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Orthorexia nervosa: A behavioral complex or a psychological condition?

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Background and aims: Numerous studies have provided evidence for orthorexia nervosa (ON), an eating pattern characterized by an almost manic obsession for and fixation on healthy eating, to be of epidemiological relevance. However, there is scientific debate on whether it is merely a behavioral or lifestyle phenomenon as compared to a mental disorder. Aim of this cross-sectional study was to explore whether ON is of epidemiological and clinical relevance, and whether ON can be distinguished from other mental health disorders and healthy lifestyle features. *Methods:* An online survey including a measure of orthorexic behaviors [Duesseldorf Orthorexia Scale (DOS)], well-being and distress, eating behaviors, pathological eating, anxiety and depression, addictive behaviors, obsessive–compulsive symptoms, personality, and health behaviors was completed by 713 subjects (79.8% women, 18–75 years, median age: 25 years). *Results:* Twenty-seven subjects (3.8%, 21 women) showed significant orthorexic eating (DOS $\geq$ 30). ON cases reported lower well-being, lower satisfaction with life, and higher current stress levels than non-ON cases. The highest percentage of variation in ON was explained by pathological eating ($R^2 = .380$), followed by eating style, Mediterranean diet, compulsive symptoms, and subjective social status. Importantly, ON provided hardly any additional predictive value for well-being when also considering pathological eating. *Discussion and conclusions:* Our data confirmed the epidemiological and clinical relevance of orthorexic behaviors, but the strong conceptual overlap with other mental health problems and pathological eating raise initial doubts as to whether ON is a distinct mental health disorder category. This co-occurrence, unique symptoms, and underlying processes need further exploration by comparing ON cases with patients with other mental disorders.

Keywords: orthorexia nervosa, eating disorder, obsessive–compulsive disorder, affective disorder, lifestyle

INTRODUCTION

There is increasing popularity of eating trends that focus on healthiness (e.g., superfoods) or purity (e.g., clean eating and paleolithic diet). In the late 1990s, Steven Bratman, a practitioner of alternative medicine, coined the term "orthorexia nervosa" (ON) to describe an eating pattern characterized by an almost pathological fixation on and obsession for healthy eating (Bratman, 1997). Preliminary criteria for the diagnosis of ON were proposed in 2004 (Donini, Marsili, Graziani, Imbriale, & Cannella, 2004). The first proposals for an official diagnosis of ON were based on a US-American case study published in 2015 (Moroze, Dunn, Holland, Yager, & Weintraub, 2015) and a review on the issue of ON by Barthels, Meyer, and Pietrowsky (2015b). Dunn and Bratman (2016) reiterated these criteria and refined them. The provisional main criteria of ON are an obsessive focus on "healthy" eating and avoidance of "unhealthy" foods, mental preoccupation regarding dietary practices, and very rigid dietary rules with violations causing exaggerated emotional distress (fear of disease, anxiety, shame, and negative physical sensations). Food choices are not based on the criterion of quantity or how to best lose weight, yet the primary goal is quality in order to promote optimum health. While there is an ongoing debate about whether to consider ON simply as a new lifestyle phenomenon rather than a disease (Bratman, 2017; Kummer, Dias, & Teixeira, 2008; Pietrowsky & Barthels, 2016), anecdotal reports of physical (malnutrition and weight loss), psychological (fatigue and emotional instability), and social consequences (social isolation, diminished quality of life, and stigma) comply with current concepts of mental disorders (Moroze et al., 2015; Nevin & Vartanian, 2017; Park et al., 2011; Saddichha, Babu, & Chandra, 2012). However, neither the current version of the International Statistical Classification of Diseases and Related Health Problems (WHO) nor the fifth edition of the *Diagnostic and Statistical Manual of Mental Disorders* (APA) consider ON as an independent mental disorder. Missing definitions of what is considered normal eating behavior complicate longitudinal studies on assumed clinical consequences, studies on pathological mechanisms, and research reflecting ON to be distinct from other symptom patterns. Overlap with eating disorders, obsessive–compulsive disorders (OCDs), and affective disorders (Koven & Abry, 2015) hamper its diagnostic classification.

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Is ON of epidemiological relevance?

