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ORIGINAL ARTICLE

Association between impulsivity and orthorexia nervosa: any moderating role of maladaptive personality traits?

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Abstract

Objectives To explore the possible moderating relation between impulsive behavior and maladaptive personality traits in regards to orthorexia nervosa (ON).

Methods This cross-sectional study was conducted between July and December 2019 and recruited 519 Lebanese adults from seven community pharmacies randomly selected from a list provided by the Lebanese Order of Pharmacists. The Teruel Orthorexia Scale (TOS) was employed to assess orthorexic eating tendencies, the I-8 measured impulsivity and the Personality Inventory for DSM-5 (PID) evaluated maladaptive personality traits.

Results Our results showed that, for I-8 subscales, only higher perseverance (B = 0.31) was significantly associated with higher ON. In regard to PID-5 subscales, only higher negative affect (B = − 0.34) was significantly associated with lower ON. Furthermore, significant interactions were found between personality traits and impulsivity to predict TOS-ON.

Conclusion The current results show that female gender, maladaptive personality traits and impulsivity present contributing factors regarding orthorexic eating. Certain impulsivity dimensions were confirmed to interact with personality traits in the prediction of orthorexic eating thereby highlighting possible risk factors and psychopathological mechanisms.

Level of evidence Level V, cross-sectional descriptive study.

Keywords Orthorexia nervosa · Impulsivity · Maladaptive personality traits

Introduction

Orthorexia nervosa (ON) can be described as an excessive preoccupation with eating only healthy foods (or "pursuing a healthy diet") to maintain physical purity and health. Individuals who meet the criteria for ON apply extreme nutritional restrictions, only consuming food they perceive as "healthy" and scrutinizing its quality as opposed to quantity [1]. The self-imposed dietary rules intensify in strictness over time and any breach of these standards induces fear of disease and negative affect [2]. The development of ON is proposed to have detrimental physiological, psychological and social consequences that include malnourishment, social isolation, anxiety and even death [2]. Having said that, at this point in time, ON is not listed in the DSM-5 as

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a confirmed psychiatric disorder [3]. The little investigation on ON has provoked extensive debate about how this phenomenon should be classified. One recent review summarized evidence for a phenomenological fit between ON and common eating disorders [4]. Diagnosis-wise, certain orthorexic behaviors are consistent with a weakness in set-shifting. For example, orthorexic subjects develop specific rules about food selection (e.g., cannot purchase foods with preservatives), preparation (e.g., must eat only raw foods), and consumption (e.g., must eat foods alone or in set combinations) [5]. As these rules increase in number or complexity, the orthorexic individual dedicates more time and energy to satisfy these rules and may limit exposure to situations in which rule-following is difficult (e.g., eating at restaurants, sharing a meal with others).

A previous study in Lebanon showed that 75.2% of individuals from a representative sample exhibit relevant ON tendencies and behaviors [6]. Different validated versions of the ORTO scale were commonly used in previous studies and produced prevalence rates in the range between 1 and more than 80% [7–11]. Therefore, this tool has been criticized for its psychometric problems and lack of specificity to detect pathological stages [12]. Based on this criticism, the Teruel Orthorexia Scale (TOS) was developed, a scale which assesses orthorexic eating on two separate dimensions: a pathological and a healthy dimension [13]. This tool, however, does not provide cut-offs beyond which the behaviors are considered pathological. The tendency to engage in pathological orthorexic eating behaviors varied but maintained a significant percentage with higher levels in Lebanon as compared to Germany or Spain [7, 8].

While there is much research on underlying sociodemographic characteristics in orthorexic eating [4], research on psychological correlates is still in its infancy. Besides studies on trait characteristics like anxiety and emotion regulation difficulties [9, 14], research also focuses on personality traits and temperament. Low-to-medium scores on perseverance were consistently connected to ON, while high Neuroticism and negative affect were positively associated with ON. In addition, there is initial evidence for maladaptive personality characteristics to relate to ON, particularly traits such as negative affectivity, detachment and psychoticism [15]. One trait to which little attention has been paid so far is impulsivity. Impulsivity is a trait-like characteristic often associated with various psychological constructs and has been established as a determinant of behavior [15]. Impulsivity, a general model of personality [8], is a multidimensional temperament with inhibitory control, or the ability to delay the performance of a behavior, as its core aspect [16]. Impulsivity-related traits include urgency, which refers to the level of recklessness during emotional arousal; premeditation, portrays the degree of planning towards goals; perseverance, which is dedication, and sensation seeking indicating liable behavior [17]. Theorists suggested that novelty seeking encompasses impulsivity, as both are linked to lack of inhibitory control [18]. A previous study found similar links between eating disorders, impulsivity and certain personality traits including novelty seeking [19].

