



# Eating-to-Cope Motives and Uncontrolled Eating as Mediators Between Negative Emotional States and Food Addiction Among Argentinean Young Adults

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## Abstract

Negative emotional states (NES; i.e., depression, anxiety and stress) are likely contributors to the development of food addiction (FA). The association between NES and FA symptoms may be mediated by altered eating behaviors or by eating-to-cope motives. This study examined, in a sample of Argentinean young adults, the association between NES and FA symptoms via eating-to-cope motives and three patterns of eating behaviors. We also examined whether the model was invariant across college status. The transition from high school to college is usually associated with increased exposure to stress, which promotes the probability of engaging in altered eating behaviors. A sample of 499 Argentinean young adults (mean age =  $24.9 \pm 3.51$  years) completed a survey that assessed FA symptoms, eating behaviors (i.e., uncontrolled, emotional, and restrained eating), eating-to-cope motives and NES. A path analysis tested the indirect association between NES and FA symptoms via uncontrolled, emotional or restrained eating, or by eating-to-cope. Stress and depression symptoms were indirectly associated with FA symptoms via uncontrolled eating and eating-to-cope motives. The model was invariant across college status. The findings suggest that NES are associated with FA symptoms by increasing uncontrolled eating and eating-to-cope motives. Young adults exhibiting greater depressive or stress symptoms, higher eating-to-cope, or higher uncontrolled eating may be at risk for FA. Future research should examine the significance of this pattern by tailoring interventions to these characteristics.

**Keywords** Food addiction · Stress symptoms · Uncontrolled eating · Depressive symptoms

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**Short Summary** Findings suggest an association between negative emotional states and food addiction symptoms via altered eating behavior patterns and eating-to-cope motives. Similarities and differences with previous work highlight the need for examining eating behavioral patterns to fully understand the peculiarities of these associations.

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In most western countries, the availability of highly palatable food (HPF, food rich in salt, sugar, or fat) has increased (Mattes & Foster, 2014), whereas obesity and overweight rates have reached alarming levels (Endalifer & Diress, 2020). The excessive consumption of HPF facilitates overeating (Burrows et al., 2018) and may be accompanied by tolerance, withdrawal, loss of control, and stimulation of brain reward systems (e.g., dopaminergic) (Lindgren et al., 2018). This pattern is similar to that associated with psychoactive substance use (Volkow et al., 2017). These observations suggest that the ingestion of HPF can result in an addictive process. Gearhardt et al. (2016) developed the Yale Food Addiction Scale (YFAS) to assess addictive-like eating by applying the substance use disorder criteria of the Diagnostic Statistical Manual of Mental Disorders (DSM-5) to the consumption of HPF. Under this definition, food addiction (FA) is characterized by loss of control over food consumption, continued consumption despite negative consequences, inability to cut down on food consumption despite the desire to do so, and significant distress related to eating (Gearhardt et al., 2011; Pursey et al., 2014). Greater YFAS scores are associated with increased body mass index (BMI) and poorer response to weight loss treatments (Ben-Porat et al., 2021; Ivezaj et al., 2018).

A meta-analysis indicated that the mean prevalence of FA, measured via YFAS in young adults (18–35 years) from North America and France, was 17% (Pursey et al., 2014). Young adulthood is considered a high-risk phase for the development of unhealthy behaviors, including substance use and dysfunctional eating behaviors (Pursey et al., 2015; Thomasius et al., 2020). For instance, individuals aged 18 to 29 years old exhibit the greatest prevalence of FA (Hauck et al., 2017) and obesity (Racette et al., 2005). Several studies conducted in young adults have reported high frequency of eating patterns likely to promote weight gain, such as low intake of fruits and vegetables and high intake of snacks and alcohol (Deforche et al., 2015; Nelson et al., 2008). Moreover, young adulthood is characterized by critical life changes, such as leaving high school and the parental home (Arnett et al., 2018). These changes require the development of self-identity, the adaptation to fluctuating contexts and increasing levels of independence, and autonomy (Arnett, 2000). In Argentina, the country where this study took place, approximately 60% of young adults are college students (OCDE, 2014). College is characterized by exposure to several stressors, including time pressures, academic demands, and financial problems (Ekpenyong et al., 2013), which contribute to the development of maladaptive lifestyles (Murphy et al., 2014; Pursey et al., 2014).

It has been reported that the prevalence of FA is higher in studies analyzing overweight/obese samples from North America or Europe (Pursey et al., 2014), than in studies conducted in other regions of the world. A significant gap in the literature, however, is that most of the studies on FA prevalence or its determinants have been conducted in economically developed countries. It is still unknown if those findings can be translated to low- and middle-income countries, such as Argentina. The last National Survey of Risk Factors (National Institute of Statistics and Censuses, 2018) reported that, among Argentinean adults, the prevalence of overweight and obesity was 61.6% and 25.4%, respectively. These rates are similar to those exhibited by high-income countries (Blundell et al., 2017). It is important to note that the prevalence of obesity found in 2018 (25.4%) represents more than a 10% increment, when compared to the values found in 2005 (14.6%). Moreover, Argentina is the country with the highest prevalence of childhood obesity in Latin America (9.9%; FAO et al., 2020). These trends generate a high health burden on the population and a great economic impact (Pou et al., 2020). For instance, Elgart et al. (2010) reported that the 40% of Argentineans with obesity are at risk for cardiovascular disease and that 14,776 deaths per year were attributable to overweight or obesity, with a total cost per premature death of 50 million USD.

