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Maria Ribeiro Coimbra

**WHEN HEALTHY EATING BECOMES PROBLEMATIC: A
STUDY ON ORTHOREXIA NERVOSA**

VOLUME 1

**Dissertação no âmbito do Mestrado Integrado em Psicologia –Intervenções
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e Ciências de Educação da Universidade de Coimbra**

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Maria Ribeiro Coimbra

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A STUDY ON ORTHOREXIA NERVOSA**

Master's Dissertation in Clinical Psychology - Cognitive-Behavioural
Interventions in Psychological Disorders and Health,
supervised by Professor Cláudia Ferreira

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Abstract - When healthy eating becomes problematic: a study on Orthorexia Nervosa

Orthorexia Nervosa was first mentioned in 1997, by Steven Bratman, and since then, this construct has risen the clinical and research interest of many. Orthorexia Nervosa is best described by a pathological fixation in healthy eating. Despite this current definition, researchers agree that there is still a lot of unknowns regarding Orthorexia Nervosa, including if it should be or not considered as a psychiatric disorder. Its detailed definition, assessment tools and clinical implications are still thoroughly discussed and subject of disagreements. Having said that, studies agree that an essential part of the development of Orthorexia Nervosa is the adoption of associated behaviours, known as orthorexic behaviours. These behaviours have an obsessive characteristic, and can encompass anything, from the shopping, preparation and consumption of food, the self-punishment and guilt, the extreme restriction and even the colour of the chosen foods. Everything that the individual perceives as a rule to its belief of healthy eating can be considered as an orthorexic behaviour. Additionally, Orthorexia Nervosa and its association with different dietary patterns, such as Vegetarian and Vegan, has been thoroughly studied, and there seems to be a relation with Orthorexia Nervosa and the chosen dietary pattern.

In Portugal, research around Orthorexia Nervosa is still scarce. One of the reasons for this lack of information is the non-existence of a valid measuring tool of Orthorexia Nervosa for the Portuguese population. Despite recent studies focus on this important step, the adapted and translated tools have not had success, due to its reliability and validity problems.

Therefore, this study aimed to further extend the research around Orthorexia Nervosa: firstly, to adapt a valid tool for the Portuguese population and study its prevalence and its relationship with different psychological indicators, with sex, with BMI, and with four dietary patterns (Omnivore, Vegetarian, Vegan and Paleo). A second study was also developed to better

understand the eating-related processes involved in the “jump” of orthorexic behaviours into disordered eating. In this study, differences in the omnivore and non-omnivore population were also explored.

Results were very successful, and a valid Orthorexia Nervosa tool was translated and adapted for the Portuguese population, with good psychometric properties: the Dusseldorf Orthorexia Scale (DOS). Its findings regarding the relationships with the variables mentioned before, seem to agree with previous literature and add to the essential progress in the understanding of Orthorexia Nervosa. Finally, the second paper’s results found an important relation in the chosen eating approach (more intuitive or inflexible), regarding the development of orthorexic behaviours into disordered eating, both for omnivores and non-omnivores. These results may have a real implication in the clinical setting, showing that professionals should focus on enhancing and cultivating a more intuitive eating approach in the prevention and treatment of individuals presenting orthorexic behaviours, independently of the chosen dietary pattern.

Keywords: Orthorexia Nervosa; Orthorexic behaviours; Validation study; Disordered eating; Dietary pattern; Eating-related processes.

Resumo – Quando a alimentação saudável se torna problemática: um estudo sobre Ortorexia Nervosa

A Ortorexia Nervosa foi mencionada pela primeira vez em 1997, por Steven Bratman, e desde então, este construto tem suscitado o interesse da clínica e da investigação. Ortorexia Nervosa é melhor descrita por uma fixação patológica numa alimentação saudável. Apesar desta atual definição, os investigadores concordam que ainda há muitas incógnitas em relação à Ortorexia Nervosa, incluindo se esta deve ou não ser considerada uma perturbação psiquiátrica. A sua definição mais detalhada, ferramentas de avaliação e implicações clínicas ainda são amplamente discutidas e motivo de discordância. Dito isto, vários estudos concordam que uma parte essencial do desenvolvimento da Ortorexia Nervosa é a adoção de comportamentos associados, também denominados de comportamentos ortoréticos. Estes comportamentos têm uma característica obsessiva e podem abranger tudo, como a compra, preparação e consumo dos alimentos, a autopunição e a culpa, a restrição extrema e, até, a cor dos alimentos escolhidos. Tudo o que o indivíduo entende como uma regra, proveniente do que crê ser uma alimentação saudável, pode ser considerado um comportamento ortorético. Para além disto, a Ortorexia Nervosa e a sua associação com diferentes padrões alimentares, como Vegetariano e Vegan, têm sido exaustivamente estudados, e parece haver uma relação entre a Ortorexia Nervosa e o padrão alimentar escolhido.

Em Portugal, a pesquisa centrada na Ortorexia Nervosa ainda é pouco substancial. Uma das razões para esta falta de informação é a inexistência de um instrumento de avaliação válido da Ortorexia Nervosa para a população portuguesa. Apesar de estudos recentes focarem este importante passo, as ferramentas adaptadas e traduzidas não tiveram sucesso, devido aos seus problemas de confiabilidade e validade.

Assim, este estudo teve como objetivo principal explorar e contribuir para a pesquisa focada na Ortorexia Nervosa: primeiramente, adaptar uma ferramenta válida para a população

portuguesa e estudar a sua prevalência e relação com diferentes indicadores psicológicos, com o sexo, com o BMI e com quatro padrões alimentares (Omnívoro, Vegetariano, Vegan e Paleo). Foi desenvolvido também um segundo estudo para explorar e compreender os processos de alimentação envolvidos no “salto” dos comportamentos ortoréticos para o comportamento alimentar perturbado. Neste estudo, foram também exploradas as diferenças nas populações omnívora e não omnívora.

Os resultados foram bem-sucedidos, e uma ferramenta válida para a Ortorexia Nervosa foi traduzida e adaptada para a população portuguesa, com boas propriedades psicométricas: a Dusseldorf Orthorexie Scale (DOS). As conclusões relativamente às relações com as variáveis mencionadas anteriormente parecem estar de acordo com a literatura já existente, e contribuem para o progresso essencial do estudo da Ortorexia Nervosa. Finalmente, os resultados do segundo artigo encontraram uma relação importante na abordagem alimentar escolhida (mais intuitiva ou inflexível), em relação ao desenvolvimento dos comportamentos ortoréticos para comportamento alimentar perturbado, tanto para omnívoros como para não omnívoros. Estes resultados podem ter implicações na área clínica, incentivando os profissionais a concentrarem-se no cultivo de uma abordagem alimentar mais intuitiva, na prevenção e tratamento de indivíduos que apresentam comportamentos ortoréticos, independentemente do padrão alimentar escolhido.

Palavras-chave: Ortorexia Nervosa; Comportamentos ortoréticos; Estudo de validação; Comportamento alimentar perturbado; Padrão alimentar; Processos de alimentação.

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PAPER I

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**To further understand Orthorexia Nervosa: DOS validity for the
Portuguese population and its relationship with psychological indicators,
sex, BMI and dietary pattern**

Cláudia Ferreira, Ph.D.¹ (ORCID: 0000-0002-7020-9606)

Maria Coimbra, B.S.^{2*} (ORCID: 0000-0001-6384-222X)

¹ CINEICC – Center for Research in Neuropsychology and Cognitive Behavioral Intervention

² Faculty of Psychology and Educational Sciences of the University of Coimbra, Portugal

* Correspondence concerning this article should be addressed to:

Maria Coimbra

Email: maria.rcoimbra@gmail.com

CINEICC, Faculdade de Psicologia e Ciências da Educação, Universidade de Coimbra

Rua do Colégio Novo, Apartado 6153

3001-802 Coimbra, Portugal

Telephone: (+351) 239851450

Fax: (+351) 239851462

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Abstract

Orthorexia Nervosa (ON) is considered a pathological fixation with healthy eating. Despite recent research focus, there is still a lot of inconsistent information concerning ON, including its definition and validity of its measuring tools. This study aimed to extend the current knowledge on ON, by developing and validating the Portuguese adaptation of the Dusseldorf Orthorexia Scale (DOS) and studying its prevalence and relationship with different psychological indicators, sex, BMI and dietary pattern. Data was collected online, through self-report questionnaires, and two different samples were collected, with 513 (Sample 1) and 541 participants (Sample 2) from the general population. Results confirmed the DOS' one-dimensional factorial structure and reliability. ON's prevalence was 10.52%. Results revealed that women present higher scores on DOS than men, but no differences were found regarding the BMI groups. DOS was positively related to all psychological indicators, with moderate and strong relationships with disordered eating and inflexible eating. Sample 2 was used to explore ON's differences between dietary patterns, with results demonstrating that omnivores present significantly lower levels of ON, when compared with the vegetarian, vegan and paleo groups. The present study is the first to successfully validate a measure that assesses ON for the Portuguese population and adds to the existing literature in several other important ON aspects.