The literature includes opposing results involving impulsivity and ON. Women who met the criteria for eating disorders were more likely to experience impulsivity [20]. Individuals that fit the criteria for ON were more likely to experience impulsivity and excitement, based on the Personality NEO Revised (NEO-PI-R) and Minnesota Multiphasic Personality Inventory (MMPI) [21, 22]. On the other hand, past research on temperament and character suggest the possibility of a negative correlation between impulsive behaviors and ON: a study showed that all eating disorders were associated with high harm avoidance (HA) [23], while another found that those with eating disorders have low levels of excitement-seeking [24].

Certain personality traits and impulsivity are more pronounced in restrictive eating behaviors [25] such as ON. Research in this regard, however, is missing and was, therefore, aim of the present report. Past research on different eating disorders such as bulimia nervosa, anorexia nervosa and binge eating disorder suggests the possibility of a link between the four impulsivity traits and maladaptive personality traits [26, 27]. In the current study, we assume that individuals exhibiting high ON are more likely to score lower on impulsivity and maladaptive traits. In addition, we aimed to examine associations between impulsivity, maladaptive personality traits and orthorexic eating. Our assumption was that there is a moderating effect between impulsive behavior and maladaptive personality traits in regards to orthorexic eating**.** Finally**,** gender was considered a moderator of orthorexic eating in our study, as gender-specific prevalence rates and risk factors have been suggested in previous research.

Methods

Procedure

Data for this report stems from a cross-sectional study conducted between July and December 2019 in Lebanon. The Lebanese sample was recruited from seven community pharmacies chosen randomly from a list provided by the Lebanese Order of Pharmacists. Each person entering a pharmacy was encouraged to participate in the study. Scales that were not available in Arabic were forward and back-translated independently. All participants aged 18 years and above were invited to participate.

Minimal sample size calculation

According to the G-power software, and based on an effect size f2 = 2%, an alpha error of 5%, a power of 80%, and taking into consideration 15 factors to be entered in the multivariable analysis, a minimal sample size of 395 was needed.

Questionnaires and variables

The self-administered questionnaire was filled in without collecting information that could potentially identify participants and was available in Arabic, the mother tongue in Lebanon. Well-trained interviewers explained the study objectives to each participant. On average, the questionnaire required approximately 15–20 min to be completed. At the end of the process, the completed questionnaires were collected back by the interviewers and sent for data entry. The anonymity of participants was guaranteed by putting filled out questionnaires into closed boxes.

The first part of the survey clarified sociodemographic characteristics: age, gender, level of education and monthly income.

The second part included the *Teruel Orthorexia Scale* (TOS; 23), currently, the only scale mapping the bi-dimensional structure and allowing for a differentiation between healthy and pathological aspect of orthorexic eating. The TOS was developed in the wake of criticism of previous procedures. Scientists believed a tool that assesses a healthy eating style and appetite that differentiates from pathological forms of obsessive healthy eating was needed [17]. This scale consists of 17 items rated on a 4-point Likert scale ranging from "completely disagree" (0points) to "completely agree" (3points) (17). It yields two subscales: Healthy Orthorexia (TOS-HeOr) (e.g. I believe that the way I eat is healthier than that of most people.) and orthorexia nervosa (TOS-ON) (e.g., I try to convince people from my environment to follow my healthy eating habits) [13]. The TOS-HeOr subscale was used for descriptive purposes, while the TOS-ON was the main dependent variable in this report. In this subscale, higher scores indicate higher orthorexia nervosa. Reliability was very good for both subscales ($\alpha_{\text{Cronbach HeOn}} = 0.87$, $\alpha_{\text{Cronbach On}} = 0.87$).

Impulsivity was measured using the *I-8 scale*, which judges urgency, premeditation, perseverance and sensation seeking on a 6-point scale from 0 (doesn't apply at all) to 5 (applies completely). Higher scores indicate higher impulsivity level in each of the four subscales: urgency ($\alpha_{\text{Cronbach}} = 0.78$), premeditation ($\alpha_{\text{Cronbach}} = 0.82$), perseverance ($\alpha_{\text{Cronbach}} = 0.73$) and sensation seeking ($\alpha_{\text{Cronbach}} = 0.74$).

To assess maladaptive personality traits, the *Personality Inventory for DSM-5 (PID)* was used; it consists of 25 items and evaluates negative affectivity (refers to the stable tendency to experience negative emotions, e.g., "I fear being alone in life more than anything else"; $\alpha_{\text{Cronbach}} = 0.94$), detachment (involves depressive affect, interpersonal withdrawal and mistrust, e.g., "I often feel like nothing I do really matters"; $\alpha_{\text{Cronbach}} = 0.96$), antagonism (involves antisocial traits as well as grandiosity and attention-seeking, e.g., "It's no big deal if I hurt other peoples' feelings"; $\alpha_{\text{Cronbach}} = 0.92$), disinhibition (which is a lack of restraint manifested in disregard of social conventions, impulsivity, and poor risk assessment, e.g., "I feel like I act totally on impulse"; $\alpha_{\text{Cronbach}} = 0.95$) and psychoticism (characterized by aggressiveness and interpersonal hostility, e.g., "I have seen things that weren't really there"; $\alpha_{\text{Cronbach}} = 0.95$) [21, 26]. Higher scores indicate higher level of each maladaptive personality trait.

