+ classification to explain additional variance in psychopathology or disordered eating behavior beyond that explained by the elevated symptom count.

Method

Participants

Participants were recruited to an "Online eating survey" using Amazon's Mechanical Turk (MTurk) worker pool. Eligibility criteria were initially limited to workers who had completed at least 100 previous "jobs" on the MTurk platform, and who had at least a 95% approval rating for their work, as this has been shown to improve data quality (Peer, Vosgerau, & Acquisti, 2014). An interim check on participant numbers and geographical location indicated that

participants from the Indian subcontinent were disproportionately represented. As we were unsure how cultural differences might impact on the findings, it was decided to limit future participants to those currently living in the US, Canada, UK, Ireland, Australia, and New Zealand. Additionally, to make the survey available to a wider sample, we reduced the required number of previous completed projects to 50, but increased the required approval rating to 100%. Participants were paid US $0.50 for their time. Seven hundred and forty-seven participants provided informed consent and began the study. Of these, 660 (88%) completed it. To ensure that participants were engaged in the survey, four "catch" questions were used. This practice also reduces the likelihood of automated form completion by "bots", and is an additional method of ensuring high-quality data (Prince, Litovsky, & Friedman-Wheeler, 2012). Given the length of the survey, we allowed up to one incorrect response; however 46 participants incorrectly answered more than one "catch" question, and their data were excluded. Thus the final sample included 614 participants. Of these, approximately 9% chose not to provide any demographic data (50 did not report gender or profession, 54 did not report ethnicity, and 57 did not report education. Additionally, 63 did not provide height and weight information and thus BMI could not be calculated. Given that these variables were not critical to the study hypotheses, these participants were included in analyses, with missing values excluded pairwise. Of the remaining participants, 59.8% identified as female; 58.6% were White, 19.1% South-Asian/Indian, 5.2% African-American, 3.4% Hispanic, and 13.7% other ethnicities; 65.6% had a college degree or higher, and just over half worked in white-collar professions, 9.6% were students, 11.5% unemployed, 10.6% blue-collar workers, and 12.9% Other. Mean age was

35.1 years (SD 11.8, range 14 to 77) and mean BMI was 27.9 (SD 8.7, range 11.4 to 84.9; 6.0% underweight, 37.1% normal weight, 21.3% overweight, and 27.4% obese by BMI category; 8.1% missing). The study was approved by the University of Birmingham Ethical Review Committee.

Measures

Participants completed the same questionnaires as in Study 1b. Additional demographic questions relating to education level and profession were added for this non-student sample. In addition, measures of binge eating, food cravings, trait impulsivity, and negative affect were included.

Binge eating

The Binge Eating Scale (BES), a 16-item questionnaire assessing the frequency and severity of behaviors, cognitions, and affect associated with binge eating. This self-report measure has been used in food addiction studies in non-eating disordered samples (e.g. Gearhardt et al., 2009; Imperatori et al., 2014), and scores on the BES have been shown to mediate the relationship between YFAS symptom count and psychopathology in treatment-seeking overweight and obese adults (Imperatori et al., 2014). The BES has good psychometric properties and strong agreement with expert interview-based assessments of binge eating problems (Gormally, Black, Daston, & Rardin, 1982). Item scoring varies by question, but a sum score is created for the whole scale, with a possible range of 0 to 46. Accepted diagnostic cut-offs are 18–26 for moderate binge eating and 27

881 or higher for severe binge eating (Marcus, Wing, & Lamparski, 1985). Cronbach's
882 α in the present study was .92.
883

884 *Food cravings*
885 Trait food cravings were measured using the Food Craving Questionnaire–Trait
886 (FCQ-T) (Cepeda-Benito, Gleaves, Williams, & Erath, 2000). This widely used
887 scale comprises 39 items assessing cognitive, affective, and behavioral aspects of
888 cravings across different situational contexts, including in the absence of a
889 craved food, prior to, during, and after eating a craved food, and what triggers
890 the cravings. In a large study of German university students, YFAS+ participants
891 scored more highly than YFAS- participants on the total scale score and all
892 subscales with the exception of anticipation of positive reinforcement, consistent
893 with the increased cravings but absence of positive reward experienced in more
894 traditional addictive conditions (Meule & Kübler, 2012). Subjects identify how
895 often each of the items would apply to themselves, with items scored on a six-
896 point Likert scale (1 = Never/not applicable to 6 = Always). Scores are summed
897 to provide a total measure of food craving propensity, with a possible range of 39
898 to 234. The scale showed excellent internal consistency in the present sample (α
899 = .98).
900

