



## EATING DISORDERS

# Assessing psychological and nutritional impact of suspected orthorexia nervosa: a cross-sectional pilot study

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### Keywords

dietary intake, orthorexia nervosa, pilot study, psychological traits.

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## Introduction

Orthorexia nervosa (ON), referring to a pathological obsession with clean or healthy nutrition, was coined by Bratman in 1997<sup>(1)</sup>. According to proposed diagnostic criteria<sup>(2,4)</sup>, those with possible ON display restrictive dietary practices aimed at maximising health, which escalate over time potentially leading to social isolation and malnutrition. Transgression of self-imposed rules on food intake results in guilt, anxiety and subsequent compensatory behaviours such as stricter restrictions or ‘cleanses’. Engaging in compensatory behaviours, individuals attempt to rid themselves of the substances perceived as impure.

Although there is growing attention to ON in the academic and popular media<sup>(3)</sup>, there is no current

## Abstract

**Background:** To date, research on the dietary patterns of individuals with potential orthorexic symptoms is lacking. This cross-sectional pilot study aimed to explore the feasibility of assessing dietary patterns with psychological traits and states of individuals with possible orthorexic tendencies.

**Methods:** Dietary intakes of 10 individuals (two males and eight females) were assessed using 24-h recall. Mean age of participants was 28.3 years; mean body mass index was 21.2 kg m<sup>-2</sup>. Nutrient intakes were compared with current dietary guidelines and the Eatwell Guide (Public Health England, 2016). Participants completed the ORTO-15, the Eating Attitude Test (EAT-26), the Obsessive-Compulsive Inventory-Revised edition (OCI-R), Paulhus’s Spheres of Control (SoC), the Rosenberg’s Self-Esteem Scale (RSES) and the Multidimensional Body-Self Relations Questionnaire (MBSRQ).

**Results:** High levels of disparity across participants’ psychometric scores and 24-h recall results were observed. There was no single pattern of self-imposed dietary restrictions among participants. Described dietary practices failed to meet the guidelines for several nutrients.

**Conclusions:** The results of this pilot study suggest that an extensive investigation of the diets of individuals with possible orthorexic tendencies in a large-scale study would contribute to the understanding of this condition. In addition, the use of multiple psychometric instruments is recommended for diagnosing orthorexia nervosa.

consensus on whether the disorder exists, and diagnostic criteria have not been established<sup>(4)</sup>. ON is not listed in the *Diagnostic and Statistical Manual of Mental Disorders* (5th edn)<sup>(5)</sup>. However, much research has been conducted subsequently.

The majority of existing research on ON has focused on identifying prevalence in different populations<sup>(6–9)</sup>, adapting the diagnostic questionnaire in different countries<sup>(10–12)</sup>, examining potential links to other eating disorders<sup>(13,14)</sup>, and identifying whether ON may be a variant of obsessive-compulsive disorder (OCD)<sup>(15)</sup>. Studies have identified similarities between ON, OCD and disordered eating<sup>(8,16–19)</sup>. Dieting, among a range of psychosocial factors such as perfectionism, poor body image and drive for thinness, was also found to be positively associated with ON<sup>(20)</sup>. The recent thinking on

ON suggests that, despite existing evidence of social impairments and changes in emotional, cognitive and behavioural functioning, labelling ON as a distinct mental illness should be carried out with caution because it is challenging to distinguish between the conscious control of dietary intake and pathological behaviour when both are aimed at achieving a healthier diet<sup>(21)</sup>.

Diets of patients suffering from recognised eating disorders such as Anorexia Nervosa (AN) have received considerable academic attention<sup>(22–24)</sup>, and the importance of including nutritional interventions in treatment programs is recognised<sup>(25)</sup>. By contrast, studies of ON have focused on psychological aspects of eating behaviours and reported on the eating behaviours of various groups following specific diets. The majority of such studies have explored whether vegetarian or vegan individuals were at increased risk of developing orthorexic tendencies<sup>(26)</sup>. Although they have used the same scale to measure ON<sup>(27)</sup>, the findings have been inconsistent. Those who followed vegetarian/vegan diets demonstrated greater orthorexic tendencies than those who did not in a sample of Italian students<sup>(28)</sup>, whereas the opposite was shown among American students<sup>(29)</sup>. Other studies did not find higher rates of ON in vegetarians/vegans compared to omnivores and those following paleo diets<sup>(19)</sup>. However, such studies only assessed dietary intake by asking whether participants adhered to vegetarianism/veganism using a questionnaire.

One study to date that we are aware of has measured the nutritional composition of orthorexic diets in a sample of Greek dietetic students<sup>(30)</sup>. Data were gathered via an online 3-day food diary. Students identified as having ON consumed less energy and saturated fatty acids than non-orthorexic students. These results should be cautiously interpreted because Bratman's Orthorexia Scale (BOT)<sup>(31)</sup> was used to identify ON. Whilst BOT was the first measure developed by Bratman based on ON characteristics observed in patients, it is not a recognised clinical diagnostic tool.