ON epidemiological research is limited regarding the definition of cases (i.e., a reliable and valid assessment tool has not yet become established) and regarding the selection of populations (i.e., mainly data from European high-risk populations). At present, the orthorexia nervosa-15 (ORTO-15; Donini, Marsili, Graziani, Imbriale, & Cannella, 2005) is the internationally mainly used self-report questionnaire. However, point prevalence rates between 4% in its original publication and up to 90% in other studies (de Souza & Rodrigues, 2014; Donini et al., 2005) raise doubts about this tools' validity (Missbach, Dunn, & König, 2016). When also asking for the personal relevance of eating as well as health problems and limitations in everyday life, prevalence rates of orthorexic eating behaviors drop to under 1% (Dunn, Gibbs, Whitney, & Starosta, 2017). In addition, new methods have been introduced including the Duesseldorf Orthorexia Scale (DOS; Barthels, Meyer, & Pietrowsky, 2015a). Using this scale, cross-sectional rates for ON are estimated between 1% and 7% in the general population and among university members, respectively (Barthels et al., 2015a; Barthels & Pietrowsky, 2012; Luck-Sikorski, Jung, Schlosser, & Riedel-Heller, 2018).

Is ON of clinical relevance?

Most of the current knowledge on the clinical relevance, that is, impairment and/or distress of ON, arises from single case studies (Moroze et al., 2015; Park et al., 2011; Saddichha et al., 2012). While these reports clearly support the notion of ON being of clinical significance in regard to physical, psychological, and social consequences, only few empirical studies have examined ON-related impairment. In particular, studies showed small to moderate associations between orthorexic eating behaviors and psychological variables, such as perfectionism, narcissism, weight and shape concern, pathological eating attitudes, obsessive–compulsive behaviors, and subjective impairment (Barnes & Caltabiano, 2017; Barthels et al., 2015a; Brytek-Matera, Rogoza, Gramaglia, & Zeppegno, 2015; Hayes, Wu, De Nadai, & Storch, 2017; Koven & Senbonmatsu, 2013; Oberle, Samaghabadi, & Hughes, 2017). To date, there is a lack of longitudinal approaches examining medical and psychiatric complications of ON.

Are proposed ON criteria sufficient for a distinct disorder?

The claim of ON being a distinct mental disorder is the subject of controversial debate. ON has been regarded an independent clinical disorder (Koven & Abry, 2015), a manifestation or epiphenomenon of an eating disorder (Brytek-Matera, 2012; Mader, 2004), an OCD (Meyer-Groß & Zaudig, 2007), or merely a social trend (Håman, Barker-Ruchti, Patriksson, & Lindgren, 2015). Some studies showed high ON prevalence rates (40%–80%) among patients suffering from anorexia nervosa or bulimia nervosa (Barthels, Meyer, Huber, & Pietrowsky, 2017a, 2017c). On the contrary, other studies showed equal numbers of ON cases in female anorexia nervosa patients and healthy controls (Brytek-Matera, 2014; Gramaglia, Brytek-Matera, Rogoza, & Zeppegno, 2017). Interestingly, results of a study comparing eating disorder patients before and after therapy showed increased orthorexic tendencies at the end of therapy. This finding suggests that ON might be regarded as a compensatory behavior – moving the focus from quantity toward the quality of food (Segura-Garcia et al., 2015). Furthermore, studies on OCD patient samples have indicated that ON prevalence rates are low (and comparable to the general population) in this disorder (Barthels et al., 2017a, 2017c). On the contrary, studies in healthy samples showed some overlap between orthorexic and obsessive–compulsive symptoms (Arusoğlu, Kabakçi, Köksal, & Merdol, 2008; Bundros, Clifford, Silliman, & Morris, 2016; Hayes et al., 2017; Oberle et al., 2017). On the whole, there is initial evidence that ON is different from conventional eating disorders as well as from OCD. However, it is still slightly tentative to consider ON to be distinct from eating disorders or OCD.

Do ON criteria demarcate a clear difference from other behaviors?

Several researchers discuss sociocultural influences on ON and consider ON a lifestyle phenomenon. In particular, interest in a healthy diet, fitness, and a healthy lifestyle in general has been related to orthorexic tendencies (Håman et al., 2015; Turner & Lefevre, 2017). Several studies have demonstrated that some restrictive forms of diet and an orientation toward health and fitness are considerably prevalent among ON (Barthels, Meyer, & Pietrowsky, 2018; Brytek-Matera, 2014; Brytek-Matera, Donini, Krupa, Poggiogalle, & Hay, 2015; Oberle, Watkins, & Burkot, 2018). Importantly, as none of the current assessment tools consider culturally specific nutritional behavior, conclusions in regard to sociocultural and healthy lifestyle features remain preliminary.

