Investigating Orthorexia Nervosa With The ORTO-R in a Sample of University Students With Or Without Subthreshold Autism Spectrum: Focus On Dietary Habits and Sex Differences

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Research Article

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Abstract

Purpose: The aim of the present study was to investigate the presence of ON symptoms, measured by means of the ORTO-R, in a sample of University students with or without AT, specifically focusing on evaluating the role of sex and of dietary habits in the association between ON and autism spectrum.

Methods: Subjects were requested to anonymously fulfil the ORTO-R and the Adult Autism Subthreshold Autism Spectrum (AdAS Spectrum) through an online form.

Results: 2140 students participated in the study. Subjects with significant AT reported significantly higher ORTO-R scores than subjects without AT. Females and subjects following a vegetarian/vegan diet reported significantly higher ORTO-R scores than males and than subjects following an omnivorous diet, respectively. Significant positive correlations were found between ORTO-R and AdAS Spectrum scores. A decision tree model, with sex, type of diet and presence of AT as independent variables and ORTO-R score as dependent variable, showed in the first step the presence of significantly higher ORTO-R scores among females than among males, and in the second step showed in both sexes the presence of higher ORTO-R scores among subjects with AT than in those without. A significant interaction of sex and presence/absence of AT was reported on ORTO-R score, with a higher increasing trend of ORTO-R score with the increase of AdAS Spectrum score among females than among males.

Conclusions: Our results further highlighted the association between AT and ON, in particular among females.

Introduction

During the last decades, in parallel with the evolution of social and cultural environment, modern psychiatry has faced the emergence of new psychopathological conditions, characterized by peculiar clinical pictures. This is the case of orthorexia nervosa (ON), a condition described for the first time by Steve Bratman in the late 1990s [1]. ON features an eating pattern mainly characterized for an abnormal fixation and obsession for a healthy style of eating (Bratman, 1997). The word "orthorexia" derives from the Greek "ortho", which means "correct / adequate", and "orexis", which means "appetite". Individuals affected by this condition usually adopt restrictive dietary habits, progressively excluding more and more foods considered unhealthy from their diet. Despite the persistence of diagnostic uncertainty for this condition, which to date is not included in the fifth edition of the Diagnostic and Statistical Manual of Mental disorders (DSM-5) [2], a wide range of possible risk factors has been proposed, such as an individual or family history of other mental disorders, previous overweight or obesity, neurotic or perfectionist personality traits. or also the presence of a high income. Other features associated with ON were the previous presence of specific dietary habits, such as veganism or vegetarianism, a high income or a high intermediate level of instruction. In addition, specific populations, such as athletes or health workers, seem to show a greater risk towards the development of ON symptoms [3][4][5][6][7][8][9]. According to previous studies, the prevalence of ON may vary depending on the kind of sample considered, ranging from 1–57.6% in the general population [3][10][11][12] and from 35–57.8% in high-risk groups. The distribution of ON in the two sexes is still debated. Several studies reported a higher prevalence among females, although with a lower male/female ratio with respect to AN [3][5][6][13][14][15]. However, not all the studies confirmed this result [16] [17]. To date, several instruments were developed for measuring ON. The most frequently employed questionnaire in this field is the ORTO-15 [15][18], although this instrument has been increasingly criticized due

to the lack of reliability and adherence to the ON symptoms. In particular, the ORTO-15 was developed and validated several years ago, before a more shared agreement on ON definition and features was reached in the scientific literature [19]. Only recently Rogoza and Donnini [19] proposed a revised version of the instrument, the ORTO-R, which was developed to be in line with the more updated descriptions of ON and reported promising results in the validation study.