Keywords: Orthorexia Nervosa; Validation study; Psychometric properties; Dietary pattern; Eating behavior.

1. Introduction

Orthorexia Nervosa (ON) is characterized by an obsession or pathological fixation with a diet considered healthy. In his work, Bratman, who first explored ON in 1997, explains that this eating-related difficulty starts off as a simple interest in healthy eating, and through time develops into a pathological one (Bratman, 2017). Unlike individuals with Anorexia Nervosa, individuals with ON do not want to lose weight, or at least that is not the focus of their diet. It is the pursuit of what the individual considers healthy eating that makes ON, meaning that the focus is in the quality of the food, not the quantity (Bağcı Bosi et al., 2007; Brytek-Matera, 2012; McComb & Mills, 2019).

An essential part in the development of ON is the presence of associated rules and behaviours (orthorexic behaviours). These orthorexic behaviours could be anything that is associated with the individual's efforts for healthy eating, from the time and energy spent on purchasing, preparing and eating food, to the obsessive thoughts, guilt, punishments and restrictions imposed, or even the colour of the food consumed (Bratman, 1997; Bratman, 2017; McComb & Mills, 2019; Varga et al., 2014). ON is linked to severe clinical impairment or distress, interfering tremendously with the daily life of the individual, compromising physical and mental health (Koven & Abry, 2015; McComb & Mills, 2019; Varga et al., 2013). Regarding its prevalence, previous research reported rates vary extremely, from less than 1% to more than 80% (Dunn et al., 2016). Thus, research investment on better understanding ON is essential.

Though recent literature has focused on ON since its first mentioning in 1997 (Bratman, 1997), its definition and recognition as a mental disorder are still disputed (Cena et al., 2018). In fact, this lack of consensus is the reason why assessment tools regarding ON and its behaviours are still scarce and, more importantly, so different from one another (Valente et al., 2019).

In 2019 (Valente et al., 2019), a systematic review of all the existing measuring tools for ON was published. The authors found six different tools that assess the presence of ON: the Orthorexia self-test (BOT; Bratman & Knight, 2000), the ORTO-15 test (Donini et al., 2004), the Eating Habits Questionnaires (EHQ; Gleaves et al., 2013), the Dusseldorf Orthorexie Scale (DOS; Barthels et al., 2015), the Barcelona Orthorexia Scale (BOS; Bauer et al., 2018) and the Teruel Orthorexia Scale (TOS; Barrada & Roncero, 2018). From these tools, the ORTO-15 has been widely used, having been adapted for at least 6 different languages. However, what was once considered the most reliable tool to assess ON, has raised concerns regarding its validity, reliability and internal consistency (Barnett et al., 2016; Clifford & Blyth, 2018; Missbach et al., 2015). A recent study (Fernandes, 2018) attempted to evaluate the psychometric properties of the Portuguese version of ORTO-15 but the psychometric evaluation failed to provide proof of validity and consistency.

Recently, studies using the DOS have had great success (Barthels et al., 2015; Chard et al., 2018; Chard et al., 2018; Parra-Fernández et al., 2019), including its English and Spanish adaptation. Therefore, the aim of this study, was to translate and validate the DOS for the Portuguese population, possibly offering a reliable and essential tool for the research and clinical development of ON in Portugal.

Additionally, since ON has been associated with disordered eating (Hayles et al., 2017; Strahler et al., 2018) we explored DOS' associations with different body and eating-related indicators. Furthermore, ON has been linked to psychological and clinical distress (Hayles et al., 2017; McComb & Mills, 2019), so other psychopathological indicators (e.g.: stress, anxiety, depression and shame) were also studied on their relationship with DOS.

ON has been studied in terms of its' relationship with different sexes and BMI, with results being inconsistent (McComb & Mills, 2019; Oberle et al., 2017; Strahler, 2019) so, in order to expand our research contribute, the study explored these relationships as well.

Finally, ON's relationship and association with different dietary patterns has been an important research focus, and diets like veganism and vegetarianism can be seen as possible risk factors (Mccomb & Mills, 2019). Once again, results are incongruous (Brytek-Matera, 2019; Çiçekoğlu & Tunçay, 2018), so the present study explored the differences regarding the prevalence of ON, assessed by DOS, in groups with different dietary patterns.

2. Material and Methods

2.1 Participants

To test the factor structure and psychometric properties of DOS a sample of 513 participants (sample 1) was analysed, comprised of 454 women and 59 men from the Portuguese general population. The age of this sample ranged from 18 to 62 ($M = 27.65$; $SD = 9.16$), with a mean of 14.84 ($SD = 2.97$) years of education. The participants' Body Mass Index (BMI) mean was 23.44 ($SD = 4.43$), which corresponds to a normal BMI according to WHO (2011). This sample was also used to explore DOS's prevalence, sex and BMI differences and DOS's association with different psychopathology indicators.

Additionally, another sample was used (sample 2) to understand the differences and similarities between dietary patterns in their relationship with DOS and to explore DOS's relationship with body and eating-related indicators. This sample consisted of 541 participants (447 women) from the Portuguese population, with an age mean of 34.66 ($SD = 11.81$) and a mean of 14.43 ($SD = 4.14$) years of educations. The BMI average corresponded to a normal BMI ($M = 24.33$; $SD = 4.57$; WHO, 2011).

2.2 Procedures

DOS's translation and adaptation process for the Portuguese population began after authorization was granted from the authors of the original scale (Barthels et al., 2015). Firstly, a bilingual researcher translated the scale. Then, another bilingual researcher back-translated the scale, in order to compare its' accuracy. After this process, a first sample of the Portuguese adaptation of DOS was drafted; 12 college students completed this draft and reviewed it. The students revealed no difficulties completing the scale, so only minor wording adjustments were made. Following these steps, the final version of the DOS's Portuguese adaptation was elaborated.

The data collection for both samples was conducted in identical ways. All ethical requirements regarding the present study were respected, receiving the approval of the Ethic Committees of the Faculty of Psychology and Educational Sciences of the University of Coimbra. Participants were invited to enter in the study through different online social networks, by clicking the survey link. The voluntary and confidential nature of the study was informed immediately, and participants could stop their participation at any time. Individuals who agreed to take part in this research gave their written informed consent before completing the questionnaire, which took approximately 20-25 minutes. The questionnaires were built so that participants could not skip questions, meaning that there were no missing data.

Sample 1: the final sample corresponded to the initial sample, since no participant was younger than 18 years old or older than 65, the only exclusion criteria applied.

Sample 2: the initial sample comprised 560 participants but exclusion criteria were applied, excluding (a) participants out of the 18 to 65 years old range and (b) participants who did not identify with one of the following dietary patterns: Omnivore, Vegetarian, Vegan or Paleo. This corresponded to 3.39% of the initial sample being excluded from the study.

2.3 Instruments and Measures

Düsseldorf Orthorexia Scale (DOS; Barthels et al, 2015). DOS assesses the presence of ON and orthorexic behaviours, through a 10-item self-report questionnaire. The scale is ranked by a four-point Likert scale (from 1 = “never” to 4 = “always”), and a higher total score (in a maximum of 40) corresponds to the presence of higher levels of orthorexic behaviors. The maximum score is 40, and the preliminary cut-off point is 30. Scores between 25 and 29 indicate possible risk of ON. DOS presented good psychometric properties in its original study ($\alpha = .84$).

Depression Anxiety and Stress Scales-21 (DASS21; Lovibond & Lovibond, 1995; Pais-Ribeiro et al., 2004). DASS21 is a self-report measure that assesses psychopathology

symptomology. The scale consists of three subscales (depression, anxiety and stress) each with 7 items. Participants answer according to a 4-point Likert scale (from 0 = “Did not apply to me at all” to 3 = “Applied to me very much or most of the time”). The subscales – depression, anxiety and stress - presented good psychometric properties. The subscales Cronbach’s alpha values in the original version were .88, .82, and .90; and .85, .74, and .81 in the Portuguese version, respectively.

External and Internal Shame Scale (EISS; Ferreira et al., 2020). EISS is constituted by 8 items that assess the experience of internal (4 items) and external (4 items) shame. Participants answer according to a 5-point Likert scale (0 = “never” to 4 = “always”) with higher scores representing more accentuated experience of shame. In the original Portuguese version EISS presented a Cronbach alpha of .89.

Body Image Shame Scale (BISS; Duarte et al., 2014). BISS measures body image shame in its’ internal and external dimensions. Constituted by 14 items (7 items for internal shame and 7 items for external shame), answered according to a 5 point Likert scale (from 0 = “never” to 4 = “almost always”). The scale presented good psychometric properties, with a Cronbach’s alpha of .92 in the original Portuguese version.

Inflexible Eating Questionnaire (IEQ; Duarte et al., 2017). IEQ measures the inflexibility of eating-related rules. It consists of an 11-item scale, where higher values reflect more inflexibility regarding dietary rules. The answers are evaluated according to a 5-point Likert scale (from totally disagree (1) to totally agree (5)). IEQ has good psychometric qualities (Cronbach's alpha is .90 for the Portuguese population).