It has been widely documented that a poor control of emotions can change food choices and the quantity and frequency of meals, thus promoting abnormal eating behaviors (Canetti et al., 2002). Consistent with this, FA is detected more often in individuals with depression or anxiety (Burrows et al., 2017; Parylak et al., 2011), or stress symptoms (Sinha, 2018), than in those not reporting such discomfort. Importantly, those with obesity exhibit comorbidity between FA and depression (Vidmar et al., 2021). Also, exposure to uncontrollable or chronic stress is associated with increase food intake (Sinha, 2018) and greater ingestion of HPF (Ivezaj et al., 2018; Steptoe et al., 1998). A likely candidate underlying the relationship between negative emotional states (NES) and FA is eating-to-cope (Macht & Mueller, 2007; Volkow et al., 2013). The latter involves eating motivated to forget about worries and problems, and to feel better when experiencing negative mood or stress exposure (Burgess et al., 2014). Greater endorsement of eating-to-cope motives, one of several motives associated with the execution of eating behaviors, has been associated with greater BMI (Burgess et al., 2014), greater binge eating (Boggiano et al., 2014), and self-reports of experiencing triggers to eat after negative mood related to frustration, anxiety, or depression (Boggiano et al., 2017).

Individuals suffering NES are also prone to develop distinct eating behaviors, including emotional eating (EE), restrained eating (RE), and uncontrolled eating (UE) (Amiri & Behnezhad, 2019; Vainik et al., 2019; Yau & Potenza, 2013). EE refers to eating, primarily energy-dense and palatable items, in response to negative emotions and UE involves losing control over intake accompanied by subjective feelings of hunger (de Lauzon-Guillain et al., 2004). Restrained eating, in turn, is a self-imposed limitation and monitoring of food intake to control body weight (de Lauzon-Guillain et al., 2004). Several studies have reported an association between UE and EE and indicators of risk for obesity such as increased BMI (Aoun et al., 2019), weight gain (Ferreira et al., 2019), and food intake (Vainik et al., 2019) and, more important, that these eating behaviors mediate the relationship between NES and BMI, weight gain, and food intake (Caso et al., 2020; Shukri et al., 2018). Additionally, UE and EE were significantly greater in patients with a diagnosis of FA (Albayrak et al., 2017; Khine et al., 2019) or exhibiting relatively high FA symptoms (Sanlier et al., 2017), compared to individuals not exhibiting FA or exhibiting relatively low FA symptoms, respectively. However, research examining whether NES is indirectly associated to FA via these eating behaviors is limited.

Additionally, the relationship between RE and obesity is still unclear. The cognitive restraint theory posits that individuals with these behaviors exhibit high levels of stress inherent to self-control and that high levels of RE lead to UE, and ultimately to weight gain (Stunkard & Messick, 1985). Several studies, however, have shown a negative or null association between RE and obesity indicators risk such as BMI and weight gain (Aoun et al., 2019; de Lauzon-Guillain et al., 2004). Brunault et al. (2017) and Khine et al. (2019) found a positive association between RE and FA, but RE did not predict severity of FA (only the diagnosis). Other work (Pepino et al., 2014) reported that bariatric surgery increased RE above normative values in subjects with FA but not in subjects without FA. It seems therefore important to assess the role of RE in the development of FA symptoms.

The studies reviewed indicate that NES are related to an increase in FA. It is, however, possible that this is mediated by eating-to-cope with negative affect which, in turn, is associated with altered eating behavior (i.e., EE, UE, and RE). The present study examined, in an atemporal (Winer et al., 2016) double mediation model and in a sample of young adults from Argentina, the associations between NES (depression, stress, and anxiety) and FA, via eating-to-cope motives and altered eating behavioral patterns. Based on previous findings, we expected that eating-to-cope motives would be associated to UE and EE (but

not to RE, see Albayrak et al., 2017) and we also hypothesized an association between NES (Khine et al., 2019; Nolan & Jenkins, 2019) and FA symptoms via eating-to-cope motives and UE/EE (but not to RE, see Albayrak et al., 2017). Another aim was to investigate if the proposed model was invariant across college status (i.e., college students vs. non-students).