901 *Impulsivity*
902 Trait impulsivity was measured using the Barratt Impulsiveness Scale–Short
903 Form (BIS-15) (Spinella, 2007). The BIS-15 is a relatively short measure,
904 comprised of 15 items across three subscales, and is moderately to strongly

correlated with other commonly used, but longer, measures of impulsivity (Meule, Vögele, & Kübler, 2011; Spinella, 2007). The three subscales capture different aspects of impulsivity – namely attention, motor, and non-planning impulsivity. Attentional impulsivity assesses difficulty concentrating or remaining focused in the present; motor impulsivity refers to the tendency to act without thinking; and non-planning impulsivity is defined as a lack of forethought regarding future events. The subscales have previously been shown to correlate differentially with eating behaviour and food addiction symptoms. Attentional impulsivity, in particular, has been linked with food cravings, emotional eating, night eating, and YFAS symptom count in non-clinical samples (see Meule, 2013 for a review of measures of impulsivity and overeating), although some studies have also found significant, but smaller, correlations with the other subscales (e.g. Meule et al., 2015). Participants indicate how often they think or behave in certain ways, using a 4-point Likert scale (1 = Rarely/Never to 4 = Almost always/Always). Sum scores for each subscale can range from 5 to 20. Internal reliability was adequate; Cronbach's αs were .71, .79, and .71 for the Attention, Motor, and Non-planning subscales, respectively.

Mood

Depressed mood was measured using the Center for Epidemiological Studies–Depression scale (CES-D) (Radloff, 1977). This questionnaire measures recent negative affect, with participants indicating how often they have experienced each of the 20 items in the previous week. Items are scored on a 4-point Likert scale ranging from 0 (Rarely or none of the time, less than 1 day) to 3 (Most or all

of the time, 5–7 days). A sum score is created for the total scale with a possible range of 0 to 60. Scores greater than 16 are considered indicative of severe depressive symptoms, although the measure was developed and recommended for research purposes, rather than as a diagnostic tool. Nevertheless, it correlates well with clinical assessments of depression and is suitable for use in population studies and primary care (Radloff, 1977; Vilagut, Forero, Barbaglia, & Alonso, 2016). Cronbach's α in the present sample was .93.

Handling of missing values

As described above, missing values on demographic and anthropometric variables were not imputed, and these variables were deleted pairwise where relevant. Sample sizes therefore varied by analysis. Five participants had a total of eight missing data points on other study outcome measures. No variable had more than one data point missing. Given the very small number of missing data points, data imputation was deemed unnecessary, and missing values were replaced with participants' mean values for the respective scale or subscale.

Statistical analysis

In addition to the analyses conducted in Study 1 (H6), multinomial logistic regression was conducted in two stages. As a first step, the model tested in study 1a was replicated in this non-student sample to confirm its generalizability. A second logistic regression was then conducted, adding in scores on the BES, FCQ-T, CES-D, and BIS-15 subscales. Improvements in model fit compared with the

basic model were assessed by changes in model χ^2, pseudo-R^2, and accuracy of food addiction status classification (H7).

Hierarchical linear regressions were used to explore the relative utility of food addiction classification versus symptom count in predicting binge eating, general eating pathology, and depressive symptoms (H8). For each outcome, symptom count was entered into the regression equation first, and then food addiction classification was entered at the second step. Clinical utility was inferred if change in variance explained at step 2 was statistically significance.

Results

H6: Characterization by food addiction status

Eighty-four participants (13.7%) were classified as YFAS+, 249 (40.6%) as SPFA+, and the remaining 281 (45.8%) as NFA. Within the YFAS+ category, most (n=76) also self-classified as food addicts, but a small subset (n=8) did not. This subset did not differ from the larger group of YFAS+ participants on YFAS symptoms, but did differ on a number of other measures. YFAS+ participants who also self-classified as food addicted had higher scores on ESES, BES, and FCQ-T, and lower scores on the IES than YFAS+ participants who did not self-classify as food addicted. All subsequent analyses were run with and without these cases and the results did not differ; therefore, all YFAS+ participants were combined into a single group.

Symptom endorsement was very similar to that in the student sample, with two exceptions. In the present sample, a greater number of participants in each food