Some authors suggested that the spreading of ON may mirror the spreading of the contemporary ideal of healthy eating, which is gradually replacing the ideal of thinness typical of the 1980s and 1990s: in this framework, ON might be considered a restrictive eating disorder in the same psychopathological spectrum of restrictive Anorexia nervosa (AN-R), with different presentations linked to environmental factors [5][20][21]. Several studies, in line with this hypothesis, highlighted the similarities between AN and ON, stressing that, despite the shift of the focus on food quality rather than food quantity, these conditions would share a common symptomatology core and would also be associated with similar personality traits, such as perfectionism or inflexibility [14][20]. On the other hand, ON has been also associated with other psychopathological dimensions, such as the obsessive-compulsive spectrum, stressing the presence of rituals, repetitive behaviours and perfectionism traits in both the disorders [4]. At the same time, increasing literature reported the presence of a possible association between AN and female phenotypes of Autism Spectrum Disorder (ASD). ASD is a neurodevelopmental disorder characterized by an impairment in social communication and interactions, narrow interests and repetitive behaviours, which shows a dramatically higher prevalence among males (while AN shows instead a great prevalence among females) [2]. Since the '70s, some authors reported a familial aggregation between AN and ASD as well as similar clinical features [14][20][22]. It was pointed out that the strict focus on food and diet and the ritualized behaviours linked to food intake typical of AN may resemble the pattern of narrow interests and repetitive behaviours of ASD more than the obsessions and compulsion of obsessive-compulsive disorder [14]. In addition to a pattern of rigid habits, inflexibility and narrow interests, the presence of deficits in socio-emotional reciprocity and alterations in theory of mind was also reported among AN patients, further stressing its symptomatological overlaps with the autism spectrum [14][23][24][25]. Several studies in the last years reported, among patients with AN, a higher prevalence of ASD [26]. The presence of subthreshold autistic traits (AT) was reported to be particularly higher among subjects with AN [14][21], although increased AT were also found in patients with Bulimia nervosa and Binge eating disorder, which were often been associated with mood disorder spectrum in the literature [14][21][27].

It should be noted that the label of “AT” is used for describing the presence of symptoms and traits similar, although sub-threshold, to those reported by subjects with ASD. In line with the spectrum model, which features a dimensional approach to psychopathology and recognizes the presence of a continuum between full-blown disorders and isolated, atypical or more nuanced symptoms [28], AT seems to be distributed in a continuum from the general to the clinical population, being particularly represented in some specific high risk groups, including subjects with other kinds of psychiatric disorders [21][29][30][31][32][33][34][35][36][37]. The similarities between AN and autism spectrum, together with the inverse prevalence of these conditions in the two sexes, led some authors to hypothesize that AN might be re-conceptualized as a female-specific phenotype of ASD [15]. The possible link between autism spectrum and AN was further supported by studies focused on female presentations of ASD, which reported that autistic-like symptoms may be underrecognized among females due to the presence of different features with respect to those typical of males. In particular, ASD females seem to report a lower impairment in social relationships, showing a higher ability to cope with the

social environment through camouflaging strategies, although reporting more often social anxiety symptoms. Moreover, female forms of ASD would feature different kinds of restricted interests, such as spending time with animals, focusing on fictions or celebrities, or also on food and diet [15][38][39]. Despite this amount of studies about the link between autism spectrum and AN, limited research focused on evaluating the possible association between ON and AT. However, as in the case of AN, the obsession with a healthy diet, the ritualized behaviours associated with the preparation and consumption of food, with a selective and narrow interest towards diet, seems to show several overlaps with autistic-like symptomatology. Similarly, the sense of moral superiority and the intolerance towards the eating habits of other people may recall the deficits of the socio-emotional reciprocity typically found in autistic patients [20]. A previous study by Carpita et al. [15] showed, in a wide University population (students as well as University workers), a greater presence of AT among subjects with ON symptoms, measured by means of the ORTO-15. Moreover, they found that being females and reporting higher AT were statistically predictive factors towards the presence of ON. While this study seems to further support the hypothesis that ON may be associated, like AN, with female presentations of the autism spectrum, the use of ORTO-15, as reported above, was criticized by previous studies.

In this framework, the aim of the present study was to investigate the presence of ON symptoms, measured by means of the ORTO-R, in a sample of University students with or without AT, specifically focusing on evaluating the role of sex and of dietary habits in the association between ON and autism spectrum.

Methods

Participants

All the students of University of Pisa received an e-mail invitation to participate in the survey. Subjects who agreed to participate were requested to fill out a form with socio-demographic variables and they were subsequently assessed with self-report psychometric instruments. All the procedures were conducted through an anonymous online form. Students did not receive any payment or benefit for agreeing to participate. The study was conducted in accordance with the Declaration of Helsinki and the local Ethics Committees approved all recruitment and assessment procedures. The questionnaire employed in the present work were the Adult Autism Subthreshold Spectrum (AdAS Spectrum) and the ORTO-R.