## Methods

### Participants and Procedure

Participants were recruited through an invitation posted on social media (i.e., Instagram, Facebook, and Twitter) and distributed through email listings (i.e., lists with contact information from people who, in previous unrelated studies, agreed to receive invitations to participate in surveys). The invitation included a link to the online survey. The first section of the survey explained the aims of the study, and emphasized the voluntary nature of the participation and the confidentiality in the handling of the data. Inclusion criteria were as follows: (i) age  $\geq 18$  years, (ii) being a resident of Argentina, and (iii) not belonging to any of the protected categories of participants (i.e., prisoners and people suffering health mental disorders undergoing conservatorship). Pregnancy, lactation, diabetes, and bariatric surgery were exclusionary criteria for this study.

Participants were instructed that by clicking on a button with the word “next,” they were providing their informed consent. All the participants gave the informed consent and did not have compensation for participating in the survey. The survey took approximately 35 min to be completed and was available for 60 days between June and August 2020. A total of 2131 subjects aged between 18 and 69 years answered the invitation to participate. Of those, 1239 participants completed the whole survey (i.e., the response rate was 58%). For the present study, we only used the subset of young adults (i.e., aged between 18 and 29 years old). Thus, the final sample was composed by 499 participants (mean age =  $24.9 \pm 3.51$  years, 80.6% women). The demographic information collected from each participant included sex, gender, age, college status, self-reported weight (kg), and height (cm), and whether the participant had a medical condition that could affect food consumption.

The study procedures were approved by the institutional review board of the Instituto de Investigaciones Psicológicas (IIPsi-CONICET-UNC) and endorsed the ethical guidelines for human research of the American Psychological Association (2016), the Declaration of Helsinki, and the Argentinean National Law for the Protection of Personal Data (Law 23.326).

### Measures

For all psychometric measures, we created composite scores by averaging or summing items such that higher scores indicate higher levels of the construct. Table 1 presents, on the diagonals, internal consistency of all variables.

### Psychological Distress

We used the Spanish Version (Daza et al., 2002) of the Depression, Anxiety and Stress Scale (DASS-21; Lovibond & Lovibond, 1995), which consists of 21 items grouped into

**Table 1** Bivariate correlations and descriptive statistics

	1	2	3	4	5	6	7	8	M	SD
1. Depressive symptoms	<u>.89</u>	<b>.57</b>	<b>.63</b>	<b>.41</b>	<b>.38</b>	<b>.29</b>	<b>.12</b>	<b>.38</b>	6.94	5.07
2. Stress symptoms		<u>.79</u>	<b>.68</b>	<b>.40</b>	<b>.36</b>	<b>.35</b>	<b>.12</b>	<b>.42</b>	7.23	4.09
3. Anxiety symptoms			<u>.79</u>	<b>.33</b>	.31	<b>.30</b>	<b>.11</b>	<b>.40</b>	4.15	3.83
4. Eating to cope				<u>.84</u>	<b>.64</b>	<b>.51</b>	<b>.12</b>	<b>.55</b>	7.44	3.40
5. Emotional eating					<u>.77</u>	<b>.67</b>	<b>.24</b>	<b>.53</b>	6.70	2.49
6. Uncontrolled eating						<u>.87</u>	<b>.12</b>	<b>.60</b>	19.70	5.63
7. Restrained eating							<u>.57</u>	<b>.12</b>	14.05	3.28
8. Food addiction symptoms								<u>.87</u>	1.74	2.60

Significant correlations ( $p \leq .05$ ) are in bold typeface for emphasis. Cronbach's alphas are underlined and shown on the diagonals. The last two columns indicate mean (M) and standard deviation (SD), for each variable. The correlations and the descriptive statistics were calculated for the total sample

three sub-scales that assess depression, anxiety, and stress symptoms in the last 7 days. The DASS-21 is scored on a four-point scale with scores from 0 (*did not apply to me at all*) to 3 (*applied to me very much, or most of the time*). The range of possible scores for each sub-scale is 0–21, where a higher score represents a higher level of depression, anxiety, or stress. In the present study, we used each sub-scale score as an index of stress, depression, and anxiety. De la Rosa-Caceres et al. (2020) provided evidence of construct and predictive validity for this scale.

### Palatable Eating Motives

The Palatable Eating Motives Scale (PEMS; Burgess et al., 2014) was used to assess motives for the consumption of tasty food and drinks (e.g., sweets, snacks, and non-alcoholic sugary drinks). The PEMS comprises 20 items rated on a 5-point scale (from 1 = never/almost never to 5 = almost always/always) that are grouped in four sub-scales: coping, reward enhancement, social, and conformity motives. The original version of the PEMS was adapted from the Drinking Motives Questionnaire Revised (DMQ-R, Cooper, 1994). In the present study, we used the items of the Spanish version of the DMQ-R (Mezquita et al., 2011). Participants reported how frequently they ate tasty foods and drinks for each motive. Given the purpose of the present study, we only used the scores of the coping motive dimension, which comprises 4 items. Following the procedure indicated by Burgess et al. (2014) and Hauck-Filho et al. (2012), item 15 of the original version of the coping sub-scale of the PEMS was omitted in the present survey. The score of the coping sub-scale was the average of the responses provided to the four items. Mezquita et al. (2011) reported adequate concurrent validity for the Spanish version of this scale.