People identified with ON are known to exclude foods perceived as lacking purity or considered harmful to health<sup>(4)</sup>. Research to date has not focused on understanding which food groups are excluded from the diet, nor the reasons for their exclusion, and so the implications of dietary restrictions in ON are unclear. Examining the dietary intake of individuals with possible ON could enhance our understanding and shed light on the eating patterns of this population.

The present pilot study is part of a larger study, which focuses on possible overlaps between ON and other conditions, and the dietary intake of individuals displaying orthorexic tendencies. This pilot study explored the feasibility and utility of simultaneously exploring dietary

practices and psychological traits and states of individuals with possible orthorexic tendencies. Alongside the qualitative interviews, participants completed a psychometric assessment and reported their dietary intakes, which formed the basis for this study. It aimed to explore whether there were possible commonalities in restrictive dietary practices between individuals in the context of their lives, as well as to investigate possible implications of dietary restrictions by comparing their intakes with recommendations.

## Materials and methods

This exploratory pilot study used mixed-methods as detailed below. Ethical approval was granted for this project by the Kingston University Research Ethics Committee.

### Participants

Only participants aged at least 18 years were eligible. No exclusion criteria were applied by ethnic background, occupation or socio-demographic status. Participants were known to the research team from personal and professional contacts (six individuals employed in the fashion industry, one student on nutrition and sports science degree, one participant employed as a psychology researcher and one person recommended by the participants based on their similar eating restrictions). They exhibited dietary restrictions reflective of possible ON symptoms as defined by Dunn and Bratman<sup>(2)</sup> (e.g. beliefs that some foods compromise 'purity' of their body, obsessive preoccupation with consuming only 'healthy' foods, sense of self-worth reliant on compliance with the diet of choice).

### Procedures

Participants were recruited using purposeful snowball sampling techniques. Ten individuals were approached and all agreed to participate in the study. An information sheet was provided to all participants at the recruitment stage and the language used was neutral; ON was not mentioned (see Supporting information, Appendix S1). Recruitment and data collection took place from June to September of 2018.

### Data collection

A three pronged approach was employed for data collection. Data collection sessions consisted of (i) semi-structured audio-recorded interviews to collect qualitative data and to ask about psychological conditions including eating disorders; (ii) 24-h recalls to assess dietary intakes;

and (iii) psychometric measures. Eight sessions were held face-to-face, whereas two sessions were conducted via Skype (<https://www.skype.com/en>) because participants were abroad at the time. Skype sessions followed the same format as in-person data collection sessions. The whole data collection process took approximately 2 h per participant. The data analysis of the driving forces behind 'qualitative attribute based' food restriction practices of participants will be published separately. Qualitative data were used only for context in the present study, which focuses on 24-h recall data and psychometric assessments.

### Measures

Participants self-reported their heights and weights from which body mass index (BMI) was calculated<sup>(32)</sup>.

#### *Dietary intake*

During the interview, participants were asked to report whether they followed any specific diets (e.g. vegetarianism) and the extent of day-to-day dietary variation. All participants indicated that they rigidly followed the same patterns every day. Consequently, nutritional intake was assessed via in-person 24-h dietary recall interviews. Participants were asked to recall all the foods and drinks consumed in the previous 24 h, followed by checking questions to clarify food preparation methods and detail about additional ingredients in foods and beverages (e.g. milk and sugar in drinks, herbs and spices in meals). Participants indicated the portion sizes of the foods/drinks consumed using photographs of different portion sizes<sup>(33)</sup>. Data were entered into DIETPLAN 7 (Forestfield Software Ltd, Horsham, UK), which generated individual reports of macro and micronutrient intakes.

#### *Psychometric measures*

A questionnaire was compiled of a battery of psychometric assessments based on previous research<sup>(15,17,34,35)</sup>. Eight participants completed this on paper after the nutrition interview, whereas two were provided with an online link using SurveyMonkey.com after their interviews via Skype.

#### *Assessment of orthorexic tendencies*

For identifying the possible presence of ON, participants completed the English version of the ORTO-15<sup>(27)</sup> questionnaire. However, participant selection did not rely on completion of ORTO-15; in the present study, it was used to identify possible orthorexic tendencies in participants, not as a diagnostic tool. At the time of ethics application and data collection, it was the only questionnaire widely available. Despite limitations, it is used in the majority of studies to identify those with ON<sup>(36)</sup>. It consists of 15

items with responses based on a four-point Likert rating scale. Scores below 40 indicate orthorexic tendencies<sup>(27)</sup>.

#### *Assessment of potential problematic eating patterns*

Participants completed the Eating Attitude Test (EAT-26)<sup>(37)</sup>, a standardised psychometric measure to identify symptoms characteristic of eating disorders. It comprises 26 items forming three subscales: dieting, bulimia and food preoccupation, and oral control. A score above 20 suggests a possible risk of eating disorder.

#### *Obsessive-compulsive tendencies*

Potential overlaps between ON and OCD were assessed using the Obsessive-Compulsive Inventory-Revised (OCI-R)<sup>(38)</sup>. This consists of 18 statements assessing six common OCD symptoms, each scored on a five-point Likert rating scale. A score at or above 21 indicates the presence of OCD<sup>(38)</sup>.