Aim of the study

The aim of this report was to add further evidence to the claims that (a) ON is a diagnostic entity of epidemiological and clinical relevance, (b) ON is different from other mental health disorders, and (c) ON can be distinguished from other restrictive forms of diet and healthy lifestyle features. Answering these claims will also characterize co-occurring characteristics of individuals who show orthorexic tendencies. Moreover, this characterization will help to better define what is and what is not part of ON.

METHODS

Participants and data collection

Potential participants were contacted through public advertisements in local shops and via mailing lists from the universities in the broader Giessen/Marburg area from February to April 2017. Furthermore, online platforms and social networks were used for recruitment. Participants were asked to respond to an Internet survey (online platform SoSci Survey; www.soscisurvey.de/) taking about 30 min to complete. The survey included measures of orthorexic behaviors,

well-being and distress, eating behaviors, pathological eating, anxiety and depression, addictive behaviors, obsessive–compulsive symptoms, personality as well as sociodemographic and health behaviors. The survey was announced as an investigation of "Health behavior, eating habits, and well-being." The link to the online survey was used 2,750 times (including accidental double clicks) and a total of 716 participants (26.0%) completed the survey. $N = 3$ data sets were excluded due to reporting "other" in regard to gender ($n = 2$) or age <18 ($n = 1$). Analyses are thus based on 713 complete data sets.

Measures

Orthorexia nervosa. Orthorexic eating behavior was assessed using the 10-item DOS (Barthels et al., 2015a). The DOS was validated in a German sample of 1,340 subjects and has good internal consistency (Cronbach's $\alpha = .84$) and acceptable retest reliability (3×, 3 months in between, r's = .67 and .79). In this study, Velicer's minimum average partial test confirmed one common factor as optimal solution to the number of DOS components, Cronbach's α was good (.87; in the following, reported coefficients refer to the sample reported herein.) and all items had a good item-total correlation (all >.48). Participants had to report on orthorexic symptoms (e.g., "I feel upset after eating unhealthy food.") on a 4-point scale ranging from "1 – *does not apply to me*" to "4 – *applies to me*." A preliminary cut-off of 30 points was suggested by the authors to reflect orthorexic eating behavior (DOS sum scores range between 10 and 40 points).

Well-being and distress. Well-being and distress were examined using the following scales: the 5-item World Health Organization Well-Being Index (WHO-5; Staehr, 1998; Cronbach's $\alpha = .83$), the single item scale L-1 for the assessment of life satisfaction (Beierlein, Kovaleva, László, Kemper, & Rammstedt, 2014), the 13-item short version of the Resilience Scale (RS-13; Leppert, Koch, Brähler, & Strauß, 2008; Cronbach's $\alpha = .89$), and the 10-item version of the Perceived Stress Scale (PSS-10; Cohen, Kamarck, & Mermelstein, 1983; Klein et al., 2016; Cronbach's $\alpha = .87$). The WHO-5 assesses subjective psychological well-being by asking the respondent to rate five positively framed statements considering the past 2 weeks (e.g., "I have felt calm and relaxed"). Scaling from "0 – *at no time*" to "5 – *all of the time*" results in possible sum scores between 0 and 25, which are then multiplied by 4 to lead to final scores between 0 (worst imaginable well-being) and 100 (best imaginable well-being; due to a programming error, this study employed a 5-point Likert scale. Resulting sum scores were therefore multiplied by five to convert values onto a 0 to 100 scale). The L-1 scale is a single-item measure assessing general satisfaction with life ("How satisfied are you with your life, all things considered?") on a bipolar scale with the anchors ranging from "1 – *not at all satisfied*" to "10 – *completely satisfied*." Retest reliability of the measure for an interval of 6 weeks is acceptable ($r = .67$; Beierlein et al., 2014). The RS-13 was employed to examine resilience as a positive characteristic of an individual's ability to adapt to negative emotions and stressful life events. This scale asks respondents to rate 13 items on a 7-point response scale (ranging from "1 – *strongly disagree*" to "7 – *strongly agree*") summing up to scores between 13 and 91. The PSS is one of the most widely used measures of perceived stress. Respondents have to rate their stress levels during the past month ("0 – *never*," "1 – *almost never*," "2 – *sometimes*," "3 – *fairly often*," and "4 – *very often*") and sum scores are created.