Forward and back translation procedure

Forward translation was first conducted by a single bilingual translator, whose native language is Arabic and who is fluent in English. An expert committee of healthcare professionals (two psychologists and two psychiatrists) and a language professional verified the Arabic translated version. A backward translation was then performed by a native English speaker translator, fluent in Arabic and unfamiliar with the concepts of the scales. The back-translated English questionnaire was subsequently compared to the original English one by the expert committee, to discern discrepancies and solve any inconsistencies between the two versions. The process of forward-back translation was repeated until all ambiguities disappeared. The questionnaire was tested on a pilot sample of 20 participants before the data collection was officially started. The results of the pilot sample were not included in the final data set.

Statistical analysis

Data entry was done by one study-independent person not involved in the data collection process, and statistical analysis was performed using SPSS software, version 23. Data were screened for missing and unrealistic values (e.g., aged 5, or BMI below 14 kg/m^2) that were restored when possible, or otherwise considered missing. A confirmatory factor analysis done on the Statistica software was carried out to confirm the original structure of the TOS scale. We reported several goodness-of-fit indicators: the Relative Chi-square (χ2/df), the Root Mean Square Error of Approximation (RMSEA), the Goodness of Fit Index (GFI) and the Adjusted Goodness of Fit Index (AGFI). The value of χ2 divided by the degrees of freedom (χ^2/df) has a low sensitivity to sample size and may be used as an index of goodness of fit (cutoff values: < 2–5). The RMSEA tests the fit of the model to the covariance matrix. As a guideline,

values of < 0.05 indicate a close fit and values below 0.11 an acceptable fit. The GFI and AGFI are Chi-square-based calculations independent of degrees of freedom. The recommended thresholds for acceptable values are ≥ 0.90 [15]. Since the TOS-ON score did not follow a normal distribution, non-parametric tests were used. The Mann–Whitney to check for an association between orthorexia nervosa scores and dichotomous variables, and Kruskal–Wallis test to compare the means of 3 or more groups. Spearman correlation was used to compare two continuous variables. A hierarchical linear regression was conducted, considering the TOS-ON score as the dependent variable, and taking in the first model gender as independent variable; in the second model, z-standardized impulsivity scores were added; in the third model, z-standardized maladaptive personality traits scores were added; finally, in the fourth model, the interactions of the standardized impulsivity scores by personality scores were added. In all models, independent variables were those that showed a $p < 0.2$ in the bivariate analysis. $p < 0.05$ was considered statistically significant (Table 1).

Results

The sample comprised 519 adults out of 700 approached (74.14%) ($n = 283$, 56.0% women) with a median age of 33.50 years (mean: 36.02, standard deviation: 14.20, range: 18–75) and a median BMI of 24.21 kg/m^2 (mean: 24.41, standard deviation: 4.32, range: 10.54–37.78). More than half of the sample had university education level ($n = 252$, 53.1%) and reported to be unmarried ($n = 264$, 51.6%).

Table 1 Sociodemographic characteristics of the sample (N = 519)

Variable	N (%)
Gender	
Male	222 (44.0%)
Female	283 (56.0%)
Marital status	
Single/widowed/divorced	264 (51.6%)
Married	247 (48.3%)
Education level	
Illiterate	3 (0.6%)
Primary	27 (5.7%)
Complementary	74 (15.6%)
Secondary	119 (25.1%)
University	252 (53.1%)
Monthly income	
No income	138 (29.5%)
< 1000 USD	148 (31.6%)
1000–2000 USD	133 (28.4%)
> 2000 USD	49 (10.5%)

The mean TOS OrNe and TOS HeOr were 7.75 ± 5.62 and 11.05 ± 5.60, respectively.

Confirmatory factor analysis

A confirmatory factor analysis was conducted using the two-factor solution from the original TOS validation. The results were as follows: $\chi 2 = 820.741$; $p < 0.001$ and Degrees of Freedom = 212.077, which gave a $\chi 2/df = 3.87$. For non-centrality fit indices, the Steiger-Lind RMSEA was 0.088 [0.079–0.098]. Moreover, the Joreskog GFI equaled 0.92 and AGFI equaled 0.90.

Bivariate analysis

The results of the bivariate analysis are shown in Tables 3 and 4. TOS-ON levels did not differ according to the sociodemographic variables (Table 2). Higher detachment, antagonism, psychoticism, urgency, premeditation and perseverance were significantly associated with higher TOS-ON, whereas higher sensation seeking was significantly associated with lower TOS-ON (Table 3).