#### *Control*

Perceived locus of control was assessed with the personal control subscale of the Paulhus Spheres of Control scale<sup>(39)</sup>. This subscale consists of 10 statements with seven-point Likert-type ratings measuring beliefs about levels of control people have over their lives. Scores below the normal range (<43.1) indicate feeling less in control than the average person, whereas scores above the normal range (>59.7) signal feeling more in control than average.

#### *Self-esteem*

The Rosenberg Self-Esteem Scale (RSES)<sup>(40)</sup> consists of 10 items with four-point Likert-type rating. Scores <15 indicate low self-esteem.

#### *Body image*

Body image perceptions were examined using the Multidimensional Body-Self Relations Questionnaire (MBSRQ)<sup>(41)</sup>. This 69-item questionnaire contains nine subscales: appearance evaluation, appearance orientation, fitness evaluation, fitness orientation, health evaluation, health orientation, body areas satisfaction, overweight preoccupation and self-classified weight. There are no cut off scores (author-provided population averages for each subscale used).

### Statistical analysis

Individual macro- and micronutrient intakes generated by DIETPLAN 7 were compared with national age and gender-specific recommendations<sup>(42–45)</sup> and to the Eatwell Guide<sup>(46)</sup>. All scores were treated individually; inferential statistics were not used as a result of the small sample size in this pilot study.

## Results

Eight females and two males participated, with mean (SD) ages of 28.4 (4.37) years and 28 (5.66) years, respectively. All participants were part-time or full-time employees. No participant reported a history of or current psychological conditions or eating disorders. Anthropometric data of the 10 participants are shown in Table 1. Four individuals had a BMI below the healthy range (18.5–24.9 kg m<sup>-2</sup>) and one had a BMI of 27.2 kg m<sup>-2</sup> in the overweight range.

Scores for psychometric measures are shown in Table 2. The internal consistency reliability of the scores of ORTO-15 in the present study was found to have a low Cronbach's alpha score of 0.50. McDonald's omega coefficient was 0.62. However, these coefficients should be interpreted with caution because of the small sample size. Eight of 10 individuals scored within the orthorexic range (scores <40; <35). The scores of the remaining two were just above the cut-off point. Results for other psychometric tests were more diverse. Only one participant exhibited eating patterns that suggested disordered eating as identified by EAT-26. Similarly, only one individual had a score indicating the presence of obsessive-compulsive symptoms.

All participants reported normal to high levels of perceived self-esteem on the RSE scale (i.e. scores of 15–30). Only one had a score indicating feeling less in control than average, according to the Paulhus's SoC scale.

Four individuals reported adhering to veganism, one to vegetarianism and one followed a halal diet. The remaining four individuals did not adhere to any specific diets. However, the four vegan participants had anomalous descriptions of veganism; three reported regularly consuming foods normally excluded by vegans (e.g. eggs, chicken). All participants indicated high levels of rigidity in their daily diets with little individual day-to-day

variation. However, none of the participants reported feeling distressed as a result of adherence to their diets.

Table 3 presents specific nutrient intakes of participants' compared with current dietary guidelines<sup>(42–45)</sup>. Reported diets of nine out of 10 participants indicated inadequate energy and calcium intakes. Eight of 10 individuals reported low intakes of fat and iron, whereas intakes of saturated fatty acids exceeded recommendations for five individuals.

Participants' dietary intakes were also compared with the Eatwell Guide to identify whether there were commonalities in restriction of particular food groups<sup>(46)</sup>. No single pattern of deviation from the recommendations was found, apart from the majority of participants reporting very low intakes in the 'dairy and alternatives' category (Table 4).

## Discussion

The present study aimed to pilot the feasibility and utility of simultaneously exploring dietary practices and psychological traits and states of individuals with possible orthorexic tendencies. Of particular interest was whether individuals exhibiting ON would present a dietary pattern specific to this elusive condition.

Of note was the high level of disparity across participants' psychometric scores, 24-h recalls and self-reported dietary preferences. We chose three participants to demonstrate the extent of disparity identified within the study population. Em was chosen because of a score in the OCD range as identified by the OCI-R; Ebou was chosen because of a high score on the SoC scale; and Rafaela was selected as a result of scoring in the eating pathology range on the EAT-26. All are referred to by their chosen pseudonyms.

Previous research suggests a possible link between ON and OCD<sup>(15)</sup>. In the present study, only one participant

**Table 1** Anthropometric measures and self-reported dietary preferences of participants (*n* = 10)

Participant ID*	Sex	Age (years)	Height (m)	Weight (kg)	BMI (kg m <sup>-2</sup> )	Self-reported dietary preferences.
Ebou	Male	32	1.89	88	24.6	Halal
Matt	Male	24	1.83	91.7	27.2	None
Anna	Female	25	1.79	58	18.1	Vegan
Em	Female	35	1.60	54.9	21.4	Vegan
Sarah	Female	29	1.73	51	17	Vegetarian
Lynn	Female	24	1.78	54	17	Vegan with occasional addition of chicken.
Silvia	Female	23	1.68	49	17.4	Vegan with occasional consumption of eggs
Elizabeth	Female	33	1.71	57	19.5	None
Rafaela	Female	27	1.65	57	20.9	None
Cat	Female	31	1.76	57	19	None

\*Pseudonyms are used throughout.