addiction group endorsed the symptoms “Continued use despite negative consequences” (72% YFAS+, 44% SPFA+, 17% NFA) and “Tolerance” (79%, 45%, and 21%, respectively). Food addiction status did not differ by gender, education level, or profession. However, consistent with findings in Study 1a, non-White ethnicity was associated with an increased likelihood of being SPFA+ than NFA. In addition, in the present sample, ethnicity was also associated with an increased risk of receiving a YFAS+ diagnosis. Again, the effect of ethnicity was driven predominantly by participants identifying as South Asian. Exploratory analyses revealed that South Asian respondents endorsed more YFAS symptoms (mean 3.2) than White and Other ethnicities (both 2.3; $p \leq .001$). Significantly more South Asian participants endorsed almost all of the YFAS symptoms, with the exception of repeated failed attempts to quit or cut down and continuing use despite negative consequences. Examination of other study outcomes by gender indicates that South Asian participants reported either no difference or more favourable scores on almost all study outcomes compared with White and participants of other ethnicities. The one exception was for scores on the Food Cravings Questionnaire. South Asians reported statistically significant higher scores on all but two of the FCQ subscales, although the absolute difference in scores was small (South Asian 38.5, White 36.6, Other ethnicities 36.2, $p = .01$). Overall food addiction status did not differ by age or sex. However, male and female participants differed on YFAS symptom count, dietary restraint, intuitive eating, EAT-26, and all measures of body image. Thus subsequent analyses were controlled for ethnicity and gender.

Participant characteristics by "food addiction" classification are shown in Table 5. The three groups did not differ on BMI, appearance orientation, or non-planning impulsivity, but were significantly different on all other measures, with the SPFA+ having scores between those of the YFAS+ and NFA groups. The pattern of eating behavior, body image, and weight self-stigma was very similar to that in the student sample, although BMI was higher overall. However, participants in the YFAS+ group had a mean EAT-26 score below the cut-off for clinically relevant eating pathology, but did score within the range of BES associated with moderately severe binge eating. Mean BES scores in the SPFA+ group did not indicate clinically significant levels of binge behavior, but were significantly higher than those in the NFA group. Likewise, food cravings, motor and attentional impulsivity, and negative affect were elevated in the SPFA+ group. In this sample, YFAS+ were less likely to be dieting than in the student sample, although more likely to be watching what they ate so at to maintain their weight; participants in the SPFA+ and NFA groups were more likely to be both weight-loss dieting and watching in this sample compared with the student sample. However, only the difference in SPFA+ participants who were weight-loss dieting in the two samples was statistically significant ($\chi^2_{(1)} = 4.6$, $p < .05$). Bivariate correlations between YFAS symptom counts and study outcomes were similar to those seen in the student sample, although there was no correlation with appearance orientation. Additionally, symptoms count was moderately correlated with all three BIS-15 subscales, and strongly correlated with food cravings, binge eating, and depressive symptoms.

1023 **Table 5. Group differences by food addiction status and correlations with YFAS symptom count**

	Range	YFAS+ (n=84)	SPFA+ (n=249)	No FA (n=281)	Test statistic†	*p*	Effect size†	*r*‡
BMI§		28.5 (8.5)	28.7 (9.6)	27.0 (7.8)	2.4	0.09	.00	.11*
Eating behavior								
RS	0–35	17.6 (6.6)[a]	15.7 (5.6)[b]	13.1 (5.7)[c]	23.0	< .001	.03	.38***
ESES	1–7	4.7 (1.1)[a]	3.5 (1.2)[b]	2.5 (1.2)[c]	128.9	< .001	.17	.49***
IES	1–5	2.8 (0.4)[a]	3.2 (0.5)[b]	3.5 (0.6)[c]	77.0	< .001	.11	-.42***
EAT-26	0–78	15.4 (10.9)[a]	10.4 (9.3)[b]	9.0 (9.5)[b]	11.6	0.001	.02	.16***
BES	0–46	22.8 (7.2)[a]	14.8 (8.3)[b]	9.0 (7.2)[c]	125.5	< .001	.17	.53***
FCQ-T	39–234	152.8 (26.3)[a]	116.8 (31.3)[b]	90.5 (31.8)[c]	167.7	< .001	.21	.54***
Dieting status¶					7.7	0.10	1.6§	-.14**
WL Dieting		30.8%[a]	24.4%[ab]	19.6%[b]				
Watching		34.6%	40.0%	35.4%				
Not Dieting		34.6%[ab]	35.6%[b]	45.0%[a]				
Body image								
Appearance orientation	1–5	3.4 (0.6)	3.4 (0.6)	3.3 (0.7)	0.7	0.5	.00	-.05
Appearance evaluation	1–5	2.8 (0.9)	3.1 (0.9)	3.2 (0.9)	6.5	0.002	.01	-.21***
Overweight preoccupation	1–5	3.3 (0.8)[a]	2.8 (0.9)[b]	2.5 (0.9)[c]	35.6	< .001	.05	.30***
Self-classified weight	1–5	3.7 (0.8)[a]	3.6 (0.8)[a]	3.4 (0.8)[b]	7.1	0.001	.01	.22***
Weight Stigma								
WSSQ-SD	6–30	19.6 (4.7)[a]	16.1 (6.2)[b]	13.1 (5.8)[c]	56.6	<.001	.08	.38***
WSSQ-FS	6–30	19.1 (5.2)[a]	14.1 (6.0)[b]	11.9 (6.0)[c]	57.1	<.001	.08	.34***
Other								