Intuitive Eating Scale -2 (IES-2; Tylka & Van Diest, 2013; Duarte et al., 2016). IES-2 is a self-report scale that measures intuitive eating, or ones’ conscious perception of hunger and satiety, leading to the ability to understand internal physiological signs. The scale consists of 23 items, with answers ranging from 1 (“Strongly Disagree”) to 5 (“Strongly Agree”) and

higher scores represent higher levels of intuitive eating. With a Cronbach's alpha of .87 in the original study and a Cronbach alpha of .97 in the Portuguese version, IES-2 has presented good psychometric characteristics.

Binge Eating Scale (BES); Gormally et al., 1982; Duarte et al, 2015). BES evaluates the presence and severity of different attitudes and behaviours regarding binge eating. It consists of 16 items, each with 3 or 4 options, in which the individual must indicate the one they identify with the most. A more superior score, in a maximum of 46, represents higher severity of binge eating, with the scores above 16 as the cut-off clinical indicator. BES has good psychometric qualities with a Cronbach's alpha of .85 in the original study and with a Cronbach's alpha of .88 for the Portuguese one.

Eating Disorder Examination Questionnaire (EDE-Q); Fairburn & Beglin, 1994; Machado et al., 2014). EDE-Q is a self-report measure, with 36 items. The scale assesses disordered eating attitudes and behaviours in the last 28 days. The questionnaire provides four different subscales, these being: Restraint (five items), Eating Concern (five items), Shape Concern (eight items) and Weight Concern (five items). Subscales are ranked by frequency and severity, according to a 7-point Likert scale. Additionally, the total score provides a final measure regarding disordered eating. In the original study and in the Portuguese version EDE-Q presented good psychometric properties ($\alpha = .97$).

Body Mass Index (BMI). Body mass index was calculated by dividing the self-reported current weight (kg) by the height squared (m).

All measures presented good psychometric properties, with Cronbach's alpha ranging from .86 to .96 (Table 2).

2.4 Data Analysis

All data was analysed using SPSS software version 22 (Chicago, IL) and AMOS software (Arbuckle, 2008), with p values of $< .05$ indicating statistical significance. With the aim of exploring the dimensionality of the Portuguese version of the DOS, first order confirmatory factor analyses (CFA), with maximum likelihood estimation method, testing the theoretical model proposed by the original authors (Barthels et al., 2015). This CFA was conducted in sample 1. Model fit was assessed through several goodness-of-fit indicators, such as: the overall model Chi square (χ^2), Goodness-of-Fit Index (GFI) > 0.90 , Adjusted Goodness-of-Fit Index (AGFI) > 0.90 , Comparative Fit Index (CFI) > 0.90 , Tucker and Lewis Index (TLI) > 0.90 , the (Standardized) Root Mean Square Residual (SMSR) < 0.08 and Root Mean Square Error of Approximation (RMSEA) < 0.08 (Kline, 2005). Local adjustments indices were explored, and the indicators used were the standardized regression weights (SRW) and the squared multiple correlations (SMC). Moreover, Cronbach alpha values, item-total correlations and Skewness and Kurtosis were calculated.

To explore DOS' relationship with other measures (general psychopathology and body and eating-related indicators) product-moment Pearson correlations analyses were conducted where correlations ranging between .1 and .3 were considered weak, above .3 to .5 moderate and strong when equal to or superior than .5, considering a significance level of .05 (Cohen et al., 2003). ON's prevalence was also explored

Finally, sex differences on ON were examined through a t-test for two independent samples, while BMI and dietary pattern differences on ON were examined through a One-way ANOVA.

3. Results

3.1 Confirmatory factor analysis

To confirm the DOS's one-dimensional structure, a CFA was conducted (Sample 1; $N = 513$). Results indicated a significant chi-square goodness of fit ($\chi^2_{(35)} = 419.882$, $p < .001$), but since this fit index has been regarded as leading to biases in results due to sample size (DeCoster, 1998), we considered other goodness of fit indices to attest for the adequacy of the structure under analysis. Results suggested a poor model fit (GFI = .86; AGFI = .78; CFI = .80; TLI = .74; NFI = .79; SMSR = .08; RMSEA = .15). The analysis of the modification indices suggested the correlation of the errors of items 6 and 10 (206.426) and 1 and 3 (57.972), which resulted in an improvement of the model to good fit ($\chi^2_{(33)} = 119.982$, $p < .001$; GFI = .95; AGFI = .92; CFI = .96; TLI = .94; NFI = .94; SMSR = .04; RMSEA = .07).

Local adjustment indicators analysis confirmed the adequacy of the DOS (Table 1). All items revealed adequate standardized regression weights (SRW), which ranged from .50 (item 1) to .79 (item 8). Thus all values were above the recommended cut-off point of .40 (Tabachnick & Fidell, 2013). The individual items reliability was also corroborated through the values of the squared multiple correlations (SMC; with a recommended minimum cut-off point of .25; Tabachnick & Fidell, 2013), which varied between .25 (item 1) and .63 (item 8).

Regarding reliability, DOS revealed a Cronbach alpha of .86, disclosing a good internal consistency (Kline, 2011). Additionally, the elimination of any item would not increase the scale reliability, suggesting that all items are relevant. Item-total correlations were also high, ranging from .48 to .72 (Table 1).

Table 1.

Items' means (M), standard deviations (SD), standardized regression weights (SRW), squared Multiple Correlations (SMC) and Cronbach's alpha if item deleted (α if item deleted) in sample 1 (N = 513).

Items	<i>M</i>	<i>SD</i>	<i>SRW</i>	<i>SMC</i>	Item-total correlation	α if item deleted
1	2.39	0.92	.50	.25	.50	.85
2	2.80	1.06	.57	.32	.50	.85
3	1.73	0.87	.54	.29	.53	.85
4	1.57	0.94	.68	.46	.63	.84
5	2.28	1.13	.59	.35	.52	.85
6	2.30	1.07	.56	.31	.58	.85
7	1.31	0.70	.54	.30	.48	.85
8	2.03	1.03	.79	.63	.72	.83
9	1.95	1.00	.73	.53	.66	.84
10	2.36	1.14	.59	.34	.59	.84

DOS items' skewness values varied between -.30 (item 2) and 2.39 (item 7), and kurtosis values ranged from -1.38 (item 10) to 5.12 (item 7) indicating no severe violation of normal distribution ($Sk < |3|$ and $Ku < |10|$; Kline, 2005).

3.2 DOS relationship with general psychopathological and body and eating indicators

Product-moment Pearson correlation coefficients (Table 2) revealed positive weak correlations between DOS and different general psychopathological indicators (DASS21 Depression, Anxiety and Stress subscales and EISS).

Correlations were also explored in Sample 2, regarding body and eating indicators (BISS, IES-2, IEQ, BES and EDE-Q). Results revealed positive weak associations with BISS and BES, positive moderate association with EDE-Q, a positive and strong association with IEQ and a negative weak association with IES-2 (Table 2).

Table 2.

DOS's correlations with psychopathological indicators (sample 1; N = 513) and body and eating indicators (sample 2; N = 541) and Cronbach's alphas.

psychopathological indicators (N = 513)			body and eating indicators (N = 541)		
	α	DOS		α	DOS
DASS21 depression	.93	.17***	BISS	.96	.20***
DASS21 anxiety	.87	.21***	IEQ	.94	.63***
DASS21 stress	.92	.23***	IES-2	.88	-.13**
EISS	.93	.24***	BES	.91	.20***
			EDE-Q ¹	.89	.37***

Note * $p < .050$, ** $p < .010$, *** $p < .001$. α = Cronbach's alpha; DOS = Düsseldorf Orthorexia Scale; DASS21 depression/ anxiety/ stress = Depression Anxiety and Stress Scales – Depression, Anxiety and Stress Subscale; EISS = External and Internal Shame Scale; BISS = Body Image Shame Scale; IEQ= Inflexible Eating Questionnaire; IES-2= Intuitive Eating Scale – 2; BES = Binge Eating Scale; EDE-Q¹ = Eating Disorder Examination Questionnaire – women only ($n = 447$).

3.3 ON prevalence in the Portuguese population, assessed by DOS

Using the original version's cut-off points (Barthels et al., 2015), where 30 is the clinical indicator and scores from 25 to 29 indicate risk of ON, the prevalence of ON was explored in Sample 1.

The total sample DOS mean score was 20.73 ($SD = 6.60$). Results found that 10.52% of participants scored 30 or higher, 15.01% scored between 25 and 29, and 74.46% scored lower than 25.

3.4 Sex differences on ON

To examine sex differences, two groups with similar demographic characteristics ($t_{(163)}\text{age} = 0.538, p = .591$; $t_{(163)}\text{education} = -2.410, p = .017$) were selected from Sample 1. One group included 59 men and the second group 106 women.

Results indicated that women presented higher scores of ON ($M = 20.75$; $SD = 6.94$), in comparison to men ($M = 16.75$; $SD = 5.18$), and these differences were statistically significant ($t_{(149.40)} = -4.196, p < .001$). The magnitude of these results was calculated ($d = .65$) and interpreted considering Cohen's guidelines (Cohen et al., 2003), where values equal or superior to .5 correspond to a strong magnitude.