BMI, body mass index.

**Table 2** Individual results from the psychometric measures

Participant ID	ORTO-15	EAT26	RSES	OCI-R	SoC	AE	MBSRQ-FE	MBSRQ-HE	MBSRQ-AO	MBSRQ-FO	MBSRQ-HO	MBSRQ-IO	MBSRQ-OWP	MBSRQ-SCW	MBSRQ-BASS
Ebou	<b>27</b>	17	27	20	<b>70</b>	5	4.80	5	4.25	3.83	4.86	1.20	1	3	5
Matt	41	19	23	11	56	3.71	2.60	4	3.33	3.67	3.43	3.40	2.50	3.50	3.11
Anna	<b>35</b>	2	<b>30</b>	6	<b>63</b>	4.71	4.60	3.67	3.67	3.92	4.29	3.60	3	3	4.56
Em	<b>33</b>	1	28	<b>21</b>	56	3.57	3.20	3.33	2.58	2.58	4.00	3.40	1.75	3	3.44
Sarah	41	14	<b>15</b>	17	52	3.14	3.80	3.50	3.58	3.58	4.14	3.80	3	3.50	2.78
Lynn	<b>35</b>	6	24	17	49	4.57	3.80	3.17	3.92	3.67	4.29	4.20	1.25	2.50	4.22
Silvia	<b>34</b>	10	21	15	<b>40</b>	3.29	3.20	4.33	4.42	3.33	4.00	2.80	2.50	3	2.89
Elizabeth	<b>35</b>	4	21	10	46	3.43	3.20	3.33	3.25	3.25	4.00	3.60	2.25	3	2.78
Rafaela	<b>29</b>	<b>22</b>	20	13	57	3.86	2.60	4	4.33	2.83	3.43	3.40	3.50	3.50	3.44
Cat	<b>31</b>	4	27	14	54	4.14	5	4.17	4.25	4	3.29	2.60	1	2.5	4.56

*ORTO-15*<sup>(27)</sup>. Cut-off scores of 40 and 35 were employed. Scores < 40; <35 indicate presence of ON. *EAT-26*, Eating Attitudes Test<sup>(37)</sup>. Scores above 20 indicate the presence of disordered eating attitudes. *RSES*, Rosenberg Self-Esteem Scale<sup>(40)</sup>. The scale ranges from 0 to 30. Scores between 15 and 25 are within normal range; scores below 15 suggest low self-esteem. *OCI-R*, Obsessive-Compulsive Inventory-Revised<sup>(38)</sup>. Cut-off score is 21, with scores at or above this level indicating the likely presence of OCD. *SoC*, Paulhus Spheres of Control Scale<sup>(39)</sup>. Scores below the normal range (<43.1) indicate feeling in less control than the average person; scores above the normal range (>59.7) indicate feeling in more control than the average person. *MBSRQ*, Multidimensional Body-Self Relations Questionnaire<sup>(41)</sup>; *MBSRQ-AE*, Multidimensional Body-Self Relations Questionnaire Appearance subscale assesses feelings about physical appearance; higher scores indicate greater satisfaction with appearance; *MBSRQ-FE*, Multidimensional Body-Self Relations Questionnaire Fitness Evaluation subscale assesses feelings of being physically fit; high scores indicate person's belief of being 'in shape'; *MBSRQ-HE*, Multidimensional Body-Self Relations Questionnaire Health Evaluation subscale assesses feelings of physical health; high scores indicate belief that one's body is in good health and is free from illness; *MBSRQ-AO*, Multidimensional Body-Self Relations Questionnaire Appearance Orientation assesses investment in appearance; higher scores indicate more importance and attention placed on looks and more engagement in grooming activities; *MBSRQ-FO*, Multidimensional Body-Self Relations Questionnaire Fitness Orientation subscale assesses the extent of investment in fitness level or athletic competence; high scorers value fitness and are actively involved in activities to enhance or maintain their fitness; *MBSRQ-HO*, Multidimensional Body-Self Relations Questionnaire Health Orientation assesses the extent of investment in healthy lifestyle; high scorers are health conscious and try to lead healthy lifestyle; *MBSRQ-IO*, Multidimensional Body-Self Relations Questionnaire Illness Orientation assesses the extent of reactivity to being or becoming ill; *MBSRQ-OWP*, Multidimensional Body-Self Relations Questionnaire Overweight Preoccupation assesses one's fat anxiety, weight vigilance, dieting, and eating restraint; *MBSRQ-SCW*, Multidimensional Body-Self Relations Questionnaire Self-Classified Weight reflects how one perceives one's weight; *MBSRQ-BASS*, Multidimensional Body-Self Relations Questionnaire Body Areas Satisfaction assesses satisfaction with discrete aspects of one's appearance, high composite scorers are generally satisfied with most areas of their body. Values in bold indicate problem scores for individual tests.