### Eating Behaviors

This variable was assessed using the Spanish version (Jáuregui-Lobera et al., 2014) of the Three-Factor Eating Questionnaire (TFEQ-R18; de Lauzon-Guillain et al., 2004). The TFEQ has 18 items, grouped in three sub-scales (EE [3 items], RE [6 items], and UE [9 items]) measured on a 4-point response scale (from 1 = *definitely true* to 4 = *definitely*

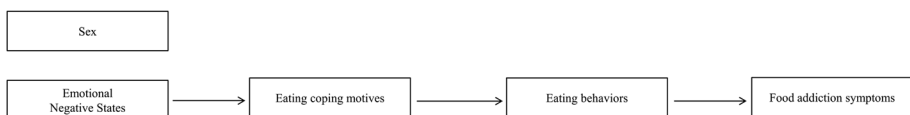
false). This version of the instrument has adequate construct, convergent, and discriminant validity (Jáuregui-Lobera et al., 2014).

## Food Addiction Symptoms

We used the Spanish version (Granero et al., 2014) of the Yale Food Addiction Scale (YFAS-2.0; Gearhardt et al., 2016). The YFAS-2.0 comprises 35 items, of which 33 relate to eleven dichotomous diagnostic criteria for FA in line with the Substance-Related and Addictive Disorders symptom criterion outlined by the DSM-V: substance taken in larger amount and for longer period than intended; persistent desire or repeated unsuccessful attempts to quit; significant time/activity invested to obtain, use, and recover; important social, occupational, or recreational activities given up or reduced; continued use despite knowledge of adverse consequences; tolerance; withdrawal; continued use despite social or interpersonal problems; failure to fulfill major social obligations and use in physically hazardous situations; and craving. The remaining two items measure the clinical relevance of the impairment or distress caused by the FA symptoms. Each question has eight response options that range from 0 = *never* to 7 = *every day*. A continuous symptom score was obtained by summing the number of criteria met (0–11 symptoms). This score did not include the clinical significance criterion. In this study, the total symptom score was used for the analysis. Granero et al. (2018) reported excellent convergent validity for this version of the scale.

## Data Analysis

We conducted Pearson correlations to examine the associations between the variables. This was followed by a path analysis that examined the associations of NES on FA symptoms via coping motives and the three types of eating behaviors. Considering the cross-sectional nature of the data, we conducted atemporal mediation analysis (Winer et al., 2016). The model was fully saturated such that all distal antecedents have paths estimated on eating-to-cope motives, each eating behaviors sub-scale and FA symptoms (e.g., depressive symptoms → eating-to-cope → emotional eating → FA symptoms). The proposed conceptual model of moderated mediation is depicted in Fig. 1. We examined the total, direct, and indirect association of each predictor variable and FA symptoms using bias-corrected bootstrapped estimates (Efron & Tibshirani, 1993) based on 10,000 bootstrapped samples, which provides a powerful test of mediation (Fritz & Mackinnon, 2007) and is robust to small departures from normality (Erceg-Hurn & Mirosevich, 2008). Statistical significance was determined by 95% bias-corrected bootstrapped confidence intervals that do not contain zero. It has been shown that, compared to other procedures, the bias-corrected bootstrap has a relatively high statistical power (Fritz & Mackinnon, 2007).



**Fig. 1** The conceptual model of mediation

To examine whether the model was invariant across college status (students, non-students), we conducted  $\chi^2$  difference tests. Specifically, we compared a freely estimated multi-group model to a constrained multi-group model (i.e., constraining the paths of the mediation model) to determine whether constraining the paths to be equivalent across groups resulted in a worse fitting model. The analyses were conducted with Mplus 6.12 (Muthén and Muthén, 2018).

## Results

### Descriptive Statistics and Bivariate Correlations

Bivariate correlations and summary statistics of FA symptoms, NES, eating-to-cope motives, and altered eating behaviors are presented in Table 1. The bivariate correlations indicated a positive and significant correlation between FA symptoms and all remaining measures (more strongly with UE, EE, and eating-to-cope motives). That is, those who experienced more psychological distress or who reported more eating-to-cope motives or exhibited greater altered eating behaviors also experienced more FA symptoms.

We also observed a significant positive correlation between eating-to-cope motives and all altered eating behavioral patterns and symptoms of psychological stress, which indicated that those more prone to psychological distress and to develop abnormal eating behaviors are more likely to eat to cope. UE and RE, but not EE, were significantly associated with psychological distress.