Multivariate analyses

A linear regression, taking the orthorexia nervosa score as the dependent variable and gender as an independent variable, showed that female gender was significantly associated with higher orthorexia nervosa (see Supplementary Table 1 for the complete Table). When adding the impulsivity scores as independent variables in the second step, only higher perseverance (B = 0.31) was significantly associated with higher TOS-ON. When adding maladaptive personality traits as independent variables, higher negative affect (B = − 0.34) was significantly associated with lower ON. In the final model (Table 4), interactions were added. The results showed that female gender (B = 1.29), higher urgency (B = 0.31), and the interaction perseverance by antagonism (B = 0.92) were significantly associated with higher ON, whereas higher negative affect (B = − 0.32), the interaction sensation seeking by negative affect (B = − 0.98), the interaction sensation seeking by disinhibition (B = − 0.94), the interaction perseverance by detachment (B = − 0.82), and the interaction urgency by disinhibition (B = − 0.79) were significantly associated with lower ON (for a graphical depiction see Figs. 1, 2, 3, 4, 5).

Discussion

The aim of our study was to explore the possible moderating relation between impulsive behavior (urgency, lack of premeditation, lack of perseverance, and sensation seeking)

Table 2 Analysis of sociodemographic factors associated with orthorexia nervosa

Variable	TOS orthorexia nervosa
Categorical data	Mann–Whitney or Kruskal–Wallis
Gender	
Male	7.35 ± 5.65
Female	8.00 ± 5.66
P	0.206
Marital status	
Single/divorced/widowed	7.80 ± 5.69
Married	7.70 ± 5.55
P	0.962
Education level*	
Illiterate/primary	6.40 ± 5.16
Complementary	8.59 ± 6.42
Secondary	7.44 ± 5.12
University	7.53 ± 5.89
p	0.429
Monthly income*	
No income	8.11 ± 6.06
< 1000 USD	7.34 ± 5.31
1000–2000 USD	7.68 ± 5.27
> 2000 USD	8.96 ± 6.50
p	0.511
Numerical data	Spearman correlation
Age	0.030, $p = 0.497$
Body Mass Index	− 0.025, $p = 0.585$

TOS = Teruel Orthorexia Scale; Numbers represent means ± standard deviations in case of the bivariate analysis of the TOS orthorexia nervosa score and categorical variables and Spearman correlation coefficients in case of the bivariate analysis of the TOS orthorexia nervosa score and continuous variables; The post-hoc analysis results did not show any significant differences between the education level and monthly income categories.

Table 3 Bivariate analysis of impulsivity and maladaptive personality traits associated with orthorexia nervosa (TOS-ON)

Variable	TOS-ON
PID-Negative affect	− 0.053
PID-Detachment	0.126[b]
PID-Antagonism	0.176[a]
PID-Disinhibition	0.069
PID-Psychoticism	0.152[b]
I8-Urgency	0.125[b]
I8-Premeditation	0.110[c]
I8-Perseverance	0.169[a]
I8-Sensation seeking	− 0.111[c]

[a]$p < 0.001$; [b]$p < 0.01$; [c]$p < 0.05$; Numbers in this table correspond to the Spearman correlation coefficients (rho)

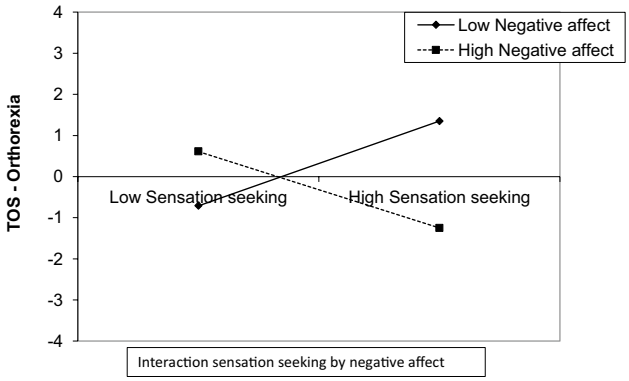

Fig. 1 Interaction sensation seeking by negative affect on TOS Orthorexia nervosa

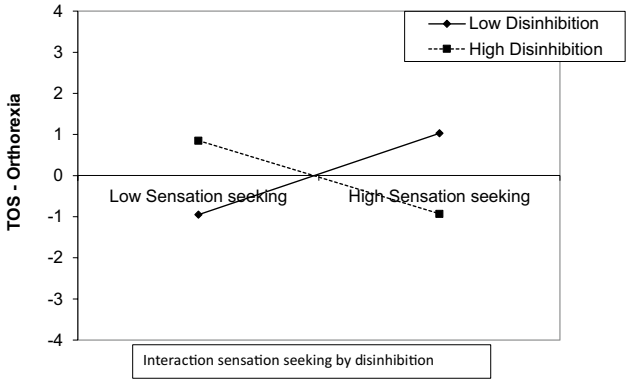

Fig. 2 Interaction sensation seeking by disinhibition on TOS Orthorexia nervosa.