**Table 3** 24-h recall assessments compared with the reference nutrient intakes and estimated average requirements

Participant	Energy		Protein		Carbohydrate		Fat (g) (%)	Trans fats (g)	SFA (g)	MUFA (g)	PUFA (g)	Fibre (g)	Iron (mg)	Calcium (mg)	Vitamin B12 (ug)	Folate (ug)	Vitamin C (mg)	Vitamin A (ug)	Zinc (mg)	
	intake (kcal)	(%)	(g)	(%)	(g)	(%)														
Ebou	<b>1125</b>	79.3	143.6	<b>29.8</b>	0.54	7	13	<b>4.2</b>	<b>9.8</b>	<b>3.57</b>	<b>148</b>	3.3	<b>101</b>	63	<b>138.8</b>	<b>5.56</b>				
Matt	2142	157.7	<b>166.5</b>	98.3	2.02	24.9	39.2	22.2	35.2	17.38	<b>532</b>	7.8	497	684	1696.7	18.27				
Anna	1721	28.5%	<b>28.2%</b>	40%	0.85%	<b>10.46%</b>	16.47%	9.33%	<b>19.5</b>	<b>10.11</b>	<b>565</b>	<b>1.4</b>	207	73	<b>204.8</b>	7.23				
Em	<b>1330</b>	<b>11.4%</b>	<b>43.6%</b>	42.8%	0.05%	12.66%	18.72%	10.30%	37	<b>10.90</b>	<b>391</b>	-	201	477	973.2	<b>4.14</b>				
Sarah	2118	<b>10.8%</b>	67.3%	<b>16.7%</b>	0.007%	2.5%	8.46%	4.4%	<b>25.3</b>	<b>9.92</b>	970	5.4	313	177	<b>163.3</b>	<b>6.47</b>				
Lynn	2183	<b>13.6%</b>	50.6%	<b>80.8</b>	0.39	17.4	38.7	16.2	<b>23.7</b>	<b>8.85</b>	<b>245</b>	-	183	167	<b>423</b>	8.73				
Silvia	839	<b>9.3%</b>	58.8%	<b>74</b>	0.07	21.4	29.6	9.5	<b>22</b>	<b>6.28</b>	<b>259</b>	-	260	154	1516.8	<b>3.29</b>				
Elizabeth	2035	<b>20.9</b>	170.5	<b>19.1</b>	0.01	10.4	5.6	1.6	43.4	18.41	<b>634</b>	<b>0.2</b>	359	134	2335.2	13.14				
Rafaela	<b>1424</b>	34.4%	<b>44.3%</b>	<b>81.3</b>	0.01	20.1	29.2	14.5	<b>13.2</b>	<b>8.41</b>	<b>540</b>	3.2	<b>134</b>	<b>9</b>	<b>253.7</b>	9.90				
Cat	842	65.5	<b>174.4</b>	<b>47</b>	0.85	20.2	17.5	<b>4.7</b>	<b>8.4</b>	<b>3.04</b>	<b>479</b>	1.9	<b>55</b>	<b>9</b>	<b>279.5</b>	<b>4.62</b>				
RNI men	2772*	17%	52.2%	<b>28.8%</b>	1.37%	<b>16.46%</b>	8.02%	1.92%	30 <sup>§</sup>	8.7 <sup>§</sup>	700 <sup>§</sup>	1.5 <sup>§</sup>	200 <sup>§</sup>	40 <sup>§</sup>	700 <sup>§</sup>	9.5 <sup>§</sup>				
RNI women	2749 <sup>†</sup>	55.5	50% <sup>†</sup>	35% <sup>§</sup>	<5 g day <sup>-1</sup>	<10%**	12% <sup>§</sup>	6% <sup>§</sup>	30 <sup>§</sup>	14.8 <sup>§</sup>	700 <sup>§</sup>	1.5 <sup>§</sup>	200 <sup>§</sup>	40 <sup>§</sup>	600 <sup>§</sup>	7.0 <sup>§</sup>				

RNI, reference nutrient intakes; SFA, saturated fatty acids; MUFA, mono-unsaturated fatty acids; PUFA, poly-unsaturated fatty acids.

Highlighted values are below the RNI. Italic values are above the RNI.

\*Estimated average requirement (EAR) values for men aged from 19 to 24 years old <sup>(43)</sup>.

<sup>†</sup>EAR values for men aged from 25 to 34 years old <sup>(43)</sup>.

<sup>‡</sup>EAR values for women aged from 19 to 34 years old <sup>(43)</sup>.

<sup>§</sup>Dietary reference values for fat and nutrients <sup>(44)</sup>.

<sup>††</sup>EAR value <sup>(42)</sup>.

\*\*Dietary reference value for saturated fats <sup>(45)</sup>.