3.5 BMI group differences on ON

With the aim of exploring BMI differences regarding ON, Sample 1 was divided into four BMI categories, following the BMI category ranges defined by WHO (2011). The four categories were: Underweight ($n = 27$), Normal weight ($n = 351$), Pre-obesity ($n = 95$) and Obesity ($n = 40$).

The groups' DOS means were the following: Underweight ($M = 23.85$; $SD = 10.39$), Normal weight ($M = 20.77$; $SD = 6.65$), Pre-obesity ($M = 20.00$; $SD = 5.62$) and Obesity ($M = 20.73$; $SD = 4.32$). These differences were analysed through a one-way ANOVA and results found no significant differences [$F_{(3, 509)} = 2.58, p = .053$].

3.6 Differences between dietary patterns on ON

Sample 2 was used to compare the differences between four dietary patterns regarding ON, assessed by DOS.

A one-way ANOVA was conducted to compare the levels of ON on different dietary patterns: Omnivores ($n = 357$), Vegetarian ($n = 66$), Vegan ($n = 60$) and Paleo ($n = 58$). Results

found a significant effect regarding the four different patterns [$F_{(3, 537)} = 21.51, p = .000$]. Post hoc comparisons using the Tukey HSD test showed that the mean score for the Omnivore group ($M = 16.94, SD = 6.08$) was significantly different from the Vegetarian group ($M = 20.39, SD = 5.31$), from the Vegan group ($M = 21.65, SD = 7.29$) and from the Paleo group ($M = 22.03, SD = 6.05$). These results show that Omnivores present significantly lower levels of ON when compared with the other dietary patterns.

4. Discussion

The aim of the present study was to further extend the knowledge on ON. In order to do this, we explored several options for measuring ON and concluded that the DOS is a measure with overall past great results in different studies and validations (Barthels et al., 2015; Chard et al., 2018). This is the first study, as far as we know, to successfully adapt and validate an ON measure for the Portuguese population. Besides this important validation, the study also explored ON's relationship with different general psychopathology and body and eating indicators. Finally, ON's prevalence and differences regarding sex, BMI and dietary patterns were also reported.

A CFA was conducted to test DOS's structure, and initially results did not reveal a good model fit. However, after correlating items 6 and 10 and items 1 and 3, a great model fit was achieved. With a Cronbach alpha of .86, the scale's internal consistency was very good and local adjustments revealed items' robustness.

Previous studies have been inconsistent regarding the prevalence of ON in the general population, with results ranging from less than 1% to more than 80% (Dunn et al., 2016). In the present study the prevalence of ON, assessed by DOS, using the original study's cut-off point (Barthels et al., 2015), was 10.52%. Despite significantly lower than several previous studies, these results are coherent with the ones obtained by the English adaptation of DOS (8%; Chard et al., 2018).

DOS was positively linked with all general psychopathology and body and eating indicators in the study, including measures of depression, anxiety and stress, shame, body-image shame, inflexible eating, intuitive eating, binge eating and disordered eating. The correlation with IEQ was strong, which is not surprising since IEQ measures inflexible eating attitudes and behaviours (e.g.: "Eating according to certain rules gives me a sense of control."; "To me, having a balanced eating plan means fulfilling certain rules rigorously"), which is an

important characteristic of orthorexic behaviours. Additionally, the correlation of DOS with EDE-Q was moderated. This is consistent with previous literature (Hayes et al., 2017; Strahler et al., 2018) but, as stated by McComb & Mills (2019), it is still unclear whether ON is a risk factor for disordered eating or if disordered eating predicts the development of ON.

To further extend this study's research contribute, we explored ON's differences regarding sex, BMI and dietary pattern. Sex differences were significant, with women presenting higher levels of ON than men, which is consistent with previous studies. Regarding ON's differences in BMI, sample 1 was divided into four groups (underweight, normal weight, pre-obesity and obesity) according to the guidelines of WHO (2011), and no significant differences between the groups were found. Nevertheless, the group with higher levels of ON was the underweight group. Finally, sample 2 was divided into four different dietary patterns (omnivore, vegan, vegetarian and paleo) and significant differences were found regarding ON levels, assessed by DOS. The vegan, vegetarian and paleo group had significant higher levels of ON when compared with the omnivore group. Vast research exists regarding ON's relationship with vegan and vegetarian patterns, showing that individuals with these patterns have greater tendency to develop ON (McComb & Mills, 2019), which confirms our results. Still, this is one of the first studies that includes individuals who identify as paleo and shows that the ON levels for this group are similar to those who identify with veganism/vegetarianism.

These results should be interpreted considering certain limitations. Despite the considerable sample sizes, they are not representative of the total Portuguese population. Future studies should explore these results in samples with a higher percentage of men. Additionally, the study should be replicated in a clinical sample. This study was conducted online, through social network advertisements, which may be associated to certain biases. However, the online character of the data collection gives participants an enhanced sense of anonymity, which may be linked to more honest answers. More importantly, a limitation of this study is the lack of

consensus that still exist around ON and its conceptualization. More research is necessary to reach an accord.

Overall, the present study fulfills its goal to extend the current research on ON and is the first to successfully validate a measure that assesses ON and orthorexic behaviours for the Portuguese population, offering DOS as a valid and reliable tool.

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PAPER II

Coimbra, M., & Ferreira, C. (2020). *Taking the jump from healthy to disordered eating: the role of intuitive and inflexible eating attitudes in orthorexic behaviours.*

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Taking the jump from healthy to disordered eating: the role of intuitive and inflexible eating attitudes in orthorexic behaviours

Maria Coimbra, B.S.^{1*} (ORCID: 0000-0001-6384-222X)

Cláudia Ferreira, Ph.D.² (ORCID: 0000-0002-7020-9606)

¹ Faculty of Psychology and Educational Sciences of the University of Coimbra, Portugal

² CINEICC – Center for Research in Neuropsychology and Cognitive Behavioral Intervention

* Correspondence concerning this article should be addressed to:

Maria Coimbra

Email: maria.rcoimbra@gmail.com

CINEICC, Faculdade de Psicologia e Ciências da Educação, Universidade de Coimbra

Rua do Colégio Novo, Apartado 6153

3001-802 Coimbra, Portugal

Telephone: (+351) 239851450

Fax: (+351) 239851462

Abstract

Purpose Orthorexia Nervosa (ON) has been a research focus in recent years. Despite the lack of consensus on its definition and classification as a psychiatric disorder, research has shown that ON is linked to certain behaviours (orthorexic behaviours), associated to disordered eating. However, very little is known about this relationship. The aim of this study was to explore the eating-related processes inherent to the relationship between orthorexic behaviours and disordered eating, and understand if it is through the adoption of a more inflexible and less intuitive eating approach, that an interest in healthy eating develops into a pathological one. Additionally, this relationship was explored for two different groups: Omnivores and Non-omnivores.

Methods 451 women (281 Omnivores and 170 Non-omnivores) from the Portuguese population participated in this study, by answering a set of self-report measures.

Results Non-omnivores presented significant higher levels of orthorexic behaviours and inflexible eating. In both groups, orthorexic behaviours and disordered eating were linked positively to inflexible eating and negatively to intuitive eating. A path model analyses showed that the preferred eating approach did mediate the relationship between orthorexic behaviours and disordered eating, explaining 51% of the variance of disordered eating. A multigroup analysis confirmed the model invariance between Omnivores and Non-omnivores.

Conclusions Our findings contribute to the better understanding of the relationship between orthorexic behaviours and disordered eating and its eating-related processes, implying the relevance of clinical interventions and prevention based on encouraging a more intuitive eating approach for women presenting orthorexic behaviours or ON symptoms.

Keywords: Orthorexia Nervosa; Orthorexic behaviours; Intuitive eating; Inflexible Eating; Disordered Eating; Women.

Introduction

In recent years, a new eating behaviour has been the center of attention in research and clinical discussion, as well as in the mass media: orthorexia nervosa (ON; [1]). From the Greek *ortho* (meaning “proper”) and *orexi*, meaning “appetite”, ON was first introduced by Steven Bratman in 1997 [2] as a new type of anorexia nervosa, and was described as a fixed preoccupation with consuming healthy food. Currently, ON is considered a possible new eating disorder, that involves a pathological preoccupation with food and rigid adherence to a diet that is perceived as healthy and pure [3-5].

Nowadays, research centered on ON is extensive and, despite not yet being considered a psychiatric disorder by *The Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition* (DSM-5; [6]), several studies have already proposed diagnostic criteria [7]. While lacking consensus, the criteria proposed by different authors [3, 4, 8], seem to agree that ON is defined by: (a) obsession or pathological preoccupation with healthy eating, marked with anxiety/exaggerated emotional distress and (b) significant clinical impairment associated with healthy eating. Further research and consensus seem necessary to officially classify ON as a psychiatric disorder [7, 9]. Regarding its prevalence in the general population, ON and orthorexic behaviours are present in varying degrees. Depending on the chosen measuring tool and the diagnostic criteria used, prevalence rates have varied tremendously, from less than 1% to almost 90% [41].