AdAS Spectrum

The Adult Autism Subthreshold Spectrum (AdAS Spectrum) is an instrument tailored to evaluate the presence of full-threshold and subthreshold autism spectrum symptoms and traits, as well as sex-specific traits, in adults with no diagnosis of intellectual disabilities and alterations in language development [40]. The questionnaire is composed of 160 items, grouped in 7 domains: *Childhood/adolescence*, *Verbal communication*, *Non-verbal communication*, *Empathy*, *Inflexibility and adherence to routine*, *Restrictive interests and rumination*, *Hyper-hypo reactivity to sensory input*. Higher scores indicate a higher impairment in the assessed dimension. According to the validation study, the AdAS Spectrum was proven to be a reliable quantitative assessment of AT, and it was employed in several clinical and non-clinical studies [21][33][34][41][42][43][44][45]. A Spanish version has also been validated [46]. The instrument features also two threshold values: a cut-off score of 70,

for identifying the presence of full-blown ASD symptoms, and a cut-off score of 43, for identifying the presence of AT [37].

ORTO-R

ORTO-R [19] is the revised and abbreviated version of the ORTO-15 [18], a questionnaire developed to assess orthorexic features. It consists of 6 items that investigate, whether food choices are conditioned by health concerns (item 1), whether the belief that healthy food consumption improves self-esteem (item 2) or appearance (item 3), if thoughts about food have caused feelings of guilt, shame, or anxiety in the last three months (item 4), how long concerns for food take up per day (item 5), and whether food concerns affect the psychosocial functioning of the individual (item 6). Each item can be answered on a four-point scale (Always, Often, Sometimes, Never). Higher scores suggest an increased tendency towards ON. The ORTO-R was developed with the aim to overcome the flaws of the ORTO-15, which was one of the first questionnaires in this field and thus was criticized for its lack of reliability and adherence to the actual ON symptoms, while ORTO-R was tailored to be in line with the most recent descriptions and definitions of ON. According to the validation study, the ORTO-R seems to be a promising and reliable tool [19].

Statistical analyses

For the aims of the present work we compared two groups of students, splitting the sample on the basis of the presence of significant AT according to the AdAS Spectrum (AT and No AT group). In particular, students with a AdAS Spectrum score beyond the cut-off of 43 for significant AT were included in the AT group, while subjects who scored below were included in the No AT group. Student's t-tests and Chi-square tests were employed to compare sociodemographic variables and ORTO-R scores between groups. Moreover, Student's t-tests were used to compare ORTO-R scores among subjects with different sociodemographic characteristics. Pearson's correlation coefficient was calculated for investigating the presence of significant correlations between the AdAS Spectrum and the ORTO-R. We performed a decision tree model in order to identify which variables among sex, type of diet and presence of AT best predicted ORTO-R scores. This analysis allows us to examine interactions among variables and create a decision tree model, graphically representing the findings as an inverted tree. The model starts with a root node with all the cases included, and then the tree grows by choosing at each step the independent variable with the higher interaction with the dependent variable. The model also merges the categories defined by predictors when no difference is reported with respect to the dependent variable. Finally, an analysis of variance (ANOVA) with a factorial design was performed with ORTO-R as dependent variable and the presence of AT and sex as independent variables. All the analyses were conducted with SPSS, version 24 (IBM Corp., 2016).

Results

On the basis of the AdAS Spectrum cut-off, we identified 1318 subjects with AT (AT group) and 822 subjects without (no AT group). The mean age of the sample was 23.80 ± 4.80 . The sample was composed by a total of 2140 students, 66.1% (N=1414) identified themselves as females and 33.9% (N=726) as males. Moreover, 1956 students (94.3%) followed an omnivorous diet, while 118 students (5.7%) were following at the time of the questionnaire a vegetarian or vegan diet.

No significant differences were found with respect of sex and type of diet distribution between AT and No AT groups. When performing Student's t-tests, we found that subjects in the AT group showed a significantly higher ORTO-R score than the no AT group (see Table 1). Moreover, in the overall sample females reported significantly higher ORTO-R scores than males, while subjects who followed a vegetarian/vegan diet showed significantly higher ORTO-R score than those following an omnivorous diet (see Table 2).