**Table 4** 24-h recall assessments compared to the 'Eatwell Guide' recommendations

	Fruits & vegetables	Beans, pulses, fish, eggs, meat and other proteins $\leq 70$ g day <sup>-1</sup> of red and processed meat. * 40 g day <sup>-1</sup> of which 20 g is oily fish. <sup>†</sup>	Potatoes, bread, rice, pasta and other starchy carbohydrates	Dairy & alternatives	Hydration
'Eatwell Guide'	$\geq 5$ portions a day 80 g = 1 portion 150 mL of juice = 1 portion*		$\geq 50\%$ of food energy*	173 g day <sup>-1†</sup>	6–8 glasses per day*
Ebou	2.16 portions = 173 g	205.2 g	47.1%	20 g	5 glasses
Matt	10 portions = 800 g	346.8 g	28.2%	0	12 glasses
Anna	6.03 portions = 482 g	106 g	43.6%	34.5 g	8.4 glasses
Em	19.9 portions = 1591 g	20 g	67.3%	20 g	3.16 glasses
Sarah	9.2 portions = 615 g + 220 mL of juice	221.8 g	50.6%	165 g	3.96 glasses
Lynn	7.18 portions = 574 g	66 g	58.8%	20 g	3.36 glasses
Silvia	6.76 portions = 485 g + 46.2 mL of juice	159 g	68.1%	0	1.6 glasses
Elizabeth	13.8 portions = 1032 g + 120 mL of juice	216 g	44.3%	0	5.2 glasses
Rafaela	1.38 portions = 110 g	165 g (processed meat)	45%	20 g	8.8 glasses
Cat	1.25 portions = 100 g	50 g (processed meat)	52.2%	75 g	1.6 glasses

\*'Eatwell Guide' recommendations <sup>(46)</sup>.

<sup>†</sup>'Eatwell guide' recommendations according to Scarborough *et al.* <sup>(47)</sup>.

(Em) scored within both orthorexic and OCD ranges. Em is a 35-year-old female who identified her diet as vegan, which she said she follows to maximise her health and physical appearance, as well as for ethical reasons. Obsessive preoccupation with food and strict adherence to food consumption rituals have been proposed as defining characteristics of ON in studies attempting to identify its diagnostic criteria <sup>(2,48,49)</sup>. However, the role of obsessive-compulsive behaviours as defining features of ON is not yet established. Several studies suggest that people who display obsessive-compulsive features have a greater risk of ON, although these tendencies were not limited to food-related behaviours <sup>(18,31)</sup>. Perhaps typical obsessive-compulsive behaviours (e.g. washing or contamination compulsions, excessive checking) are more likely to surface in relation to eating behaviours too. No studies, to our knowledge, suggest a link between veganism and OCD. Her intense interest in food (she describes herself as very particular about the foods she eats) therefore appears to reflect Em's possible orthorexic tendencies, which she expresses through her veganism. Orthorexic tendencies may lead to adverse consequences for an individual; however, caution should be exercised when assigning a label of pathology to orthorexic tendencies <sup>(21)</sup>. The use of ORTO-15 in the present study limits our ability to interpret Em's possible orthorexic tendencies as pathological.

Ebou is a 32-year-old male who reported following a halal diet for religious reasons. He also reported consuming only organic fruits and vegetables and avoiding processed foods plus products containing additives or exposed to pesticides. Ebou scored within the orthorexic range on ORTO-15 and obtained the highest score possible on the SoC questionnaire, indicating exceptionally high levels of personal control. Control has been highlighted as central in previous research on AN <sup>(50)</sup>. Individuals suffering from AN constantly strive for control over their dietary intakes, activity levels and body weights <sup>(51)</sup>. Control over body weight may be used by those with AN as an index of their overall self-control and self-worth <sup>(52)</sup>. Although accounts of the role of perceived self-control in eating disorders differ, the common underlying feature is that individuals control their eating behaviours as a coping strategy when there is a lack of perceived control in other aspects of daily life <sup>(52)</sup>. Ebou did not score within the OCD or eating disorder pathology ranges, although high scores on SoC scale are related to both. A recent review on ON <sup>(20)</sup> suggested that control over eating behaviour is important for individuals displaying ON symptoms and those suffering from AN, although the difference lies in their motivations. Although those with ON symptoms control their intake based on the perceived quality of foods, those diagnosed with AN control the quantity of foods consumed. There are also

differences in the ideal body images of the two groups. Individuals with orthorexic tendencies seek 'pure' bodies<sup>(53)</sup>, whereas the ideal body shape and weight for those with AN is significantly underweight<sup>(54)</sup>. Nonetheless, there may be closer relationships between some aspects of ON and body weight than previously assumed. One recent distinction is that between 'healthy' orthorexia and ON<sup>(55)</sup>. There is nothing intrinsically wrong with the desire to eat a healthier diet; indeed, it is encouraged. Researchers, therefore, proposed that ON can be viewed as a two-dimensional construct: healthy/protective and pathological<sup>(56)</sup>, with different motives for food choices between individuals who score in the ON range and those identified as having 'healthy' orthorexic tendencies<sup>(56)</sup>. Weight control was the strongest motivator among the ON group, whereas the healthiness of food motivated the healthy orthorexia group. In the present pilot study, participants did not identify weight loss as a motivator for their chosen dietary practices.