BIS-15								
BIS-15-M	5–20	11.2 (2.8)[a]	9.6 (2.6)[b]	8.7 (2.5)[c]	30.0	< .001	.05	.26***
BIS-15-A	5–20	11.3 (3.0)[a]	9.6 (2.7)[b]	8.8 (2.5)[c]	25.3	< .001	.04	.27***
BIS-15-NP	5–20	11.1 (3.0)	10.8 (3.1)	10.3 (3.0)	2.5	0.08	.00	.13**
CES-D	0–60	27.2 (9.9)[a]	16.1 (11.5)[b]	13.2 (10.8)[c]	62.9	< .001	.09	.30***

Data are Means (Standard deviation) unless otherwise stated

* $p < .05$, ** $p < .01$, *** $p < .001$

† Test statistics are Welch's F for continuous variables and χ^2 for categorical variables. Effect sizes are ω^2 for ANOVA and odds ratios for χ^2 tests.

‡ Correlation with YFAS symptom count

§ N = 555.

¶ N = 563. All pairwise comparisons calculated; groups not sharing a superscript differ at .05 level. Odds ratio for YFAS+ currently weight-loss dieting versus other groups currently weight-loss dieting. Dieting status coded 1 = Weight-loss dieting, 2 = Watching, 3 = Not dieting.

[a,b,c] Within variables, *consecutive* food addiction categories that do not share a superscript differ significantly at the .01 level.

Abbreviations: YFAS+, positive diagnosis on Yale Food Addiction Scale; SPFA+, self-perceived food addiction without positive diagnosis on the YFAS; NFA, no food addiction; BMI, Body Mass Index; RS, Restraint Scale; ESES, Eating Self-Efficacy Scale; IES, Intuitive Eating Scale; EAT-26, Eating Attitudes Test-26; BES, Binge Eating Scale; FCQ-T, Food Craving Questionnaire-Trait; WL, Weight-loss; WSSQ-SD, Self-Devaluation subscale; WSSQ-FS, Fear of Stigma subscale; BIS-15, Barratt Impulsiveness Scale-15; BIS-15-M, Motor subscale; BIS-15-A, Attentional subscale; BIS-15-NP, Non-planning subscale; CES-D, Centre for Epidemiological Studies-Depression.

Overall, there were no significant differences in dieting status between the food addiction groups (Table 5).

H7: Predictors of food addiction status

As a first step, the model tested in Study 1a was replicated in this non-student sample. Scores on the Restraint Scale, EAT-26, ESES, Overweight Preoccupation scale, and WSSQ Self-devaluation and Fear of enacted stigma subscales were entered as predictors. Sex and ethnicity were entered as covariates. The model was a good fit for the data but several of the hypothesized predictors did not significantly contribute to the model. A series of reduced models were tested by sequential removal of predictors with non-significant likelihood ratio tests. In this way, overweight preoccupation, weight self-stigma, and gender were removed from the model with no loss of model fit or predictive accuracy. The final model was a good fit for the data ($\chi^2_{(10)} = 229.2$, $p < .001$; Nagelkerke $R^2 = .40$), and correctly predicted 35.9% of YFAS+ cases, 55.6% of SPFA+ and 72.4% of NFA, with overall accuracy of 60.5%. Predictive accuracy for YFAS+ classification was higher than in the student sample (20.0%).

The predictors that influenced the model were largely the same in this community sample as in the student sample in Study 1a, with the exception of the roles played by dietary restraint and weight self-stigma. First, dietary restraint remained in the model and significantly predicted categorization as SPFA+ versus NFA, with a 5-point increase in restraint scores being associated with a 30% increased likelihood of being SPFA+. Restraint did not distinguish

between YFAS+ and SPFA+. The significant roles of eating pathology (EAT-26) and eating self-efficacy (ESES) were the same in both samples. However, while weight self-stigma was a significant discriminator between YFAS+ and SPFA+ in the student sample (OR 1.12, $p = .01$), it did not contribute to the model in this community sample. Fear of enacted weight stigma significantly discriminated between SPFA+ and NFA in the present sample, but not between YFAS+ and SPFA+, the opposite pattern to that seen in the student sample. There was also a trend for non-White ethnicity to be associated with increased likelihood of receiving a YFAS+ diagnosis, but this did not reach statistical significance (OR 0.55, $p = .06$).