Pathological eating. To assess pathological dietary habits, we employed the *susceptibility to external cues* (5 items; e.g., "If I see others eating, I have a strong desire to eat too") and the *emotional eating* scale (5 items; e.g., "When I feel lonely, I console myself by eating") from the Weight-Related Eating Questionnaire (WREQ; Schembre, Greene, & Melanson, 2009; Cronbach's $\alpha = .88$). Averages of the summed item scores, 5-point scale from "1 – *not at all*" to "5 – *completely*," are calculated. Global eating disorder pathology was assessed using the 8-item brief version of the Eating Disorder Examination – Questionnaire (EDE-Q8; Kliem et al., 2016; Cronbach's $\alpha = .91$). Equivalent to the original 28-item EDE-Q, the EDE-Q8 consists of the subscales *restraint, eating concern, weight concern*, and *shape concern*. Items are rated on a 7-point scale (ranging from "1 – *no day*" to "7 – *every day*") for the past 28 days. At present, there are no cut-offs for the short version, but an average score above 2.5 is considered a sensitive and specific threshold to identify clinically relevant symptoms of an eating disorder among non-clinical samples (Machado et al., 2014; Rø, Reas, & Stedal, 2015).

Affective disorder screening. To monitor the severity of depressive symptoms, we employed the 9-item depression module of the Patient Health Questionnaire (PHQ-9; Kroenke, Spitzer, & Williams, 2001; Cronbach's $\alpha = .86$). Respondents rate specific complaints and impairments for the past 2 weeks from "0 – *not at all*" to "3 – *nearly every day*" and sum scores are created. The Hospital Anxiety and Depression Scale (HADS; Zigmond & Snaith, 1983; Cronbach's $\alpha = .87$) served as an additional screening tool to examine depression and anxiety. For each scale, seven items are answered on a 4-point (0–3) response category resulting in possible sum scores between 0 and 21. Current mental illness, current therapy, and current psychotropic drug use were indicated by simple "*yes*" or "*no*" questions.

Substance-related addictive behaviors. As there are instruments for the measurement of substance-related addictions, we used the Fagerström Test for Nicotine Dependence (Fagerström, 2011; Cronbach's $\alpha = .64$), the Alcohol Use Disorders Identification Test (AUDIT; Babor, Higgins-Biddle, Saunders, Monteiro, & World Health Organization, 2001; Cronbach's $\alpha = .72$), and we additionally asked participants about their current drug use ("*yes*" or "*no*" question). The 6-item Fagerström Test measures the degree of physical dependence to tobacco smoking (e.g., "Do you smoke more frequently in the morning?"). The potential range for this test is 0–10, non-smokers were treated as having a score of "0," and sum scores above 4 are considered "significantly dependent." The AUDIT offers an easy 10-item screening method (e.g., "How often do you have six or more drinks on one occasion?") for excessive drinking and alcohol-use disorders. Scores below 8 are considered low risk, scores above 8 represent hazardous drinking, and scores higher than 15 indicate alcohol dependence.

Obsessive and compulsive symptoms. The Yale–Brown Obsessive–Compulsive Scale (Y-BOCS; Goodman et al., 1989; Cronbach's $\alpha = .93$) was originally developed as a semi-structured interview to rate obsessions and compulsions with respect to the dimensions time spent or occupied, resistance, control, interference with functioning or relationships, and degree of distress. Subjects affirming our two screening questions asking for the presence of obsessions and compulsions and attempts to do something about it were presented with an adapted shortened 10-item self-report version of the Y-BOCS. Subjects self-rated each question from "0 – *no symptoms*" to "4 – *extreme symptoms*." We created an overall sum score (0–40) and subscale scores for obsessions (0–20) and compulsions (0–20). Overall scores above 16 (or scores above 10 on either sub index) indicate clinical relevant obsessive–compulsive symptoms; scores above 30 are considered severe OCD (Goodman et al., 1989).