### Path Analysis

The comparison of the freely estimated multi-group model to the constrained multi-group model indicated that the model was invariant across college status ( $\chi^2_{(27)} = 30.465$ ,  $p = 0.29$ ); CFI = 0.996; TLI = 0.992; RMSEA = 0.023 [90% CI (0.000, 0.058)]. Table 2 and Fig. 2 summarize the total, direct, and indirect associations of each dimension of NES with FA symptoms via eating-to-cope and each altered eating behavior. Additionally, they display the total, direct, and indirect associations of each dimension of NES with each type of eating behavioral patterns via eating-to-cope.

Sex was not significantly associated, directly or indirectly, with any of the variables. NES were indirectly associated with eating behaviors via eating-to-cope motives. Specifically, stress and depressive symptoms were indirectly associated with UE and EE (i.e., more stress/depressive symptoms were associated with greater eating-to-cope which, in turn, were associated with more uncontrolled/emotional eating). Stress also had a significant direct positive association with UE, while depressive symptoms had a significant direct positive association with EE. There were no significant direct or indirect associations between NES and RE. The direct associations between EE ( $\beta = -0.57$  [95% CI -0.037, 0.150]) and RE ( $\beta = -0.009$  [95% CI -0.054, 0.073]) with FA symptoms were not statistically significant. The associations between NES and FA via eating-to-cope motives and altered eating behaviors are described below, as a function of each NES variable.

**Anxiety Symptoms** These symptoms were directly and positively associated with FA. There were no significant indirect associations between anxiety symptoms and FA.

**Table 2** Summary of total, indirect and direct effects on food addiction symptoms and on eating behaviors

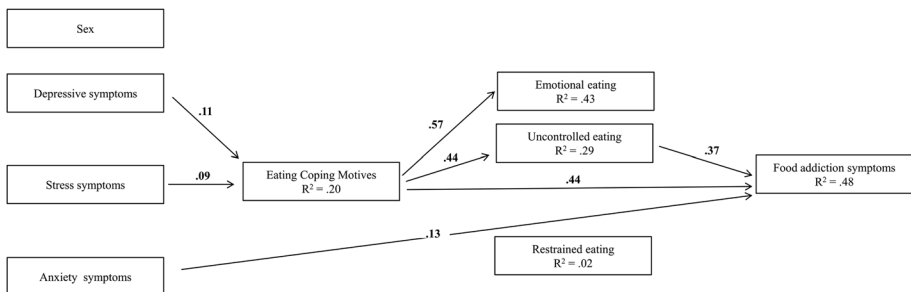
Outcome variables	<i>Uncontrolled eating</i>		<i>Emotional eating</i>		<i>Restrained eating</i>		<i>FA symptoms</i>	
	$\beta$	95% CI	$\beta$	95% CI	$\beta$	95% CI	$\beta$	95% CI
Predictor: <i>sex</i>								
Total	.023	-.053, .098	<b>.090</b>	<b>.013, .167</b>	.048	-.038, .134	-.004	-.072, .064
Total indirect <sup>1</sup>	.021	-.015, .056	.027	-.019, .073	.004	-.005, .013	.026	-.018, .070
Coping	.021	-.015, .056	.027	-.019, .073	.004	-.005, .013	.012	-.009, .033
Uncontrolled eating	-	-	-	-	-	-	.001	-.025, .027
Emotional eating	-	-	-	-	-	-	.004	-.003, .011
Restrained eating	-	-	-	-	-	-	.000	-.003, .005
Coping—uncontrolled eating	-	-	-	-	-	-	.008	-.006, .021
Coping—emotional eating	-	-	-	-	-	-	.002	-.003, .006
Coping—restrained eating	-	-	-	-	-	-	.000	.000, .000
Direct	.002	-.068, .072	.063	-.002, .128	.045	-.042, .131	-.030	-.089, .029
Predictor: <i>anxiety symptoms</i>								
Total	.57	-.089, .204	.019	-.115, .154	.014	-.123, .151	<b>.154</b>	<b>.003, .305</b>
Total indirect <sup>1</sup>	.000	-.064, .064	.000	-.084, .083	.000	-.013, .013	.022	-.063, .108
Coping	.000	-.064, .064	.000	-.084, .083	.000	-.013, .013	.000	-.037, .037
Uncontrolled eating	-	-	-	-	-	-	.021	-.025, .068
Emotional eating	-	-	-	-	-	-	.001	-.007, .009
Restrained eating	-	-	-	-	-	-	.000	-.005, .005
Coping—uncontrolled eating	-	-	-	-	-	-	.000	-.024, .024
Coping—emotional eating	-	-	-	-	-	-	.000	-.006, .006
Coping—restrained eating	-	-	-	-	-	-	.000	.000, .000
Direct	.058	-.068, .183	.020	-.087, .127	.014	-.124, .152	<b>.132</b>	<b>.021, .243</b>
Predictor: <i>stress symptoms</i>								
Total	<b>.244</b>	<b>.111, .377</b>	<b>.159</b>	<b>.029, .288</b>	.066	-.077, .209	<b>.211</b>	<b>.073, .349</b>
Total indirect <sup>1</sup>	<b>.095</b>	<b>.036, .153</b>	<b>.123</b>	<b>.049, .198</b>	.016	-.008, .040	<b>.154</b>	<b>.080, .228</b>
Coping	<b>.095</b>	<b>.036, .153</b>	<b>.123</b>	<b>.049, .198</b>	.016	-.008, .040	<b>.054</b>	.015, .094
Uncontrolled eating	-	-	-	-	-	-	<b>.055</b>	<b>.005, .105</b>
Emotional eating	-	-	-	-	-	-	.002	-.007, .011
Restrained eating	-	-	-	-	-	-	.000	-.005, .006
Coping—uncontrolled eating	-	-	-	-	-	-	<b>.035</b>	<b>.013, .057</b>
Coping—emotional eating	-	-	-	-	-	-	.007	-.006, .020
Coping—restrained eating	-	-	-	-	-	-	.000	-.001, .001