Contrary to other eating disorders, ON is normally not caused by a desire to lose weight. On the contrary, the aim of ON is to be as healthy as possible, involving a raising concern about food quality not quantity [10, 11]. However, it is important to stress that ON is not to be confused with healthy eating. In 2017, Bratman clarifies his previous work, stating that it is the presence of associated orthorexic behaviours (e.g.: obsessive-compulsive behaviours; adoption of rigid dietary rules; self-punishment and guilt; extreme restriction) that make an interest in

healthy eating develop into a pathological one, leading to orthorexia nervosa [12]. Koven and Senbonmatsu [13] also suggested that in the development of ON, orthorexic behaviours (e.g.: revolving food selection, food preparation and food consumption) will become more rigid, predominant and complex. Previous literature has shown that in fact, this adherence to specific eating rules is associated with pathological eating behaviours [14, 15, 16]. Moreover, psychological inflexibility has a strong association with eating-related difficulties [17, 18, 19, 20].

The psychological inflexibility focused on eating, or eating inflexibility, is defined by Duarte and colleagues [15] as a rigid adherence to eating related rules, without respecting or following internal cues; acquiring a sense of control when fulfilling such rules, and, on the contrary, suffering when failing to fulfill such rules.

On the other hand, intuitive eating consists of a positive eating approach, centered around understanding internal physiological hunger and satiety cues to determine when and what to eat, while discouraging restrictive, emotional and situational eating [21, 22, 23]. Intuitive eaters do not center their food choices around “good” or “bad” properties. Though they value taste, they choose foods that will help their body function to its best ability [24].

Both constructs can be considered as two different attitudes to eating. In fact, previous literature proves that inflexible eating has a strong and positive correlation with disordered eating, confirming that this is a key aspect of understanding eating psychopathology [15, 18, 25, 26] while intuitive eating has a strong but negative association with disordered eating [24, 26, 27].

No previous study, to our knowledge, explores the emotional processes that may link orthorexic behaviors to disordered eating. This study aimed to test a model to explore this relationship through its mediating processes, based on the following question: is the “jump” from a simple interest in healthy eating to eating psychopathology explained by a more

inflexible eating and a less intuitive eating approach? Our hypothesis is that women with higher levels of orthorexic behaviours, tend to present higher severity of disordered eating, through the adoption of a more inflexible and a less intuitive eating approach.

Additionally, our research shows that previous studies on orthorexic behaviours have focused on its relationship with omnivore and non-omnivore diets [e.g.: 28, 29, 30] so, the study was conducted having into account these two groups.

Material and methods

Participants

The present study comprised 451 female Portuguese participants, with an age range of 18 to 65 years old ($M = 33.84$; $SD = 11.45$). Participants also reported a mean of 14.59 ($SD = 4.33$) years of education. Regarding their area of residence, 55.2% of participants resided in an urban area, 23,1% live in a semi-urban area and 21,7% live in a rural one. Most participants are single (50.1%), 44.3% are married or in a long-term relationship, 5.3% are divorced or separated and 0.2% are widowed. The participants' Body Mass Index (BMI) ranged from 16.56 to 40.89 with a mean of 24.03 ($SD = 4.59$) [31].

Participants were assigned into two different groups according to their diet: Omnivores ($n = 281$) and Non-omnivores ($n = 170$; individuals who identified as vegan or vegetarians - including pescetarians – or declared they do not eat meat).

The Omnivore group reported an age mean of 33.45 ($SD = 11.81$) years old and of 14.58 ($SD = 5.07$) years of education, and a BMI mean of 24.16 ($SD = 4.54$).

The Non-omnivore group, included individuals with distinct dietary patterns, including vegetarian and pescatarian ($n = 61$), paleo ($n = 55$), vegan ($n = 50$), macrobiotic ($n = 2$), climatarian ($n = 1$) and ketogenic ($n = 1$). Non-omnivores presented an age mean of 34.48 ($SD = 10.84$) and of 14.59 ($SD = 2.71$) years of education. Mean BMI of this group was 23.81 ($SD = 4.68$).

The two groups presented no significant differences in their demographic characteristics: age ($t_{(449)} = -0.924$; $p = .356$), years of education ($t_{(449)} = -0.042$; $p = .967$), BMI ($t_{(449)} = 0.800$; $p = .424$), area of residence ($X^2_{(2)} = 4.632$; $p = .099$) or civil status ($X^2_{(3)} = 4.851$; $p = .183$).

Procedures

The procedures of data collection respected all ethical and deontological requirements intrinsic to scientific research. After the Ethics Committee of the Faculty of Psychology and Educational Sciences of the University of Coimbra provided their approval to the present study, participants were invited through an online advertisement in different social networks. All participants who chose to participate in the study, entered the survey by clicking in the link advertised online. The survey took 15-25 minutes to be completed, and before beginning participants were required to read and sign an informed consent document. This document stated that the study is voluntary and anonymous and included all necessary information about the study's purpose and procedures.

Self-report measures were initially completed by 560 participants (460 women and 100 men) from the Portuguese general population, with the age ranging from 15 to 70 years old. After exclusion criteria were applied (excluding (a) male participants and (b) individuals who were younger than 18 years old or older than 65), 19.64% of the original sample was excluded from this study.

Measures

Demographic Data Gender, age, educational level, nationality, area of residency, civil status, height, current weight and dietary Information (including typology and food specifications).

Body Mass Index (BMI). BMI was calculated using the Quetelet method (Kg/m^2), based on self-reported participants' current height and weight.

Düsseldorf Orthorexia Scale (DOS); [32]; Ferreira & Coimbra, 2020). DOS measures orthorexic behaviours, using a 10-item self-report questionnaire (e.g., "I can only enjoy eating foods considered healthy"). A four-point Likert scale (from 1 = "never" to 4 = "always") is applied, with higher total score representing higher levels of orthorexia. This scale presented

good psychometric properties both in the original study ($\alpha = .84$) and in the present study ($\alpha = .86$).

Inflexible Eating Questionnaire (IEQ; [15]). IEQ accounts for the inflexibility of eating-related rules. It consists of an 11-item self-report measure (e.g.; “I feel proud when I can rigorously follow certain food rules.”), rated on a five-point Likert scale (from 1 = “totally disagree” to 5 = “totally agree”). Higher scores reflect a higher inflexible adherence to dietary rules. The scale has proven to have good psychometric qualities, with a Cronbach's alpha of .95 in the original study and of .94 in the current one.

Intuitive Eating Scale -2 (IES-2; [24, 33]). IES-2 measures intuitive eating, i.e., the ability of being aware and using your body's internal cues regarding hunger and fullness. This measure consists in 23 items (e.g.: “I rely on my hunger signals to tell me when to eat”), rated in a 5-point Likert scale (1 = “Strongly Disagree” to 5 = “Strongly Agree”). The scale has good psychometric properties, with a Cronbach's alpha of .87 for the original version and .97 in the Portuguese version. Regarding the present study, the Cronbach's alpha was .89.

Eating Disorder Examination Questionnaire (EDE-Q; [34, 35]). EDE-Q is a self-report questionnaire designed to assess disordered eating attitudes and behaviours in the last 28 days. With 36 items, ranked by frequency or severity, according to a 7-point Likert scale. EDE-Q has consistently demonstrated good psychometric properties, both in the original and in the Portuguese version (with Cronbach's alpha of .97). EDE-Q presented a Cronbach's alpha of .92 in the current study.

Data Analyses

All analyses were performed using the IBM SPSS Statistics 22.0 software (SPSS IBM; Chicago, IL) and AMOS software [36].

Differences between the two groups in categorical variables were examined through chi-square tests, and continuous variables were examined through t-tests for two independent samples. Additionally, differences between groups (omnivores and non-omnivores) regarding variables were tested through t-tests, and effect size was calculated through Cohen's *d*. Effect sizes above 0.2 were considered small, equal or above to 0.5 moderate, and equal or above to 0.8 strong [42].

In order to explore the different associations between age, BMI, orthorexic behaviours (DOS), intuitive eating (IES-2), inflexible eating (IEQ) and disordered eating (EDE-Q), product-moment Pearson correlations analyses were conducted; magnitudes between .1 and .3 were considered small, above .3 and below .5 moderate, and equal or above .5 strong, with a significance level of .05 [37].

To test the moderator effect of intuitive eating and inflexible eating in the link between orthorexic behaviours (DOS) and disordered eating (EDE-Q), a path analyses was conducted to estimate the presumed relations within the suggested model. This analysis was performed with AMOS (Analysis of Momentary Structure, v.22, SPSS Inc., Chicago, IL). Finally, with the intent of analyzing the plausibility of the model for each group, a multi-group analysis was performed.

Results

Preliminary Data Analyses

Univariate and multivariate normality was assessed by the coefficients of Skewness and Kurtosis, which indicated that there was no severe violation of normal distribution ($|Sk| < 3$ and $|Ku| < 8-10$; [38]), with skewness values ranging from $-.34$ (IES-2) to 1.26 (EDE-Q), and with kurtosis values ranging from $-.63$ (IEQ) to 1.00 (EDE-Q).