As a second step, scores on the BES, FCQ-T, CES-D, and BIS-M and BIS-A subscales were added to the model. The BIS-NP subscale was not included as scores did not differ between the three groups. Sequential removal of predictors not contributing to the model led to the removal of dietary restraint, EAT-26, WSSQ-Fear, and the BIS-15 attentional and motor subscales with no loss in model fit or predictive accuracy. The final model is displayed in Table 6. The model was a good fit for the data ($\chi^2_{(10)} = 271.9$, $p < .001$, Nagelkerke $R^2 = .45$) and correctly predicted 41.0% of YFAS+ cases, 55.6% of SPFA+ cases, and 75.5% of NFA cases, overall accuracy 62.7%.

Table 6. Multinomial logistic regression comparing predictors of SPFA with YFAS-diagnosed and non-food addicts

	B	SE	Sig.	OR	95% CI for OR	
					Lower	Upper
YFAS vs SPFA						
Intercept	-6.95	0.91	< .001			
ESES	0.32	0.18	.07	1.37	0.97	1.94
FCQ-T	0.02	0.01	.01	1.02	1.01	1.03
BES	0.02	0.02	.32	1.02	0.98	1.07
CES-D	0.06	0.01	< .001	1.06	1.03	1.09
Ethnicity	-0.63	0.32	.05	0.53	0.29	0.99
SPFA vs NFA						
Intercept	-3.01	0.40	< .001			
ESES	0.38	0.12	.002	1.46	1.15	1.85
FCQ-T	0.01	0.01	.05	1.01	1.00	1.02
BES	0.04	0.02	.03	1.04	1.01	1.08
CES-D	-0.01	0.01	.56	0.99	0.97	1.01
Ethnicity	-0.88	0.22	< .001	0.41	0.27	0.64

N=560

Abbreviations: YFAS+, Positive "diagnosis" on Yale Food Addiction Scale; SPFA+, self-perceived food addiction without positive "diagnosis" on YFAS; NFA, no food addiction; ESES, Eating Self-Efficacy Scale (range 1–7); FCQ-T, Food Craving Questionnaire-Trait (range 39–234); BES, Binge Eating Scale (range 0–46); CES-D, Center for Epidemiological Studies-Depression scale (range 0–60)

Ethnicity scored 1 = White, 0 = Other ethnicities.

In the final model, food cravings, depressive symptoms, and ethnicity were the only statistically significant discriminators between YFAS+ and SPFA+, with scores on the CES-D being the most important predictor. A 5-point increase was associated with a 30% increased likelihood of being YFAS+. Depressive symptoms did not distinguish between SPFA+ and NFA. Eating self-efficacy remained an important predictor. A 1-point increase in ESES score was associated with a 37% increased likelihood of being YFAS+ compared with SPFA+ and 46% increased likelihood of being SPFA+ versus NFA. Although food craving was a statistically significant discriminator in each comparison, the effect sizes were small. The FCQ-T is scored between 39 and 234, and each 5-point increase was associated with a 10% increased likelihood of being YFAS+

compared with SPFA+, and a 5% increased likelihood of being SPFA+ compared with NFA. Surprisingly, binge eating did not discriminate YFAS+ from SPFA+ but did distinguish between SPFA+ and NFA. The BES has a possible range between 0 and 46. Each 5-point increase in BES score was associated by a 20% increased likelihood of being SPFA+ compared with NFA. Participants of non-White ethnicity were approximately twice as likely to be classified in each food addiction category compared with White participants.

H8: Clinical utility of food addiction classification

Finally, we tested whether food addiction classification explained additional variance in depressive symptoms, binge eating severity, and general eating pathology, beyond that accounted for by YFAS symptom count alone. To determine the utility of a YFAS+ diagnosis, we conducted hierarchical linear regressions with symptom count entered at step 1, and then diagnostic status (yes/no) entered at step 2. As YFAS+ status is partly defined by clinically significant distress or impairment, the analyses were repeated excluding YFAS+ participants to assess the utility of an SPFA+ classification compared with NFA. The findings are summarised in Table 7.

Table 7. Utility of food addiction status on psychopathology

	Symptom count			YFAS+ diagnosis (yes/no)		
	Adj R^2	*F (1,612)*	*p*	*ΔR^2*	*ΔF (1,611)*	*p*
CES-D	.189	137.2	< .001	.009	13.4	< .001
EAT-26	.043	28.7	< .001	.008	5.0	.03
BES	.369	359.6	< .001	.024	24.5	< .001
	Symptom count			SPFA+ status (yes/no)		
	Adj R^2	*F (1,528)*	*p*	*ΔR^2*	*ΔF (1,527)*	*p*
CES-D	.089	52.7	< .001	0	0.09	.77
EAT-26	.025	14.4	< .001	0	0.04	.84
BES	.274	201.0	< .001	.025	18.8	< .001

Abbreviations: YFAS+, Positive "diagnosis" on Yale Food Addiction Scale; SPFA+, self-perceived food addiction without positive "diagnosis" on YFAS; CES-D, Center for Epidemiological Studies-Depression scale; EAT-26, Eating Attitudes Test-26; BES, Binge Eating Scale

In the full sample, positive diagnosis on the YFAS explained a small but statistically significant amount of variance in all three outcomes, beyond that accounted for by the YFAS symptom count. When the sample was restricted to non-YFAS+ participants, SPFA did not explain additional variance in depressive symptoms of eating pathology, but explained an additional 2.5% of the variance in binge eating severity.