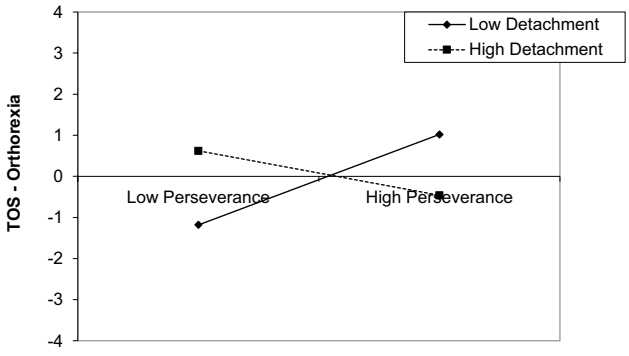

Fig. 3 Interaction lack of perseverance by detachment on TOS Orthorexia nervosa

and maladaptive personality traits (negative affectivity, detachment, antagonism, disinhibition, and psychoticism) in regards to orthorexic eating. Results of the hierarchical regression showed that being female and higher urgency were significantly associated with higher orthorexic eating. Additionally, maladaptive personality traits moderated the

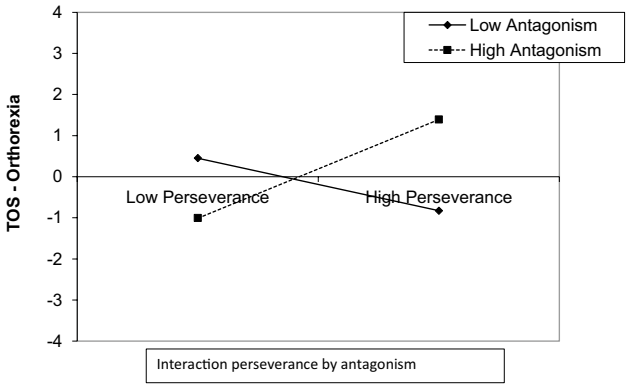

Fig. 4 Interaction lack of perseverance by antagonism on TOS Orthorexia nervosa

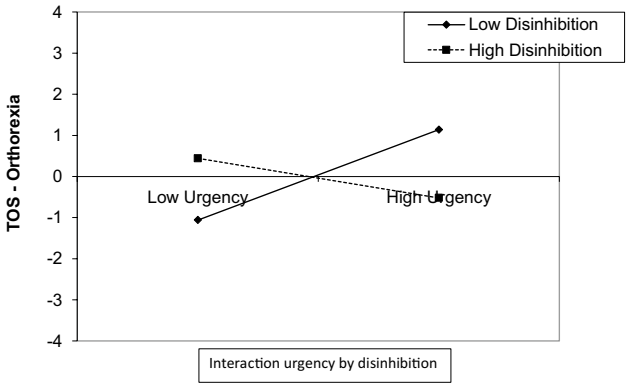

Fig. 5 Interaction urgency by disinhibition on TOS Orthorexia nervosa

effects of impulsive behaviors, which will be discussed in more detail in the following.

Impulsivity and orthorexic eating

In our study, higher urgency, lack of premeditation and lack of perseverance were linked to higher TOS-ON, and higher sensation seeking was related to lower TOS-ON. Notably, coefficients were of only small magnitude. The literature suggests that eating disorders that involve food restriction are generally associated with impulsivity traits [28], and ON involves a pattern of disordered eating where unhealthy foods are avoided and consumption of nutrients is heavily premeditated. In our multivariable analyses, the only main effect was between urgency, i.e. acting rashly when in extreme distress and impairments in inhibitory control, and higher TOS-ON levels. High urgency levels found among individuals who engage in orthorexic eating may reflect a poor ability in adopting adequate coping strategies to finalize action in everyday life [29]. Urgency and impulsivity in general were shown to be related to uncontrolled eating and greater difficulty in inhibiting urges to eat [30]. This, however, does not fit the proposed indicators of orthorexic eating such as rigid avoidance of foods and ritualized preoccupation with nutrition-related behaviors. These discrepancies between present findings and diagnostic criteria suggest a possible interactive role played by other factors. In this study, we investigated the role of maladaptive personality traits in this regard. Furthermore, additional research on impulsivity and orthorexic eating might reveal more compelling coefficients that allow concrete interpretation. Overall, the current findings oppose our initial hypothesis about the relationship between orthorexic eating and impulsivity.

Interaction of maladaptive personality and impulsivity, and orthorexic eating.