Descriptive analyses

Results indicated that the two groups did not present significant differences concerning Age, body mass index (BMI), intuitive eating (IES-2) or disordered eating (EDE-Q). However, results showed that participants from the Non-omnivore group presented higher significant levels of orthorexic behaviours (DOS) and inflexible eating (IEQ), when compared with the Omnivore group (Table 1). Considering Cohen's guidelines to discuss the effect size of these differences [42], orthorexic behaviours presented moderate differences between groups and inflexible eating small differences.

Table 1.

Means (M), Standard Deviations (SD), t-Test (t) and its significance (p) and effect size (d) for both groups (Omnivore and Non-omnivore).

	Omnivore group (n = 281)		Non-omnivore group (n = 170)		t	p	d
	M	SD	M	SD			
Age	33.45	11.81	34.48	10.84	-0.92	.356	0.09
BMI	24.16	4.54	23.81	4.68	0.80	.424	0.08
Orthorexic behaviours	16.69	5.92	21.16	6.21	-7.63	.000	0.74

Intuitive eating	3.53	0.67	3.61	0.69	-1.30	.195	0.12
Inflexible eating	24.01	10.41	28.99	11.55	-4.73	.000	0.45
Disordered eating	1.21	1.17	1.37	1.36	-1.27	.204	0.13

Note. * $p < .050$, ** $p < .010$, *** $p < .001$. BMI = Body Mass Index; Orthorexic behaviours = Düsseldorf Orthorexie Scale; Intuitive eating = Intuitive Eating Scale – 2; Inflexible eating = Inflexible Eating Questionnaire; Disordered eating = Eating Disorder Examination Questionnaire.

Correlations Analyses

Results (table 2) demonstrated that age has non-significant associations with all variables in the study, except with BMI and orthorexic behaviours (in both groups) and with inflexible eating in the Non-omnivore group. All other variables reported a positive and small to moderate association with BMI, with intuitive eating reporting a negative association. Additionally, BMI showed no significant association with orthorexic behaviours for the Non-omnivore group.

Orthorexic behaviours revealed small to moderate associations with all study variables, including with intuitive eating, with whom it is inversely associated in both groups. In contrast, the association of orthorexic behaviours with inflexible eating was positive and presented strong magnitudes in both Omnivores and Non-omnivores.

Intuitive eating was found to be negatively associated with all variables in both groups, presenting moderate correlations with most variables except with disordered eating in Non-omnivores (strong correlation). On the other hand, inflexible eating was positively linked with all other variables, with moderate to strong associations.

Table 2.

Correlations between the study's measures in the Omnivore (n = 281) and Non-omnivore (n = 170; in bold) female groups.

	1.	2.	3.	4.	5.	6.
1. Age	-	.37***	.19**	.02	.15*	.10
2. BMI	.28***	-	.06	-.43***	.18**	.45***
3. Orthorexic behaviours	.14**	.12*	-	-.22**	.65***	.44***
4. Intuitive eating	-.09	-.40***	-.16**	-	-.36***	-.58***
5. Inflexible eating	.04	.24***	.62***	-.28***	-	.60***
6. Disordered eating	.01	.49***	.33***	-.46***	.54***	-

Note * $p < .050$, ** $p < .010$, *** $p < .001$. BMI = body mass index; orthorexic behaviours = Düsseldorf Orthorexie Scale; Intuitive eating = Intuitive Eating Scale – 2; Inflexible eating = Inflexible Eating Questionnaire; Disordered eating = Eating Disorder Examination Questionnaire.

Path Analyses

A path analysis test was performed to test whether intuitive eating (IES-2) and inflexible eating (IEQ) moderated the impact that orthorexic behaviours (DOS) have on disordered eating (EDE-Q), while controlling the effect of body mass index (BMI) and age. Initially, the model tested was fully saturated (i.e., zero degrees of freedom), consisting of 27 parameters. The results showed that two path models were not significant: the direct association of DOS with EDE-Q ($b_{\text{DOS}} = 0.014$; $SE_b = 0.009$; $Z = 1.640$; $p = .101$) and the direct association of Age with IEQ ($b_{\text{Age}} = -0.070$; $SE_b = 0.036$; $Z = -1.942$; $p = .052$). These paths were eliminated, and the model readjusted, progressively.

The final model presented an excellent fit to the empirical data, as indicated by the analysis of well-known and recommended goodness of fit indices [$\chi^2_{(2)} = 6.439$, $p = .040$,

CMIN/DF = 3.219; TLI = .956; CFI = .994; RMSEA = 0.070, $p = .220$; 95% CI = .013 to .134], [36, 39].

Analysing the direct associations of the model, DOS had a significant direct association of -.14 with IES-2 ($b_{\text{DOS}} = -.014$; $SE_b = .005$; $Z = -3.173$; $p < .010$) and a direct association of .64 with IEQ 2 ($b_{\text{DOS}} = 1.113$; $SE_b = .061$; $Z = 18.300$; $p < .001$). BMI presented a significant direct association of -.44 with IES-2 ($b_{\text{BMI}} = -.064$; $SE_b = .007$; $Z = -9.811$; $p < .001$); a direct significant association of .15 with IEQ ($b_{\text{BMI}} = .374$; $SE_b = .085$; $Z = 4.415$; $p < .001$); and a direct significant association of .30 with EDE-Q ($b_{\text{BMI}} = .082$; $SE_b = .010$; $Z = 7.865$; $p < .001$). Age also presented a significant direct association of .09 with IES-2 ($b_{\text{Age}} = .005$; $SE_b = .003$; $Z = 2.109$; $p < .05$) and with EDE-Q ($b_{\text{Age}} = -.011$; $SE_b = .004$; $Z = -2.839$; $p < .010$), of -.10. In turn, IES-2 had a direct association of -.26 with EDE-Q ($b_{\text{IES}_2} = -.479$; $SE_b = .069$; $Z = -6.929$; $p < .001$), and IEQ also presented a direct association of .44 with EDE-Q ($b_{\text{IEQ}} = .049$; $SE_b = .004$; $Z = 12.603$; $p < .001$).

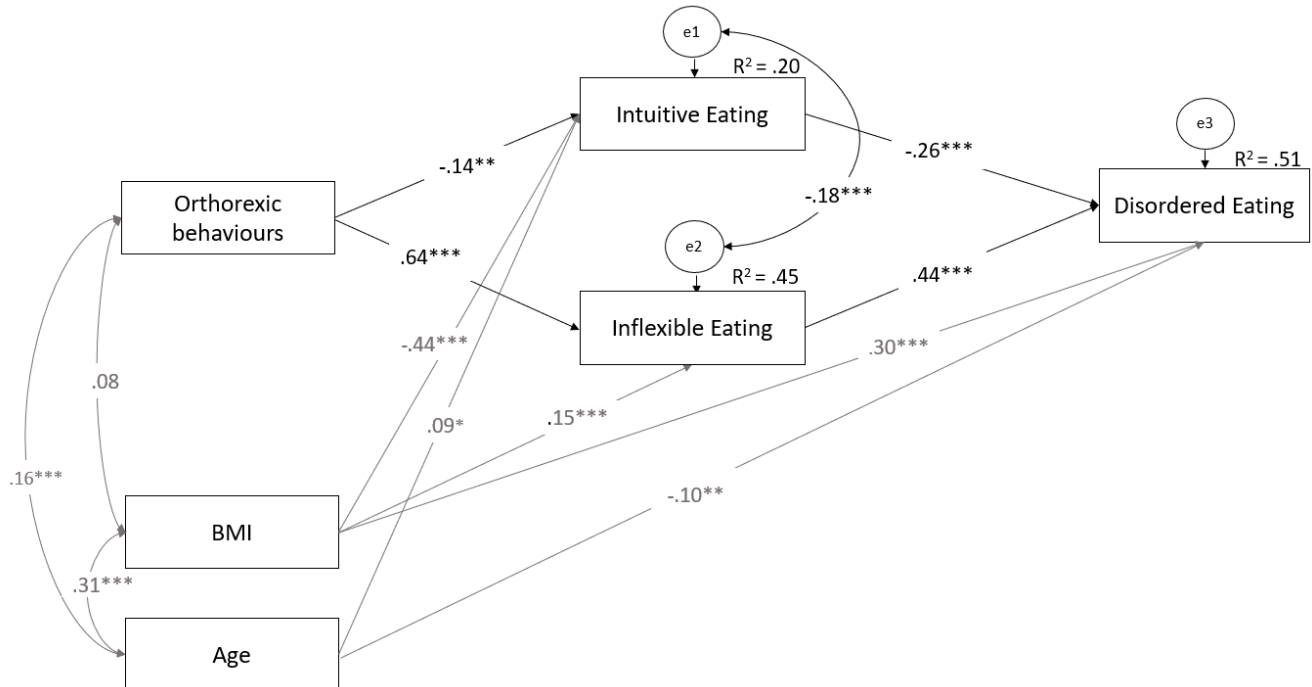
The analysis of indirect effects demonstrated that DOS presented indirect effects on EDE-Q through IEQ and IES-2 of .316 (95% CI = .252 / .379).