**Table 2** (continued)

Outcome variables	<i>Uncontrolled eating</i>		<i>Emotional eating</i>		<i>Restrained eating</i>		<i>FA symptoms</i>	
	$\beta$	95% CI	$\beta$	95% CI	$\beta$	95% CI	$\beta$	95% CI
Direct	<b>.149</b>	<b>.024, .274</b>	.035	-.079, .150	.050	-.096, .196	.058	-.062, .177
Predictor: <i>depressive Symptoms</i>								
Total	.091	-.035, .217	<b>.257</b>	<b>.132, .382</b>	.064	-.071, .199	<b>.142</b>	<b>.009, .275</b>
Total indirect <sup>1</sup>	<b>.113</b>	<b>.060, .166</b>	<b>.147</b>	<b>.084, .210</b>	.019	-.010, .048	<b>.113</b>	<b>.042, .184</b>
Coping	<b>.113</b>	<b>.060, .166</b>	<b>.147</b>	<b>.084, .210</b>	.019	-.010, .048	<b>.065</b>	<b>.026, .103</b>
Uncontrolled eating	-	-	-	-	-	-	-.008	-.051, .034
Emotional eating	-	-	-	-	-	-	.006	-.007, .019
Restrained eating	-	-	-	-	-	-	.000	-.005, .006
Coping—uncontrolled eating	-	-	-	-	-	-	<b>.042</b>	<b>.019, .065</b>
Coping—emotional eating	-	-	-	-	-	-	.008	-.006, .023
Coping—restrained eating	-	-	-	-	-	-	.000	-.001, .002
Direct	-.022	-.137, .093	<b>.110</b>	<b>.000, .220</b>	.045	-.092, .182	.029	-.077, .134
Predictor: coping								
Total	<b>.436</b>	<b>.347, .526</b>	<b>.568</b>	<b>.503, .633</b>	.074	-.030, .178	<b>.443</b>	<b>.343, .544</b>
Total indirect <sup>1</sup>	-	-	-	-	-	-	<b>.193</b>	<b>.135, .252</b>
Uncontrolled eating	-	-	-	-	-	-	<b>.161</b>	<b>.108, .213</b>
Emotional eating	-	-	-	-	-	-	.032	-.021, .085
Restrained eating	-	-	-	-	-	-	.001	-.005, .007
Direct	-	-	-	-	-	-	<b>.250</b>	<b>.137, .362</b>

Total, indirect, and direct effects of food addiction antecedents on food addiction symptoms via coping motive and eating behaviors (emotional eating, uncontrolled eating, and restrained eating) and total, indirect, and direct effects of eating behaviors antecedents on eating behaviors scores via coping motive. *FA*, food addiction. Significant associations are in bold typeface for emphasis and were determined by a 95% bias-corrected standardized bootstrapped confidence interval (based on 10,000 bootstrapped samples) that does not contain zero. <sup>1</sup>Total indirect reflects the combined indirect associations within the model



**Fig. 2** Depiction of the significant standardized effects of the fully saturated mediation model. Significant associations were determined by a 95% bias-corrected standardized bootstrapped confidence interval (based on 10,000 bootstrapped samples) that does not contain zero. For parsimony, non-significant path coefficients are not shown in the figure; however, they are presented in Table 2

**Stress Symptoms** These symptoms were indirectly associated with FA via eating-to-cope (i.e., stress symptoms → eating-to-cope → FA symptoms) and UE (i.e., stress symptoms → uncontrolled eating → FA symptoms). Moreover, the double-mediated association between stress symptoms and FA symptoms via eating-to-cope and uncontrolled eating was also significant. That is, participants with relatively high levels of stress were more likely to consume HPF to cope with distress. This, in turn, was associated with more UE and more FA symptoms.

**Depressive Symptoms** These symptoms were indirectly associated with FA symptoms via eating-to-cope (i.e., stress symptoms → eating-to-cope → FA symptoms). The double-mediated path from depressive symptoms and FA via motives and uncontrolled eating was also significant. That is, more depressive symptoms were associated with a greater eating-to-cope which, in turn, was associated with more UE which was associated with more FA symptoms.