While no direct effect was found between impulsivity and orthorexic eating, maladaptive personality traits appeared to contribute to higher risk of orthorexic eating.

Urgency, disinhibition and orthorexic eating

Results showed that low urgency coupled with high disinhibition and high urgency with low disinhibition showed higher TOS-ON scores. Urgency is a determinant related to personality that has a significant contribution to the persistence of maladaptive eating patterns [31]. Previously, higher urgency was associated with uncontrolled eating [27], which opposes features of orthorexic eating, further emphasizing the possibility of a variable such as disinhibition contributing to the relationship between urgency and orthorexic eating. Individuals with higher disinhibition are more likely to exhibit lower ON scores or less restraint when it comes to food consumption, which is an accordance with our results showing low urgency and high disinhibition's link to high orthorexic eating. However, high urgency, low disinhibition and high orthorexic eating can be perceived as logically false as high disinhibition is associated with the initiation and maintenance of eating disorders where there is lack of control in regards to food consumption [32]. Our findings show a negative interaction between urgency and disinhibition in relation to orthorexic eating, confirming that the connection between these variables has a significant impact on orthorexic eating. In a previous study, impulsivity was negatively related to cognitive restraint in regards to eating habits [17]; meaning that individuals with high impulsivity and poor ability to control food intake were more likely to suffer from uncontrolled eating, while the opposite relation was found to be associated with eating disorders characterized by under-eating. In our study, both directions of the interaction between urgency and disinhibition were associated with higher orthorexic eating, despite it being a restrictive eating pathology, which could indicate that ON does

Table 4 Multivariable analysis: Final model of the linear regressions taking the orthorexia nervosa score as the dependent variable

Model 1: Interactions of personality traits and impulsivity scores as independent variables					
Variable	Unstandardized Beta	Standardized Beta	t	*p*	95% CI
Gender (females vs males*)	1.29	0.11	2.61	**0.009**	0.32–2.26
Urgency	0.31	0.13	2.50	**0.013**	0.07 to 0.55
Premeditation	− 0.04	− 0.01	− 0.23	0.819	− 0.34 to 0.27
Perseverance	0.28	0.11	1.93	0.055	− 0.01 to 0.57
Sensation seeking	0.05	0.02	0.36	0.719	− 0.21 to 0.31
Detachment	0.08	0.05	0.80	0.425	− 0.12 to 0.28
Antagonism	0.19	0.12	1.73	0.084	− 0.03 to 0.41
Psychoticism	0.16	0.09	1.42	0.155	− 0.06 to 0.39
Negative affect	− 0.32	− 0.19	− 3.35	**0.001**	− 0.51 to − 0.13
Disinhibition	− 0.04	− 0.03	− 0.39	0.696	− 0.25 to 0.17
Interaction sensation seeking by negative affect	− 0.98	− 0.20	− 3.28	**0.001**	− 1.58 to − 0.39
Interaction sensation seeking by detachment	0.66	0.13	1.91	0.057	− 0.02 to 1.34
Interaction sensation seeking by antagonism	− 0.69	− 0.13	− 1.78	0.076	− 1.44 to 0.07
Interaction sensation seeking by disinhibition	− 0.94	− 0.19	− 2.88	**0.004**	− 1.58 to − 0.30
Interaction sensation seeking by psychoticism	0.26	0.05	0.73	0.464	− 0.44 to 0.96
Interaction perseverance by negative affect	− 0.37	− 0.08	− 1.25	0.211	− 0.96 to 0.21
Interaction perseverance by detachment	− 0.82	− 0.18	− 2.27	**0.024**	− 1.52 to − 0.11
Interaction perseverance by antagonism	0.92	0.19	2.45	**0.015**	0.18 to 1.66
Interaction perseverance by disinhibition	− 0.30	− 0.07	− 0.85	0.394	− 1.00 to 0.40
Interaction perseverance by psychoticism	− 0.03	− 0.01	− 0.06	0.951	− 0.84 to 0.79
Interaction premeditation by negative affect	− 0.46	− 0.10	− 1.49	0.136	− 1.06 to 0.15
Interaction premeditation by detachment	0.41	0.09	1.10	0.271	− 0.32 to 1.14
Interaction premeditation by antagonism	0.20	0.04	0.53	0.600	− 0.55 to 0.95
Interaction premeditation by disinhibition	0.30	0.07	0.87	0.387	− 0.39 to 0.99
Interaction premeditation by psychoticism	0.11	0.02	0.28	0.783	− 0.68 to 0.90
Interaction urgency by negative affect	0.47	0.10	1.66	0.098	− 0.09 to 1.03
Interaction urgency by detachment	0.29	0.06	0.96	0.336	− 0.31 to 0.89
Interaction urgency by antagonism	− 0.36	− 0.07	− 1.01	0.314	− 1.06 to 0.34
Interaction urgency by disinhibition	− 0.79	− 0.16	− 2.81	**0.005**	− 1.34 to − 0.24
Interaction urgency by psychoticism	0.04	0.01	0.11	0.917	− 0.65 to 0.72

*Reference group; Numbers in bold indicate significant *p*-values; R^2 values for all models: Model 1 = 0.3%; Model 2 = 3.4%; Model 3 = 7.8%; Model 4 = 23.1%

not have the same properties as eating disorders and could potentially belong to another category of psychopathology that describes it better [33]. Given these points, it is important to consider the possibility that risk of developing orthorexia eating risk is higher when urgency and disinhibition are more pronounced.