Finally, groups' variance was examined through a multigroup analysis. Findings supported the model invariance between Omnivores and Non-omnivores.

As presented in Figure 1, the present model explained 51% of disordered eating, and all path coefficients were statistically significant ($p < .05$). Moreover, it is possible to conclude that intuitive eating and inflexible eating have a significant effect on the relationship between orthorexic behaviours and disordered eating.

Figure 1.

The moderator role of intuitive eating and inflexible eating on the associations between orthorexic behaviours and disordered eating.



Note. $*p < .050$, $**p < .010$, $***p < .001$.

Discussion

Several empirical studies have emphasized the relationship between orthorexic behaviours and disordered eating [8, 40]. However, research lacks in understanding which eating-related and emotional processes are involved in this relationship. This study aimed to clarify the relationship between orthorexic behaviours and the severity of disordered eating, and whether this relationship is mediated by an increased inflexible eating and a decreased intuitive eating approach. These associations were examined in a sample of 451 women from the Portuguese general population.

The study also had into account two different groups, according to the chosen dietary pattern: Omnivores and Non-omnivores. The two groups did not present significant differences regarding age, BMI, intuitive eating or disordered eating. However, the non-omnivore group (including vegans, vegetarians and pescetarians) presented higher levels of orthorexic behaviours and inflexible eating. This might indicate that women with certain eating patterns may be at higher risk of presenting orthorexic behaviours, meaning that future studies focusing on different eating patterns are relevant.

Correlation results revealed that, in both groups, orthorexic behaviours and inflexible eating have a positive and strong correlation. Additionally, intuitive eating presented a negative association with orthorexic behaviours and orthorexic behaviours and disordered eating presented a moderate positive relationship in both groups.

To further understand these relationships, a path model was tested to explore whether the link between orthorexic behaviours and disordered eating is mediated by inflexible eating and intuitive eating. The tested model showed an adequate fit to the empirical data, explaining 51% of the variance of disordered eating severity. Even more, data suggested that 45% of inflexible eating and 20% of intuitive eating variance is explained by higher levels of orthorexic behaviours. Additionally, the model suggested that the relationship between the adoption of

orthorexic behaviours and disordered eating, is mediated by an increased inflexible eating attitude and by a decreased intuitive eating attitude. This data seems to underline the important role of these eating-related processes in the jump from an interest in healthy eating into a pathological one. Results also supported the model's invariance plausibility between Omnivores and Non-omnivores.

Despite recent literature's focus on ON [7, 9], to our knowledge this is the first study to identify and examine the eating-related processes that are involved in the relationship between orthorexic behaviours and disordered eating. Our model indicates that it is in fact the adoption of a more inflexible eating approach, instead of a more intuitive eating one, that creates the jump from a simple interest in healthy eating into disordered eating. Furthermore, data seems to agree with previous research [15, 23, 26] when it comes to the positive and strong relationship of inflexible eating with disordered eating and the negative relationship of intuitive eating with disordered eating.

However, these findings can only be interpreted and understood when having into account certain limitations. Firstly, the use of a transversal design annuls the possibility of drawing causal conclusions and the singular use of self-report measures may make it more susceptible to biases. Future research should test the study's model through longitudinal or experimental designs and include other assessment methodologies. The fact that data collection was conducted online may also be considered as a limitation; however, it also allows participants to be more honest by giving a real sense of privacy and anonymity. Secondly, this study was conducted only with female participants. Despite being more prevalent in women, men can also experience disordered eating; therefore, future studies should test this model in a sample that includes male participants and explore gender differences.

Nevertheless, the present study sheds light on new empirical data, essential to better understand the gradual development of ON. The study's data may be relevant not only for

research purposes but to clinical and practical purposes too. In fact, the results suggest that intervention and prevention programs for women presenting symptoms of ON or orthorexic behaviours, should focus on encouraging and cultivating a more intuitive eating approach, rather than an inflexible eating one.

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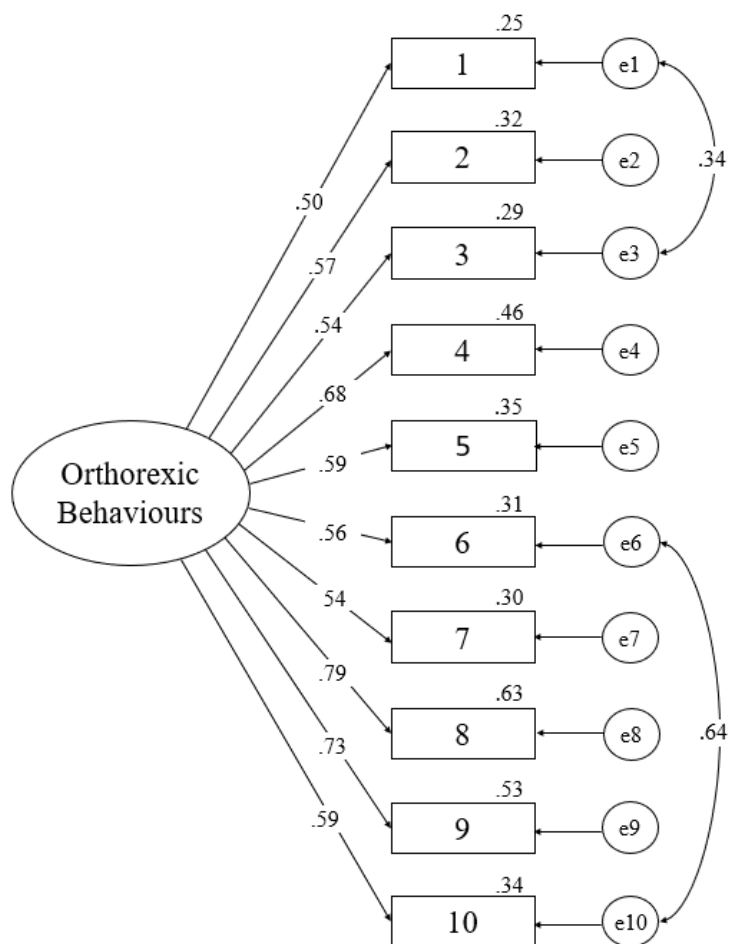
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APPENDICES

Appendix A

Confirmatory factor analysis of the Düsseldorf Orthorexia Scale

Figure 1. *Confirmatory factor analysis of the Düsseldorf Orthorexia Scale adaptation for the Portuguese population (N = 513).*



Appendix B

Submission information for Paper I

- Instructions for authors of *Appetite*



APPETITE

AUTHOR INFORMATION PACK

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ISSN: 0195-6663

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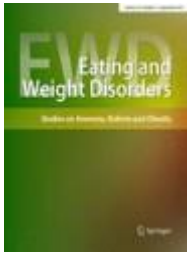
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Appendix C

Submission information for Paper II

- Instructions for authors of *Eating and Weight Disorders*



Eating and Weight Disorders - Studies on Anorexia, Bulimia and Obesity

(Taken and adapted from: <https://www.springer.com/journal/40519/submission-guidelines>)

Impact factor: 3.634 (2019)

Submission guidelines

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Instructions for Authors

Types of Papers

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Brown B, Aaron M (2001) The politics of nature. In: Smith J (ed) *The rise of modern genomics*, 3rd edn. Wiley, New York, pp 230-257

- Online document

Cartwright J (2007) Big stars have weather too. IOP Publishing PhysicsWeb. <http://physicsweb.org/articles/news/11/6/16/1>. Accessed 26 June 2007

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Authors should treat all communication with the Journal as confidential which includes correspondence with direct representatives from the Journal such as Editors-in-Chief and/or Handling Editors and reviewers' reports unless explicit consent has been received to share information.

Compliance with Ethical Standards

To ensure objectivity and transparency in research and to ensure that accepted principles of ethical and professional conduct have been followed, authors should include information regarding sources of funding, potential conflicts of interest (financial or non-financial), informed consent if the research involved human participants, and a statement on welfare of animals if the research involved animals.

Authors should include the following statements (if applicable) in a separate section entitled "Compliance with Ethical Standards" when submitting a paper:

- Disclosure of potential conflicts of interest
- Research involving Human Participants and/or Animals
- Informed consent

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The corresponding author should be prepared to collect documentation of compliance with ethical standards and send if requested during peer review or after publication.

The Editors reserve the right to reject manuscripts that do not comply with the above-mentioned guidelines. The author will be held responsible for false statements or failure to fulfill the above-mentioned guidelines.

Disclosure of potential conflicts of interest

Authors must disclose all relationships or interests that could have direct or potential influence or impart bias on the work. Although an author may not feel there is any conflict, disclosure of relationships and interests provides a more complete and transparent process, leading to an accurate and objective assessment of the work. Awareness of a real or perceived conflicts of interest is a perspective to which the readers are entitled. This is not meant to imply that a financial relationship with an organization that sponsored the research or compensation received for consultancy work is inappropriate. Examples of potential conflicts of interests **that are directly or indirectly related to the research** may include but are not limited to the following:

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- Support from a project sponsor
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The corresponding author collects the conflict of interest disclosure forms from all authors. In author collaborations where formal agreements for representation allow it, it is sufficient for the corresponding author to sign the disclosure form on behalf of all authors. Examples of forms can be found [here](#):

The corresponding author will include a summary statement in the text of the manuscript in a separate section before the reference list, that reflects what is recorded in the potential conflict of interest disclosure form(s).