## Discussion

One of the main results of the present study was that stress or depressive symptoms were significantly associated with UE/EE via eating-to-cope. Specifically, we found a significant double mediation that suggests that greater depressive or stress symptoms are associated with an increased motivation to consume palatable food to cope with distress. This, in turn, was associated with higher UE which was ultimately associated with higher FA symptoms. These results are in line with a plethora of studies that put forward the pathways between NES and EE/UE (or between NES and eating-to-cope) as risk indicators for obesity (van Strien et al., 2016; Wang et al., 2020) or greater BMI (Boggiano et al., 2014; Burgess et al., 2014). These results suggest that, for some young adults, the consumption of palatable food is seen as an incentive to alleviate the distress associated with the critical life changes that characterize this developmental stage, a pattern that puts them at risk for developing altered eating behaviors, greater BMI, and obesity.

The effect of eating-to-cope seems to be broad, affecting a wide spectrum of addictive behaviors. For instance, coping motives are key factors, over other motives, in the prediction of alcohol-related negative consequences (Cummings et al., 2021; Hamilton et al., 2020) and they significantly mediate the relationship between NES and alcohol problems (McPhee et al., 2020). Under this perspective, substance use disorders can be considered to be driven by the need to reduce ongoing negative affect. This postulate, widely known in the substance addiction field as the “self-medication hypothesis” (Turner et al., 2018), could also explain the main result of the present study, namely, that NES are associated with FA symptoms by increasing UE and eating-to-cope motives. In other words, the intake of high-reward foods could be a strategy to ameliorate negative affectivity. Notably, and despite their mechanistic role in the emergence of problematic use of psychoactive substances (Bravo et al., 2017), coping motives have been largely neglected in the design of obesity reduction programs or interventions. The present study pinpoints the usefulness of identifying individuals with high levels of eating-to-cope, which may benefit from treatments such as psychoeducation (Hilker et al., 2016) or mindfulness (Nightingale & Cassin, 2019)]. Futures studies should analyze if a reduction in eating-to-cope motives is subsequently associated with reduced FA.

Our expectation that every dimension of NES would be associated with FA symptoms via eating-to-cope and altered eating behaviors was not corroborated. Anxiety had a direct and positive association with FA, yet we did not detect indirect associations mediated by the other variables included in the model. Ahmed et al. (2016) reported that the magnitude of the association between anxiety and FA varies as a function of the type of anxiety symptoms measured. Specifically, the association is greater when generalized anxiety or symptoms of panic disorders are measured rather than when focusing on social or separation anxiety. Moreover, Nolan and Jenkins (2019) measured trait-like anxiety (i.e., “how individuals feel in general”) and found it was indirectly associated with FA symptoms, via EE. We, however, measured anxiety symptoms (i.e., state-like anxiety) as a unitary construct, which may have limited our chances of detecting indirect associations. It is of course possible that anxiety symptoms are indirectly associated with FA via other, unmeasured, factors. Impulsivity could be one of these potential mediators (Çelebi et al., 2021; Sönmez Güngör et al., 2021). A recent work (Jacques-Tiura et al., 2021), conducted in a sample of young adult women, indicated that impulsivity mediated the association between traumatic events (i.e., being a victim of sexual violence or intimate partner violence) and symptoms of FA. Similarly, da Fonseca et al. (2020) reported that impulsivity predicted the consumption of sugar or foods rich in saturated fat, in women with generalized anxiety disorders. Also, some studies have reported associations between FA symptoms and different dimensions of impulsivity, such as negative urgency (Wolz et al., 2016), impulse control (Rose et al., 2018), or motor impulsivity under negative mood states (Sönmez Güngör et al., 2021). These findings suggest that, when undergoing negative emotional states, individuals with deficits in impulse control are more prone to consume HPF as means to reduce the emotional distress.

Unlike our expectations, and despite exhibiting a significant bivariate association with FA, EE neither had a direct association with FA nor mediated the association between NES and FA. These findings seem to clash with research showing significant associations between these variables, or between EE and the ingestion of HPF (Pepino et al., 2014; Zhang et al., 2020). Methodological differences, however, may explain these differences. The present study examined NES in a non-clinical sample, whereas those previous studies focused on clinical samples, or analyzed EE as a putative mediator between FA and personality traits that exert a broad, distal control upon addictive behaviors (e.g., reward sensitivity, impulsivity). It is also important to highlight that our measure of EE is composed by only three items. Future studies should include more comprehensive instruments, such as the Dutch Eating Behavior Questionnaire (van Strien et al., 1986) or the Emotional Eating Scale II (Kenardy et al., 2003), which assess overeating triggered by specific negative and positive emotions.