Interim Discussion

This study confirmed that SPFA is prevalent in the general community, and that individuals who self-classify as addicted to foods differ from those who do not on a range of parameters associated with eating and addiction problems. It also confirmed that self-perceived food addicts do not experience the severity of problems associated with a YFAS-based food addiction "diagnosis". Thus H6 was supported.

The logistic regression model derived in the student sample was largely replicated in this community sample, with lower sense of self-control around food increasing the likelihood of being YFAS+ compared with SPFA+, and SPFA+ compared with NFA. General eating pathology distinguished between YFAS+ and SPFA+, but not between SPFA+ and NFA, as in the student sample. In both samples, neither overweight preoccupation nor gender significantly predicted classification between the groups. The main difference in the community sample was that higher levels of dietary restraint, as measured by the Restraint Scale, now increased the likelihood of being SPFA+ compared with NFA, but did not distinguish the two "addiction" groups. Findings regarding weight self-stigma and fear of stigma from others were inconsistent, and further research is needed to elucidate these relationships, perhaps by experimentally manipulating weight stigma. Non-White ethnicity was again associated with increased likelihood of addictive-like eating behavior, despite either no difference or more favourable scores on all study outcomes compared with White participants, and this finding was driven predominantly by South Asian participants. This pattern was therefore replicated in both a predominantly British student sample and an international community sample with a large number of participants from the Indian subcontinent.

Partial support for H7 was observed. Addition of measures of craving, binge eating, impulsivity, and depressive symptoms to the regression models improved classification accuracy for YFAS+ participants compared with the model that used more traditional measures of disordered eating and body image only; however, given the importance of these additional variables in addictive-like

behaviors, the improvement was smaller than might have been expected. Additionally, the variables predicted to significantly discriminate between YFAS+ and SPFA+ and between SPFA+ and NFA only partially supported our hypotheses. As predicted, one of the main distinguishing feature between YFAS+ and SPFA+ was severity of depressive symptoms, with YFAS+ mean scores in the range indicative of severe depression, while SPFA+ scores were much lower and just on the cut-off point suggestive of clinically relevant symptoms. Although YFAS+ scores on the BES also indicated moderately severe binge behavior, while SPFA+ scores did not, BES was no longer a significant discriminant between these two groups when depressive symptomatology was included in the model. General eating pathology, as measured by the EAT-26, were also no longer a significant predictor in this model. Contrary to our hypothesis, trait craving scores also significantly discriminated between YFAS+ and SPFA+. This suggests that it is not only distress about symptoms that distinguishes between these conditions, but that severity of cravings in YFAS+ are noticeably more intense than in SPFA+. As predicted, cravings and binge behavior distinguished between SPFA+ and NFA, but attentional impulsivity did not. Eating self-efficacy remained a significant discriminating variable between SPFA+ and NFA in the expanded model. Finally, the data provide evidence for the clinical utility of the "diagnostic" scoring method of the YFAS. A positive "diagnosis" on the YFAS explained additional variance in binge eating, general eating pathology, and depressive symptoms beyond that accounted for by the symptom count alone. As predicted, believing oneself addicted to food, in the absence of a YFAS+ diagnosis, does not explain additional variance in eating pathology or depression beyond YFAS symptom count, although, contrary to predictions, it does make a small

contribution to explaining the variance in binge eating scores, suggesting that self-classification as a food addict does have some utility in identifying problematic eating behavior beyond what can be inferred from the elevated YFAS symptom counts in most SPFA+ participants.