Only one participant had scores simultaneously indicative of possible ON and of pathological eating patterns using EAT-26. Rafaella is a 27-year-old female who reported no religious or ethics-based dietary restrictions and only buys groceries using an organic food delivery service. Earlier studies linked pathological eating attitudes and ON<sup>(17)</sup>. Similarities between ON and established eating disorders, such as adapting one's lifestyle to suit eating patterns, over-concern about food and constructing one's identity based on diet, have been identified<sup>(4)</sup>. The relationship between ON and recognised eating disorders is complex. ON may represent a mechanism for past sufferers of eating disorders to retain control over their food intake, with a different justification for dietary restrictions<sup>(17)</sup>. Individuals who have recovered from an eating disorder may follow special diets (e.g. vegetarianism or veganism) to continue restricting their food intakes in a socially acceptable way<sup>(57)</sup>. Similarly, orthorexic behaviour characterised by restricting intake to foods considered 'healthy' or 'pure' may be an excuse to control the amounts of food consumed that would otherwise worry healthcare professionals. An examination of the prevalence and progression of ON among patients suffering from AN and BN found that, although the eating disorder symptoms decreased after treatment, orthorexic tendencies increased<sup>(17)</sup>. It is possible that ON can be considered as a residual symptom of eating disorders or a coping behaviour to overcome AN symptoms, where patients shift their focus from food quantity to quality<sup>(58)</sup>. Another possibility is that ON might result from cognitive-behavioural therapy that aims to change patients' perceptions of food as threatening to their body shape. Patients are encouraged to establish a pattern of regular eating<sup>(59)</sup>. From this perspective, ON offers a

compromise; at the same time as perceiving eating as a 'body-protective' practice, patients can still maintain control over their eating patterns.

### Dietary assessments

As with the psychometric measures, participants' dietary intakes varied. One of the defining features of ON is obsessive striving for a healthy diet<sup>(2)</sup>. However, few studies have examined the extent to which the ON diet could actually be considered healthy.

Em's dietary intake was characterised by lower than recommended intakes of energy, protein, fat, iron, calcium, vitamin B<sub>12</sub> and zinc. Her carbohydrate, fibre, vitamin A and C intakes exceeded recommendations. Previous studies comparing diets of vegans with omnivores similarly identified lower energy, protein, fat and calcium intakes and higher fibre intakes<sup>(60)</sup>. Adherence to a vegan diet is not generally viewed as pathological. People who choose veganism cite various reasons, which include animal welfare, ecological reasons, culture, religion and health. On the one hand, studies report lower blood cholesterol levels, rates of cardiovascular disease, hypertension, obesity and diabetes mellitus among vegans compared to their omnivore counterparts<sup>(60)</sup>. On the other hand, adherence to a vegan diet is associated with an increased risk of anaemia<sup>(61)</sup> and osteoporosis<sup>(62)</sup>. Furthermore, having any dietary restrictions, regardless of whether these are for ethical or weight reasons, was associated with more orthorexic behaviour compared to individuals with no restrictions<sup>(63)</sup>. More recent evidence suggests that ON is associated with differing motivation for following a vegan diet<sup>(64)</sup>. Namely, health, aesthetics and healing were associated with orthorexic tendencies, whereas animal welfare, politics and ecology were not.

There are some similarities between Em's and Ebou's nutrient intakes. Ebou's intake was characterised by lower than recommended energy, fat, iron, calcium, polyunsaturated fats, fibre, folate, vitamin A and zinc, whereas intakes of protein, vitamin B<sub>12</sub> and vitamin C were higher. Both avoided dairy products, albeit for different reasons (ethical versus physical symptoms post-consumption).

Rafaella's diet suggested a number of issues, with low intakes of energy, carbohydrates, fat, PUFA, fibre, iron, calcium, folate, vitamins C and A, and an intake of saturated fatty acids that exceeded recommendations. Her diet included a high intake of processed red meat (165 g day<sup>-1</sup> compared to the recommendation of <70 g day<sup>-1</sup>) and an inadequate consumption of fruit and vegetables (1.38 portions). This indicates a discrepancy between a major feature of ON (striving for a healthy diet) and actual intake. A high intake of red and processed meat is a risk factor for bowel cancer and the



consumption of little, if any, processed meat and a minimum of five portions of fruit and vegetables daily is recommended<sup>(65)</sup>. Indeed, despite the variations between individual diets, all participants' dietary intakes were characterised by inadequacies compared to recommendations (Table 3).

In this small sample of individuals with rigid and highly restrictive dietary intakes, there are a number of interesting observations. Eight of 10 participants displayed characteristics of ON using ORTO-15, whereas only one displayed features of disordered eating, using EAT-26. Most participants described usual intakes that failed to meet healthy eating guidance, despite a strong motivation for, and commitment to, pure and healthy diets. The conceptualisation of 'pure' and 'healthy' clearly differs greatly among individuals because no single pattern of restrictions was identified. Bratman<sup>(1)</sup> also found that definitions of a 'healthy eating behaviour' differed among those with ON. All of our participants described rigid diets with a lack of variation day-to-day. If true, long-term dietary health is a concern. Although discipline in relation to diet and activity is needed to achieve and maintain a healthy weight and adequate dietary intake, the level of self-discipline described by participants in this pilot exceeded what might be considered usual or desirable.