Perseverance, antagonism and orthorexic eating

In participants with low perseverance, those with low antagonism had higher TOS-ON scores. In participants with high perseverance, those with high antagonism had higher TOS-ON scores. This effect can be expected as antagonism, which can be considered the opposite of agreeableness, involves antisocial traits such as grandiosity and attention-seeking [34]. The results of a recent Lebanese study [33] showed that lower agreeableness was associated with higher ON. The interaction between antagonism, impulsivity and orthorexic eating has not been investigated so far. Results of the present study showing that high antagonism levels in interaction with high lack of perseverance lead to higher orthorexic eating can be interpreted as logically contradictory. Low self-discipline and difficulties maintaining focus on a task, combined with high antagonism or low agreeableness lead to an inability to inhibit the response to attractive food stimuli upon exposure to such stimuli [35], which is not in agreement with ON features. Research found that treatment targeting antagonism reduced restrictive eating in mice

[36], which provides grounds that high antagonism can be related to orthorexic eating. Our results imply that the positive coupling of perseverance and antagonism in both ways promote high orthorexic eating. A previous study found that perseverance was not the strongest indicator of pathological eating behaviors [8], which could imply that it can not exclusively predict eating patterns. Having said that, perseverance is a reliable predictor of psychological disorders, especially those involving restrictive dietary behaviors such as orthorexic eating [37]. As previously mentioned, ON has an ambiguous classification and is not an official disorder mentioned in the DSM; therefore, our findings hint at the possibility of it belonging to a category other than eating disorders given the conflict evident when results of ON studies are contrasted with previous eating disorders studies. Ultimately, lower perseverance and antagonism scores can indicate a risk of developing orthorexic eating patterns.

Perseverance, detachment and orthorexic eating.

In addition, a negative interaction between detachment levels and perseverance was associated with higher TOS-ON scores. To the best of our knowledge, no previous study has investigated the interaction between detachment, impulsivity and orthorexic eating. Detachment can include negative affect, interpersonal withdrawal and mistrust [38]. Another study showed that individuals with high ON levels showed higher dismissing attachment style, which can be defined as tendency to detach from potential sources of rejection [39]. Having said that, some findings suggest that perseverance is positively associated with psychopathology and maladaptive behaviors [40]. Previously, high detachment and low impulsivity was associated with restrictive eating disorders [36], which can be considered similar to our results. In sum, the relationship between impulsivity trait perseverance and detachment might be a risk-potentiating factor for the tendency towards orthorexic eating.

Sensation seeking, negative affect and orthorexic eating

Sensation seeking was not a main contributor to orthorexic eating but in interaction with negative affect and disinhibition, there were significant associations. Results of our study showed that the interaction of sensation seeking with negative affect was associated with higher orthorexic eating; in participants with high sensation seeking, those with low negative affect had higher TOS-ON scores. The literature offers many findings related to sensation seeking and eating disorders centered on restriction: sensation seeking was high among younger individuals who were diagnosed with Anorexia [41]. Having said that, patients diagnosed with restrictive eating disorder showed less sensation seeking than those with eating disorders related to overconsumption of food [42]. It is evident that high sensation seeking is more prevalent among individuals with binge eating behaviors [43], especially women [44]. Previous studies showed that orthorexic attitudes were positively associated with neuroticism [45, 46]; the latter can be characterized as having a tendency toward a negative emotional state, which includes depressive and anxious feelings. The interaction between high sensation seeking and low negative affect being related to higher TOS-ON scores in our sample can explain the positive association between sensation seeking and orthorexic eating, despite ON being a restrictive eating pattern. This further confirms the role of maladaptive personality traits on the relation between orthorexic eating and impulsivity. The current findings imply that high sensation seeking coupled with low negative affect could increase the risk for orthorexic eating behaviors.