Table 1
Comparison of sociodemographic variables and ORTO-R scores between AT and No AT group

		<i>AT group</i> <i>(N=1318)</i>	<i>No AT group</i> <i>(N=822)</i>	<i>t</i>	<i>p</i>
		<i>mean±SD</i>	<i>mean±SD</i>		
ORTO-R		13.30±3.67	11.79±3.26	-9.95	<.001
		<i>N(%)</i>	<i>N(%)</i>	Chi-square	p
Sex	F	855(64.9)	559(68.0)	2.22	.136
	M	463(35.1)	263(32.0)		
Diet°	Omnivorous	1195(93.7)	761(95.2)	2.11	.146
	Vegetarian/	80(6.3)	38(4.8)		
	Vegan				
°only a subset of 2074 students reported this data					

Table 2
Comparison of ORTO-R scores depending from sex and diet

	Sex		Diet					
	<i>F (N=1414)</i>	<i>M (N=726)</i>	<i>t</i>	<i>p</i>	<i>Omnivorous (N=1956)</i>	<i>Vegetarian/ Vegan (N=118)</i>	<i>t</i>	<i>p</i>
ORTO-R (mean±SD)	13.31±3.63	11.57±3.24	-11.32	<.001	12.63±3.59	14.19±3.40	-4.58	<.001

When performing a Pearson's correlation coefficient, we also found that ORTO-R was significantly correlated with the AdAS Spectrum in both females and males, although correlation coefficients were slightly higher among females for total AdAS Spectrum and most of the domain scores (see **Table 3**).

Table 3. Correlations between ORTO-R and AdAS Spectrum scores among males and females

	ORTO-R	
	Males (N=726)	Females (N=1414)
AdAS Spectrum		
Childhood/Adolescence	.165*	.210*
Verbal communication	.187*	.147*
Non verbal communication	.229*	.272*
Empathy	.090*	.125*
Inflexibility and adherence to routine	.227*	.266*
Restricted interests and rumination	.230*	.244*
Hyper-Hypo reactivity to sensory input	.198*	.175*
AdAS Spectrum total score	.243*	.274*

**Significant correlation, $p < .001$*

Results from the decision tree model, with sex, type of diet and presence of AT as independent variables and ORTO-R score as dependent variable, showed in the first step the presence of significantly higher ORTO-R scores among females than among males. Subsequently, among both females and males, the AT group scored higher than the no AT group. No effect was found for the type of diet (See Figure 1). Finally, in order to further deepen the investigation on the effect and the interaction between the presence of AT and sex on ORTO-R scores, we performed a factorial ANOVA analysis. Results reported a significant main effect of sex and of AT on ORTO-R score: $F(1,2136)=105.79$, $p < .001$ and $(F1,2136)=73.83$, $p < .001$ respectively. There was also a significant interaction between sex and AT on ORTO-R score: $F(1,2136)=12.06$, $p = .001$. In particular, we found that, although in both sexes ORTO-R scores increased with the increase of the AdAS Spectrum scores, the increasing trend was higher among females (see Table 4 and Figure 2). A similar trend was also observable when performing a Student's t tests to compare ORTO-R scores between AT and No AT groups in the two sexes. In particular, while in both sexes subjects with AT showed higher ORTO-R scores than subjects without, t-test results among females showed a greater level of significance and higher t values (See Table 5).

Table 4
Factorial ANOVA analysis with sex and presence of AT as independent variables and ORTO-R score as dependent variable

Source	Type III Sum of Squares	df	Mean Square	F (1,236)	p
Corrected model	2854.16	3	951.39	81.77	<.001
Intercept	270755.07	1	270755.07	23271.24	<.001
Sex	1230.87	1	1230.87	105.79	<.001
AT	859.03	1	859.03	73.83	<.001
Sex*AT	140.28	1	140.28	12.06	.001
Error	24851.82	2136	11.64	-	-
Total	374265.00	2140	-	-	-
Corrected total	27705.99	2139	-	-	-
<i>R squared=.103; Adjusted R squared=.102</i>					

Table 5. Comparison of ORTO-R scores between AT and no AT group among males and females

	Males				Females			
	No AT group (N=263)	AT group (N=463)	t	p	No AT group (N=559)	AT group (N=855)	t	p
ORTO-R (<i>mean±SD</i>)	11.04±2.98	11.87±3.34	-3.42	.001	12.14±3.32	14.08±3.61	-10.38	.001

Discussion

The aim of the present study was to assess the presence of ON in a population of University students, with and without AT, with a focus on the role of diet and sex differences.