The present pilot study aimed to identify the type and nature of eating practices of a group with orthorexic tendencies, comparing intakes with dietary recommendations. The results obtained suggest that there is no single dietary pattern characteristic of those with possible orthorexic tendencies, nor can the patterns of restrictions adopted be described as healthy. Intakes described failed to meet dietary recommendations for several nutrients. Failure to meet nutritional guidelines is not exclusive to this sample and, according to the National Diet and Nutrition Survey rolling programme, many adults fail to meet the recommended daily amounts for several nutrients<sup>(66)</sup>. However, the individuals in the present study claimed to adhere to a healthy diet. Similarly, psychological test results were characterised by disparity between individuals, illustrating the difficulties inherent in diagnosing this condition. This suggests that no single psychometric measure is sufficient and that identification of ON should include a range of diagnostic tools. The present study indicates that a positive diagnosis might include scoring within obsessive-compulsive eating pathology ranges and attaining a high score on a measure of perceived control.

The data for this research derive from a larger study aiming to explore all aspects of ON. Dietary intake and psychometric measures were recorded as part of in-depth qualitative interviews to obtain a holistic view of dietary restrictions, what they meant to individuals and aspects of their psychology. The findings suggest that this

approach is useful in helping to identify potential diagnostic elements of ON, as well as participants' reasons for their dietary choices. Understanding the context of dietary choice is an essential component of dietetic treatment, enabling tailored approaches. Our intention is to follow up the participants to gain a more comprehensive view of the dietary patterns associated with possible ON.

Although this pilot study offers a tantalising view of aspects of this elusive condition, a number of limitations were identified. Recruitment of participants to ON studies is challenging because there are no officially accepted diagnostic criteria for ON. The present study used the ORTO-15 questionnaire to assess ON symptoms. Despite being the most frequently used tool, it has been criticised for identifying cases of peculiar dieting as pathological and overestimating the prevalence of ON<sup>(36)</sup>. In addition, its validity and reliability have been questioned<sup>(67)</sup>. It has been suggested that using a lower cut-off point of 35 would result in an improvement<sup>(68)</sup>; however, when we did so in the present study, the same eight individuals were identified as having possible orthorexic tendencies (Table 2).

Dietary intake was recorded using self-reported 24-h recalls, which are subject to misreporting<sup>(69,70)</sup>. Misreporting of food intake has been associated with dietary restraint and is more likely in women<sup>(71)</sup>. Because ON is characterised by strict dietary restrictions, it is very likely that our participants under-reported their food intakes, and so the macro- and micronutrient deficiencies observed may be overestimated. Dietary consumption is complex with potentially large seasonal and day-to-day variations. Intakes over 24-h give a limited overview of dietary patterns, particularly of micronutrient intakes. The individuals in the present study indicated high dietary rigidity with little variation in the foods consumed. Given the nature of the condition a decision was made to explore dietary intakes in the pilot study using the least invasive methods, in addition to self-reported weights and heights. However, in the longer-term follow up, we intend to explore diets in more detail with a more comprehensive dietary assessment method.

Of the other psychometric measures, OCD-I, SoC and EAT-26, similar to previous research<sup>(15,17,18,19)</sup>, identified that individuals with possible orthorexic tendencies also present eating behaviours indicative of pathology, high levels of perceived personal control and obsessive-compulsive tendencies. These measures will contribute to our understanding of ON in future work along with a reliable measure of ON. The MBSRQ and RSES scales did not identify issues with participants' self-esteem and body image, suggesting that motivations for adhering to a diet striving for 'health' may not be related to concerns about physical appearance and self-esteem. In future work, the use of the Teruel Orthorexia Scale<sup>(55)</sup> not only to identify individuals with orthorexic tendencies, but also to

distinguish between healthy and pathological dimensions of ON would be useful. Comparison of the dietary intakes of individuals identified as 'healthy ON' with those with a pathological score would be insightful.

In conclusion, this small pilot study demonstrates considerable heterogeneity between individuals scoring within or just over the cut-off points for identification of ON using the most frequently used diagnostic tool. No single pattern of dietary restrictions was identified that could flag up such individuals in practice; similarly, their psychometric measures demonstrated considerable variation. Of note, despite expressing a strong motivation for clean and healthy nutrition, the dietary intakes of participants did not represent a healthy diet. High levels of dietary restraint and excessive rigidity in terms of intake will always raise concerns. However, within the ON population, those with weight concerns may be a group of greater concern to healthcare professionals.

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The authors have no conflict of interest to declare.

AP conceived and designed the study and oversaw the data collection, as well as the analysis and the writing of the paper. EM carried out the data collection and analysis and wrote the initial draft of the paper. HM contributed to the data analysis and the writing of the paper. All authors critically reviewed the manuscript and approved the final version submitted for publication.

#### Transparency declaration

The lead author affirms that this manuscript is an honest, accurate, and transparent account of the study being reported. The reporting of this work is compliant with STROBE2 guidelines. The lead author affirms that no important aspects of the study have been omitted and that any discrepancies from the study as planned have been explained.

#### Participant details

Participants were recruited in the UK.

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### Supporting information

Additional supporting information may be found online in the Supporting Information section at the end of the article.

**Appendix S1.** Qualitative exploration of the driving forces behind ‘qualitative attribute based’ food restriction practices in young adults.