General Discussion

The present study is the first to explore the relative prevalence and characteristics of "food addiction" using both a diagnostic measure of food addiction and individuals' own perceptions of their addiction status. Food addiction status did not differ by age, sex, or BMI. Despite the absence of inter-group differences in BMI, individuals receiving a YFAS+ diagnosis, those who only self-classify as food addicts, and non-addicts differed significantly on almost all measures of eating behavior, body image, and psychopathology. In all cases, YFAS+ individuals experienced the most severe symptoms, followed by SPFA+, and with the NFA group reporting only mild levels of problematic eating and body image concerns. While SPFA+ participants did not report clinical levels of eating pathology, they nevertheless exhibited significantly higher levels of problematic eating behavior, more dietary restraint, and a reduced sense of control around food than did "non-addicts". These findings are strengthened by being replicated in both a student sample, which was largely homogeneous across demographic and anthropometric variables, and in a community sample with a good gender balance, a broad age spectrum, and a wider range of BMI. Although no data were available regarding participant income in the community sample, using employment status as a proxy for socioeconomic status suggests

1221 that this was also quite varied within the community sample, and was also
1222 unrelated to food addiction classification.
1223
1224 In contrast, ethnicity was a significant predictor of food addiction status in both
1225 samples. In particular, individuals either resident in or whose families originated
1226 from the Indian subcontinent reported significantly higher levels of addictive-
1227 like eating symptomatology, and were also significantly more likely to self-
1228 classify as food addicts. This effect was observed despite either no differences or
1229 slightly preferable scores on all other measures of eating behavior and body
1230 image in participants of South Asian ethnicity compared with White participants.
1231 This finding is consistent with the wider literature on disordered eating in South
1232 Asian ethnic samples (Dolan, Lacey, & Evans, 1990; Furnham & Adam-Saib, 2001;
1233 Wardle, Bindra, Fairclough, & Westcombe, 1993), including sometimes atypical
1234 presentations of eating disorders (Sharan & Sundar, 2015), but extends that
1235 literature to include addictive-like eating behavior. From a clinical perspective,
1236 the presence of addictive-like eating behavior in this population should be
1237 investigated independent of evidence of traditional weight concerns or
1238 pathological eating patterns.
1239
1240 This is also the first study to look at the stability of SPFA over time. Despite the
1241 apparent subjective nature of SPFA, it appears to be a moderately stable
1242 construct. Interestingly, SPFA appeared to be more stable over time than was a
1243 YFAS-based "diagnosis", with 59% of students who had received an SPFA+
1244 classification at baseline, but only 42% of those receiving a YFAS+ classification,
1245 maintaining the same status at follow-up. Only one previous study has examined

the stability of a YFAS-based diagnosis over time. In an online survey of a community sample, 54% of participants receiving a YFAS+ diagnosis at baseline remained so after 18 months (Pursey, Collins, Stanwell, & Burrows, 2015, 2016). However, the follow-up sample in that study suffered nearly 80% attrition overall compared with baseline, and approximately 90% in individuals who were YFAS+. The follow-up data indicate that those who were YFAS+ at follow-up had a slightly higher mean symptom count and endorsement of individual symptoms than the baseline sample, and suggest that the follow-up group were likely a subsample for whom the questionnaire was particularly relevant. It seems probable that the stability of YFAS+ in this subsample would be higher than if more of the original sample had completed the second survey. In contrast, in the present study, all baseline participants who were eligible to complete the follow-up study did so.

The most reliably predictive variable among traditional measures of disordered eating behavior and weight and shape concern that distinguished between the three "food addiction" groups was perceived self-control around food, which is also consistent with self-classifying individuals' own qualitative descriptions of their experiences (Hetherington & MacDiarmid, 1993; Ruddock et al., 2015). When factors associated with more severe eating pathology were included, self-perceived control around food remained a significant predictor distinguishing SPFA+ from NFA+, but food cravings and depressive symptoms were the main discriminating variables between YFAS+ and SPFA+.

However, addition to the analyses of variables often linked with substance-use and impulsivity disorders resulted in only a small improvement in classification accuracy of YFAS+ status compared with that achieved when only traditional measures of disordered eating and body image were included. The most recent revision of the Diagnostic and Statistical Manual of Mental Disorders (5th edition; DSM-5), released in 2013, combined the previously separate diagnostic criteria for substance abuse and substance dependence into a new category of Substance-Related and Addictive Disorders (SRADs; American Psychiatric Association, 2013), which includes both substance use disorders and behavioral addictions. This change resulted in the addition of several new symptom types, most of which could be relevant to addictive-like eating behavior, and included the incorporation of "cravings" into the diagnostic criteria (Meule & Gearhardt, 2014). The original version of the YFAS was created to reflect DSM-IV criteria for substance use disorders, and thus did not include an assessment of craving frequency or intensity; an updated version that reflects DSM-5 diagnostic criteria has now been designed and validated (YFAS 2.0; Gearhardt, Corbin, & Brownell, 2016). It is possible that the addiction-related constructs used in the present study would have better predictive accuracy for classifying YFAS+ diagnosis based on this updated version of the scale.