Sensation seeking, disinhibition and orthorexic eating

Results of our study show that high sensation seeking with low disinhibition portray high levels of TOS-ON scores. Individuals with high disinhibition seek unusual and risky sensations, the tendency to give way to cravings to encounter attractive food stimuli is determined by the presence or absence of an impulsive trait such as sensation seeking; the latter can encourage the person to inhibit or not his response to attractive food stimuli upon exposure to such stimuli [24]. Previously, a study showed that high disinhibition and high restraint were associated with disordered restrictive eating behaviors while high disinhibition and low restraint were related to overeating [47]; these findings support our results in the aspect that disinhibition plays a significant role in the dynamics connected to problematic eating behaviors such as orthorexic eating. In another investigation, disinhibition was not found to have a significant effect on ON among nutrition students [48], which also reinforces the hypothesis that interaction between a variable, such as sensation seeking, and disinhibition could cause a significant effect on orthorexic eating. In conclusion, high sensation seeking and low disinhibition present the possibility of higher orthorexic eating patterns.

Gender and orthorexic eating

Results of our study showed that being female was associated with higher TOS-ON scores. The results from past research have been mixed on possible gender differences, with studies finding greater ON levels in women than men [8, 49], greater ON levels in men than women [5, 50], while other found no gender differences [24, 51]. Having said that, women are historically more likely to report having maladaptive eating patterns [52], which could affect the accuracy of prevalence of eating disorder among the genders.

Moreover, our findings did not indicate a significant contribution from other sociodemographic variables (age, BMI, marital status, education and monthly income). These analyses can be replicated in samples that are more representative for the general population for more concrete results.

Clinical implications

The value of our study is solidified by the high rate of orthorexic behaviors in Lebanon [18]. Our findings confirm the role of maladaptive personality traits in the relation between impulsivity and orthorexic eating, which could help identify pathological orthorexic behaviors in the future and apply tailored intervention plans focusing on impulsivity-related traits and particular maladaptive personality characteristics, such as Cognitive Behavioral Therapy (CBT). These results reinforce the pending legitimization of ON as an eating disorder and add to the limited body of research concerning this pathology.

What is already known about the subject?

Currently, ON is not qualified as an eating disorder due to insufficient clinical pertinence; therefore, no diagnostic criteria or clear set of signs exist for orthorexia nervosa, however, it is defined as an excessive preoccupation with eating only healthy foods.

What does this study add?

Our study provides insight into impulsivity, maladaptive personality traits and orthorexic eating, as well as sociodemographic correlates and moderating relationships. Considering that orthorexia is a newly emerging eating disorder that has not yet been included as a legitimate pathology, our findings provide a pathway for further investigations regarding ON, both in Lebanon and worldwide.

Limitations and strengths

This study has a couple notable limitations. First, the data were collected through a questionnaire, which introduces bias related to self-report measures and the element of subjectivity in answering the items. Also, the I-8 scale was translated into Arabic but has not been validated for the Lebanese population yet. Second, we could not compare our results to a dependable number of previous researches concerning the variables at hand. Our results cannot be generalized to the general Lebanese population as the sample was recruited from community pharmacies and might be biased towards more educated and higher socioeconomic status populations. Residual confounding is also possible after controlling for multiple factors in the study design; this might be due to some factors that were not taken into consideration or due to errors in classifying participants in terms of orthorexia nervosa, personality traits and impulsivity. Furthermore, our study design is cross-sectional, hence it does not prove cause and effect relationships. Finally, one has to keep in mind that associations found herein could only be regarded small-sized. This might be related to the heterogeneity of the current sample. While thus only allowing exploratory but not confirmatory research, results offer important approaches for future research on the correlates of orthorexic eating.

Conclusion

Results of our study showed that being female and higher perseverance scores were significantly associated with higher TOS-ON scores. Furthermore, the moderating role of maladaptive personality on the link between impulsivity and orthorexic eating in our study presents novel findings both in Lebanon and worldwide. Adding to the limited literature on personality and orthorexic eating, and orthorexic eating in general, we were able to extend knowledge about the topic. The current results show that the interaction of maladaptive personality traits and impulsivity both present contributing factors regarding orthorexic eating. The associations found between orthorexic eating, impulsivity traits and maladaptive personality traits offer insights into the potential causes and/or effects of this pathological eating style, which inspire experimental research about the topic. Additionally, present results may inform preventive and therapeutic disease management strategies as they highlight possible risk and vulnerability factors or factors that may complicate treatment.

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Authors' contributions PS, HS, SO and SH conceived and designed the survey. SH, SO and JS were involved in the statistical analysis and data interpretation. EA and SO wrote the manuscript. HS reviewed the manuscript. All authors read the manuscript, critically revised it for intellectual content, and approved the final version.

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Data availability Data cannot be shared publicly because of the restrictions of the ethics committee. Data are available upon a reasonable

request to the corresponding author for researchers who meet the criteria for access to confidential data.

Declarations

Conflict of interest The authors have no conflicts of interest to report.

Ethics approval and consent to participate Written consent was obtained from all participants. The study was approved by the ethics committees of the Psychiatric Hospital of the Cross (reference: HPC-13–2019). Participants were not compensated.

Consent for publication Not applicable.

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