We found a significantly higher prevalence of ON symptoms in women and in subjects following a vegetarian/vegan diet. Despite some authors did not found significant sex differences in ON, or even reported a higher prevalence among men [10][11][18][47][48] (Fidan et al., 2010; Dunn et al., 2017), our results seem in line with the several studies which instead reported a higher prevalence of ON among females [14][49][50].

Dell’Osso et al. reported a higher prevalence of ON among females and among subjects with a vegetarian/vegan diet among university students [5][6]. As previously highlighted, the increased prevalence of ON among females supported the hypothesis of a possible continuum between ON and AN, which might also share a similar distribution among sexes [6][14][15]. Regarding the role of diet, our results confirm previous reports from the literature, which highlighted a link between ON, obsession for healthy eating and vegan/vegetarian dietary habits [6][14][15][40][51][52]. In particular, in a recent review from Brytek-Matera et al. [53], an association between vegetarianism and eating behaviours typical of ON was found in 11 out of the 14

studies included, thus raising the question if vegetarianism may represent a risk factor for the development of ON. The higher prevalence of ON symptoms in subjects with AT reported in this study is in line with the higher levels of AT among subjects scoring over the threshold for ON (as measured by the ORTO-15) previously reported in a university population [15]. The similar findings reported by means of different questionnaires strengthen the validity of the association between these two conditions. Our results, further support the link between ON and the autism spectrum, according to the spreading hypothesis of an association between ASD and restrictive eating disorders [20][21][22][54][55][56][57]. Noticeably, patients with ASD often display restrictive eating behaviours, such as highly selective food choices or a total refusal of specific kinds of food [20][58], a feature that may resemble the habits of orthorexic subjects. At the same time, subjects affected by ON typically show ritualized behaviours in the preparation and consumptions of food and often report a strong cognitive focus on eating habits, which recall the well-known stereotyped behaviours and interests of ASD. In addition, the feeling of moral superiority and the intolerance towards eating behaviours of other people may suggest the presence of autistic-like deficits in socio-emotional reciprocity in ON subjects [2][20].

A significant correlation was also found between ORTO-R and the AdAS Spectrum, with a tendency towards stronger correlation coefficients among females. Moreover, according to our results, there was a significant interaction of AT and sex on ON: while ORTO-R scores rose with the increase of AdAS Spectrum scores, the rising of the ORTO-R scores was higher among females. These findings, suggesting a specifically higher association between ON and autism spectrum among females, may be considered in line with the literature which hypothesized a link between AN and female presentations of ASD, leading to hypothesize that the overlap between autism and eating disorder spectra among females may extend also to ON [14][59]. According to this hypothesis, ON may be included in the same autism spectrum phenotype of AN and, subsequently, AN and ON might share the same autistic core which, in this case, would be expressed by an inflexible and narrow focus on eating habits, together with stereotyped and repetitive behaviours related to food and altered socio-emotional reciprocity.

This study should be considered in light of several limitations. Firstly, our sample included only University students, and thus our results could not be extended to the general population. Secondly, subjects were recruited on a voluntary basis, eventually leading to selection biases in the sample.

Moreover, both the AdAS Spectrum and ORTO-R are self-reported questionnaires, and the use of this kind of instruments may lead to biases in the results due to an underestimation or an overestimation of the symptoms by the subjects. In addition, no information was available about the presence among the subjects of an actual diagnosis of ASD or of Feeding and eating disorders, or also of other comorbid mental disorders, which may have affected our results. Finally, this study featured a cross-sectional design, and subsequently it was not possible to make inferences on any cause-effect or temporal relationship regarding our findings. Further studies featuring a full-fledged clinical assessment and possibly, a longitudinal design are warranted for clarifying the relationship between ON and AT.

Declarations

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Competing Interests

The authors have no relevant financial or non-financial interests to disclose.

Ethics approval

This study was performed in line with the principles of the Declaration of Helsinki. Approval was granted by the Committee on Bioethics of the University of Pisa (Protocol number: 0072245/2019; Date: July 07, 2019).

Consent to participate

Informed consent was obtained from all individual participants included in the study.

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Figures

ORTO-R mean score

Figure 1

Tree decision model with ORTO-R score as independent variable and sex, type of diet and presence of AT as independent variables

Figure 2

Profile plot of estimated marginal means for ORTO-R depending from presence/absence of AT in males and females