Interestingly, binge eating behavior, a construct closely linked with food addiction, did not distinguish between YFAS+ and SPFA+. Nevertheless, both self-classification and YFAS-based diagnosis explained additional variance in binge eating scores, beyond that accounted for by YFAS symptom counts, suggesting that these classifications are capturing additional information. However, SPFA+

status did not explain additional variance in a more general measure of eating pathology or in depressive symptoms. In contrast, a YFAS+ diagnosis explained additional variance in general eating pathology and depressive symptoms, beyond that attributed to the symptom count alone. As a YFAS+ diagnosis requires endorsement of clinically significant distress or impairment, in addition to the presence of three or more symptoms, it is perhaps unsurprising that depressive symptomatology should be such an important distinguishing factor between YFAS+ and SPFA+.

It has been suggested that the categorical diagnostic criteria for eating disorders are of limited clinical utility, and that eating disordered behaviours are more usefully considered as lying on a continuum (Perosa & Perosa, 2004). Indeed, in an 8-year longitudinal study of adolescent girls, Stice and colleagues (2009) found that sub-threshold eating disorders were more prevalent than threshold cases, that they were associated with significant functional impairment and psychological distress. Davis (2013) has also advanced a spectrum hypothesis of food misuse, beginning with intermittent passive overeating, and marked by increasing severity, compulsion, and psychopathology, with the development of "food addiction" at the end of the continuum. Further support for this continuum hypothesis comes from two recent analyses of commonly used questionnaires that assess different patterns of eating behavior (Price, Higgs, & Lee, 2015; Vainik, Neseliler, Konstabel, Fellows, & Dagher, 2015). In one analysis, measures of disinhibition, emotional eating, hedonic eating, and binge eating shared a significant proportion of variance with a common latent factor, conceptualized as "uncontrolled eating"; additionally, the individual questionnaires could be

mapped onto a severity continuum of uncontrolled eating, from mild (eating impulsivity) to severe (binge eating) (Vainik et al., 2015). In another study, which included the YFAS, principal components analysis produced two factors: the restraint subscales of two commonly used measures loaded onto one factor, labelled "Dietary Restraint", whereas all other subscales from measures assessing hedonic, emotional, external, and disinhibited eating, and a sum score from the YFAS, loaded onto a second factor, labelled "Food Reward Responsiveness" (Price et al., 2015). Taken as a whole, the findings from the present studies are consistent with the concept of both YFAS-diagnosed and self-classified "food addiction" lying on a spectrum of "food misuse", possibly characterized by loss-of-control eating. Additionally, we propose that the most extreme form of food misuse be classified as a "food use disorder" in preference to the term "food addiction" (Nolan, 2017), in line with the revised nomenclature utilized in the DSM-5.

Strengths of the present studies include replication of findings in two diverse samples and follow-up data with no attrition. However, the follow-up period was relatively short, and limited to a young, homogeneous, predominantly normal-weight, student population. It may be useful to observe whether SPFA+ is predictive of worsening eating pathology in a more diverse adult population. Additionally, we examined the characteristics of both clinical and self-classified "food addiction" in terms of both traditional measures of problem eating behavior and body concerns, and also constructs more generally associated with substance use disorders. A major limitation of the present studies is reliance on self-report questionnaire measures. Nevertheless, a previous laboratory-based

study found that SPFA+ individuals demonstrated a greater desire to eat and consumed more high-fat snack foods after previously eating to satiety than did SPFA- individuals, despite no differences between the groups in levels of hunger of liking of the foods (Ruddock et al., 2016). Previous studies using neuroimaging and genotypic analysis have identified objective correlates of YFAS-diagnosed "food addiction" (Davis et al., 2013; Gearhardt, Yokum, et al., 2011). Future studies could explore whether SPFA+ is also associated with altered neurobiology or genotype compared with individuals who do not consider themselves addicted to food. Another possible limitation is that self-classifying as food addicted at the start of the study may have influenced how respondents answered subsequent questions on the YFAS. However, it seems likely that the reverse would also be true, and it was decided that a naïve response to a question about "food addiction" would be a more reliable indication of the prevalence of "food addiction" as conceived by the lay population. Finally, both of these studies were conducted in non-clinical samples. Future studies should explore the applicability of these findings to clinical samples of higher-weight and/or eating disordered populations.

Conclusion

Self-perceived "food addiction" is prevalent and is relatively stable over time. Findings from the present studies in two diverse samples indicate that SPFA+ status is associated with elevated levels of disordered eating behavior, overweight preoccupation, internalized weight stigma, impulsivity, and depressive symptoms. Given that SPFA+ can be determined by a single question,

it may provide a useful method for health care professionals to identify individuals manifesting a potential “food use disorder”, who may need help with food misuse, loss-of-control eating and body image issues.

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