See below examples of disclosures:

Funding: This study was funded by X (grant number X).

Conflict of Interest: Author A has received research grants from Company A. Author B has received a speaker honorarium from Company X and owns stock in Company Y. Author C is a member of committee Z.

If no conflict exists, the authors should state:

Conflict of Interest: The authors declare that they have no conflict of interest.

Research involving human participants, their data or biological material

Ethics approval

When reporting a study that involved human participants, their data or biological material, authors should include a statement that confirms that the study was approved (or granted exemption) by the appropriate institutional and/or national research ethics committee (including the name of the ethics committee) and certify that the study was performed in accordance with the ethical standards as laid down in the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards. If doubt exists whether the research was conducted in accordance with the 1964 Helsinki Declaration or comparable standards, the authors must explain the reasons for their approach, and demonstrate that an independent ethics committee or institutional review board explicitly approved the doubtful aspects of the study. If a study was granted exemption from requiring ethics approval, this should also be detailed in the manuscript (including the reasons for the exemption).

Retrospective ethics approval

If a study has not been granted ethics committee approval prior to commencing, retrospective ethics approval usually cannot be obtained and it may not be possible to consider the manuscript for peer review. The decision on whether to proceed to peer review in such cases is at the Editor's discretion.

Ethics approval for retrospective studies

Although retrospective studies are conducted on already available data or biological material (for which formal consent may not be needed or is difficult to obtain) ethics approval may be required dependent on the law and the national ethical guidelines of a country. Authors should check with their institution to make sure they are complying with the specific requirements of their country.

Ethics approval for case studies

Case reports require ethics approval. Most institutions will have specific policies on this subject. Authors should check with their institution to make sure they are complying with the specific requirements of their institution and seek ethics approval where needed. Authors should be aware to secure informed consent from the individual (or parent or guardian if the participant is a minor or incapable) See also section on **Informed Consent**.

Cell lines

If human cells are used, authors must declare in the manuscript: what cell lines were used by describing the source of the cell line, including when and from where it was obtained, whether the cell line has recently been authenticated and by what method. If cells were bought from a life science company the following need to be given in the manuscript: name of company (that provided the cells), cell type, number of cell line, and batch of cells.

It is recommended that authors check the [NCBI database](#) for misidentification and contamination of human cell lines. This step will alert authors to possible problems with the cell line and may save considerable time and effort.

Further information is available from the [International Cell Line Authentication Committee](#) (ICLAC).

Authors should include a statement that confirms that an institutional or independent ethics committee (including the name of the ethics committee) approved the study and that informed consent was obtained from the donor or next of kin.

Research Resource Identifiers (RRID)

Research Resource Identifiers (RRID) are persistent unique identifiers (effectively similar to a DOI) for research resources. This journal encourages authors to adopt RRIDs when reporting key biological resources (antibodies, cell lines, model organisms and tools) in their manuscripts.

Examples:

Organism: *Filip1^{tm1a(KOMP)Wtsi}* **RRID:MMRRC_055641-UCD**

Cell Line: RST307 cell line **RRID:CVCL_C321**

Antibody: Luciferase antibody DSHB Cat# LUC-3, **RRID:AB_2722109**

Plasmid: mRuby3 plasmid **RRID:Addgene_104005**

Software: ImageJ Version 1.2.4 **RRID:SCR_003070**

RRIDs are provided by the [Resource Identification Portal](#). Many commonly used research resources already have designated RRIDs. The portal also provides authors links so that they can quickly [register a new resource](#) and obtain an RRID.

Clinical Trial Registration

The World Health Organization (WHO) definition of a clinical trial is "any research study that prospectively assigns human participants or groups of humans to one or more health-related interventions to evaluate the effects on health outcomes". The WHO defines health interventions as "A health intervention is an act performed for, with or on behalf of a person or population whose purpose is to assess, improve, maintain, promote or modify health, functioning or health conditions" and a health-related outcome is generally defined as a change in the health of a person or population as a result of an intervention.

To ensure the integrity of the reporting of patient-centered trials, authors must register prospective clinical trials (phase II to IV trials) in suitable publicly available repositories. For example www.clinicaltrials.gov or any of the primary registries that participate in the [WHO International Clinical Trials Registry Platform](#).

The trial registration number (TRN) and date of registration should be included as the last line of the manuscript abstract.

For clinical trials that have not been registered prospectively, authors are encouraged to register retrospectively to ensure the complete publication of all results. The trial

registration number (TRN), date of registration and the words 'retrospectively registered' should be included as the last line of the manuscript abstract.

Purely observational trials will not require registration.

Standards of reporting

Springer Nature advocates complete and transparent reporting of biomedical and biological research and research with biological applications. Authors are recommended to adhere to the minimum reporting guidelines hosted by the [EQUATOR Network](#) when preparing their manuscript.

Exact requirements may vary depending on the journal; please refer to the journal's Instructions for Authors.

Checklists are available for a number of study designs, including:

Randomised trials ([CONSORT](#)) and Study protocols ([SPIRIT](#))

Observational studies ([STROBE](#))

Systematic reviews and meta-analyses ([PRISMA](#)) and protocols ([Prisma-P](#))

Diagnostic/prognostic studies ([STARD](#)) and ([TRIPOD](#))

Case reports ([CARE](#))

Clinical practice guidelines ([AGREE](#)) and ([RIGHT](#))

Qualitative research ([SRQR](#)) and ([COREQ](#))

Animal pre-clinical studies ([ARRIVE](#))

Quality improvement studies ([SQUIRE](#))

Economic evaluations ([CHEERS](#))

Summary of requirements

The above should be summarized in a statement and placed in a **"Declarations"** section before the reference list under a heading of **'Ethics approval'**.

Please see the various examples of wording below and revise/customize the sample statements according to your own needs.

Examples of statements to be used when ethics approval has been obtained:

- All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. The study was approved by the Bioethics Committee of the Medical University of A (No. ...).
- This study was performed in line with the principles of the Declaration of Helsinki. Approval was granted by the Ethics Committee of University B (Date.../No. ...).
- Approval was obtained from the ethics committee of University C. The procedures used in this study adhere to the tenets of the Declaration of Helsinki.
- The questionnaire and methodology for this study was approved by the Human Research Ethics committee of the University of D (Ethics approval number: ...).

Examples of statements to be used for a retrospective study:

- Ethical approval was waived by the local Ethics Committee of University A in view of the retrospective nature of the study and all the procedures being performed were part of the routine care.
- This research study was conducted retrospectively from data obtained for clinical purposes. We consulted extensively with the IRB of XYZ who determined that our study did not need ethical approval. An IRB official waiver of ethical approval was granted from the IRB of XYZ.
- This retrospective chart review study involving human participants was in accordance with the ethical standards of the institutional and national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. The Human Investigation Committee (IRB) of University B approved this study.

Examples of statements to be used when no ethical approval is required/exemption granted:

- This is an observational study. The XYZ Research Ethics Committee has confirmed that no ethical approval is required.

- The data reproduced from Article X utilized human tissue that was procured via our Biobank AB, which provides de-identified samples. This study was reviewed and deemed exempt by our XYZ Institutional Review Board. The BioBank protocols are in accordance with the ethical standards of our institution and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Authors are responsible for correctness of the statements provided in the manuscript. See also Authorship Principles. The Editor-in-Chief reserves the right to reject submissions that do not meet the guidelines described in this section.

Informed consent

All individuals have individual rights that are not to be infringed. Individual participants in studies have, for example, the right to decide what happens to the (identifiable) personal data gathered, to what they have said during a study or an interview, as well as to any photograph that was taken. This is especially true concerning images of vulnerable people (e.g. minors, patients, refugees, etc) or the use of images in sensitive contexts. In many instances authors will need to secure written consent before including images.

Identifying details (names, dates of birth, identity numbers, biometrical characteristics (such as facial features, fingerprint, writing style, voice pattern, DNA or other distinguishing characteristic) and other information) of the participants that were studied should not be published in written descriptions, photographs, and genetic profiles unless the information is essential for scholarly purposes and the participant (or parent or guardian if the participant is incapable) gave written informed consent for publication. Complete anonymity is difficult to achieve in some cases. Detailed descriptions of individual participants, whether of their whole bodies or of body sections, may lead to disclosure of their identity. Under certain circumstances consent is not required as long as information is anonymized and the submission does not include images that may identify the person.

Informed consent for publication should be obtained if there is any doubt. For example, masking the eye region in photographs of participants is inadequate protection of anonymity. If identifying characteristics are altered to protect anonymity, such as in genetic profiles, authors should provide assurance that alterations do not distort scientific meaning.