Notably, the model was invariant across students and non-students. This may seem paradoxical, since numerous studies have reported high levels of stress, anxiety, and depression in college students (Hoying et al., 2020), which promote unhealthy eating behaviors (Choi, 2020). The analysis of the relationship between NES and eating behaviors in university students has yielded, however, contradictory results (for a review see Haidar et al., 2018). Moreover, most of the studies on this subject have been conducted in North American or European university samples. College life in those countries is significantly different from that of Argentina. Typically, European or North American students move to universities far from their hometown, settle in college dorms, and experience high tuition fees. In contrast, in Argentina, most university students attend tuition-free public universities that are close to their hometown and do not provide in-campus residences. Moreover, Argentinean universities lack the student’s social organizations (i.e., sororities/fraternities) characteristic of American university life, which promote the development

of dysfunctional eating behaviors (Basow et al., 2007; Becker et al., 2018) or substance use disorders (McCabe et al., 2018). It is conceivable that those with membership in these organizations exhibit greater frequency of attendance to social events or meals, which in turn could favor excessive intake of HPF and the development of FA over time.

We found no significant associations between sex and the other variables included in the model. In general, the literature has shown that women exhibit higher prevalence of FA than men (Obregón et al., 2015; Yu et al., 2018). In recent years, however, some studies reported the absence of sex differences in this outcome (Meadows et al., 2017; Murphy et al., 2014). It is also worth discussing the context of the country where the study took place. A nation-wide survey (Zapata et al., 2016) reported that high consumption of HPF is gradually replacing the traditional Argentinean diet, mainly characterized by minimally processed food. In more general terms, eating habits in Argentina are characterized by a high prevalence of animal proteins (traditionally coming from cattle) and low prevalence of plant proteins (Arrieta et al., 2021), over and below the regular recommendations, respectively. Intake of soft drinks has doubled in the last 20 years, whereas in the same period fruit and vegetable intake decreased by 41% and 21%, respectively (Zapata et al., 2016). Notably, the consumption of foods high in sugar ( $\geq 150$  gr/day) is much more prevalent in Argentina than in the remaining South American countries (Pou et al., 2020). For instance, in a yearly basis, Argentineans consume 131 L per capita of soft drinks and 194.1 kg per capita of ultra-processed foods (Vandevijvere et al., 2019). Taken together, these data highlight the importance of implementing public policies to reduce the consumption of ultra-processed foods (e.g., front-of-package labeling, price increases via higher taxes) or to promote the intake of fruits and vegetables (e.g., nutritional education or promotion of production via monetary incentives).

There are several limitations to the current study. First, like most of the studies on eating behaviors or FA, the participants were mostly females (Romero et al., 2019, Şahan et al., 2021). Women are, probably due to sex-related differences in the use of online environments (Jackson et al., 2001), more likely than men to participate in online surveys (Smith, 2008). A second limitation is that the recruitment of participants (i.e., via social media and email listings) precluded the involvement of those who do not use social networks or that were not included in those lists. Third, the cross-sectional nature of the study impedes establishing temporal interpretations of the associations between the variables. Another limitation is that during the timeline of the survey, there were, due to the COVID-19 pandemic, some restrictions in the operation of the food and grocery shopping stores in Argentina. This may have altered the normative consumer behavior. Another caveat is that we only focused on FA as an outcome. Future studies will benefit from measuring other problem eating behaviors such as binge eating disorder. The latter is a behavioral pathology with focus on concerns about body shape and weight (Davis, 2017). A last limitation of the present study is the low reliability of the RE dimension of TFEQ-R18. Future, experimental or longitudinal, studies might build up from the present findings to investigate causal/temporal association between these variables and should include instruments more adequate to evaluate RE.

Despite the limitations, this study suggests that, during young adulthood, the pathway including eating-to-cope and altered eating behaviors could be key for the development of FA symptoms in individuals exhibiting stress or depressive symptomatology. The results advance our understanding of the potential mechanisms underlying FA among young adults. The individuals at risk should benefit from interventions aimed at increasing emotional regulation or distress tolerance ability, to disrupt engagement in situations where food is consumed to cope with negative states.

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**Author Contribution** Drs. Fernández, Pilatti, and Pautassi conceptualized the research question and designed the study. Dr. Fernández collected the data, conducted the analyses, and wrote the first draft of the manuscript and its subsequent versions. Dr. Pilatti coordinated and supervised all the analyses, helped draft the manuscript, and edited all the sections of the first draft and its subsequent versions. Dr. Pautassi helped draft the manuscript and edited all the sections of the first draft and its subsequent versions. All authors contributed to and approved of the final manuscript.

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**Data Availability** The data underlying this article will be shared on reasonable request to the corresponding author.

## Declarations

**Ethics Approval** All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2000. The study was approved by the institutional review board of IIPSI-CONICET-UNC, and endorsed the ethical guidelines for human research of the American Psychological Association (2016) and the Argentinean National Law for the Protection of Personal Data (Law 23.326).

**Consent to Participate** Informed consent was obtained from all patients for being included in the study.

**Conflict of Interest** The authors declare no competing interests.

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