Nutritional behaviors. To estimate adherence to the Mediterranean form of diet, often associated with beneficial effect for health (Martínez-González et al., 2012), the 14 item Mediterranean Diet Assessment Tool as used in the Prevención con Dieta Mediterránea (www.predimed.es) study was employed (MEDAS; Schröder et al., 2011). Of note, our survey did not include the question on "traditional sauce of tomatoes, garlic, onion, or leeks sautéed in olive oil." Instead, we asked for the subject's adherence to the Mediterranean form of diet on a 5-point scale from "1 – *not at all*" to "5 – *a lot*." Each question was scored with 0 or 1. In more detail, subjects received 1 point in the following cases: rating the adherence item with "≥3," using olive oil as the principal source of fat when cooking, preferring white meat over red meat, using ≥4 tablespoons olive oil/day, having ≥2 servings of vegetables/day, consuming ≥3 pieces of fruit/day, having <2 servings of red meat or sausages/day, having <2 servings of animal fat/day, consuming <2 cups of sugar-sweetened beverages/day, having ≥7 servings of red wine/week, having ≥3 servings of pulses/week, having ≥3 servings of fish/week, consuming <4 commercial pastries/week and having ≥3 servings of nuts/week (sum score range: 0–14). In addition to the MEDAS items, eating style was assessed using a single question with the response options *vegan, vegetarian, semi-vegetarian*, that is, eating meat only occasionally, and *omnivore*.

Healthy lifestyle. Additionally assessed was regular physical activity via the General Practice Physical Activity Questionnaire (GPPAQ; Department of Health, 2009). The GPPAQ considers physical activity during working hours and during leisure time. It provides a four-level physical activity index categorizing subjects as *active, moderately active, moderately inactive*, and *inactive*. In addition, a question about regular medical and dental checkups (from "1 – *never*" to "5 – *very often*") was asked.

Sociodemographics. Questions on anthropometric and sociodemographic variables comprised weight and height to compute body mass index (kg/m^2) and define weight status (according to current recommendations; CDC, 2017), age, gender, relationship status, number of children, highest education, current employment, and the MacArthur scale of subjective social status (Adler & Stewart, 2007). By using a numbered 10-point stepladder image, this scale intends to capture perceived social status. Higher scores indicate a higher subjective social rank. Cross-sectional and longitudinal studies support the ladder's usefulness in clarifying variance of the relationship between socioeconomic factors and health (Adler, Epel, Castellazzo, & Ickovics, 2000; Singh-Manoux, Marmot, & Adler, 2005).

Statistical analysis

We conducted both dimensional and categorical analyses and relied mainly on cross-tables and *t*-tests for variance in heterogeneous populations, as well as correlation and regression analyses. For the purpose of answering our aims, the following analyses were conducted and specific effect sizes were calculated:

(1) ON is a diagnostic entity of epidemiological and clinical relevance: Exploratory data analysis provided main characteristics of DOS sum scores. ON and non-ON subjects (cut-off score: 30) were compared in regard to sociodemographic data and anthropometric measures using *t*-tests and frequency analyses. In addition, the well-being and distress measures (WHO-5, L1, RS-13, and PSS-10) were compared between groups.

(2) ON is different from other mental health problems: ON and non-ON subjects were compared in regard to disordered eating (WREQ and EDE-Q8), addictive behavior (Fagerström, AUDIT, and current addictive drug use), mental health (PHQ-9, HADS, current mental illness, current psychotherapy, and current psychotropic drug use), and OCD symptoms (Y-BOCS) using univariate analyses of variances, *t*-tests, and frequency analyses. Syndrome overlap was examined using (stepwise) linear regression analysis. Sets of predictors (pathological eating, addictive behaviors, affective pathology, obsessive and compulsive symptoms) were separately tested in predicting the DOS sum score. To determine the conceptual overlap of the DOS items with pathological eating (i.e., the WREQ and EDE-Q8 subscales susceptibility to external cues, emotional eating, restraint, eating concern, weight concern, and shape concern), Pearson's product–moment correlations and multiple regressions were used to examine relative agreement.

(3) ON can be distinguished from other (restrictive) forms of diet and healthy lifestyle features: Whether ON owns specific characteristics was analyzed by comparing ON and non-ON subjects in regard to health-related and nutritional behaviors (GPPAQ, checkups, MEDAS, and eating style).

(4) A final stepwise linear regression analysis included pathological eating in step 1, variables distinguishing between ON and non-ON found in the previous analyses were entered in step 2 (forward method) to predict DOS sum scores. As such, the less useful predictors were removed until change of R^2 was no longer significant thereby identifying the most significant risk factors.

Ethics

According to the current version of the Declaration of Helsinki, participation was entirely voluntary and anonymous, and could be terminated at any time for any reason.

All subjects were informed about the study and provided informed consent before conducting the survey. Participants were not directly financially compensated (except course credit for students) but were invited to take part in a lottery with a chance of winning 3× 50€ gift certificates. Contact data were stored separately from questionnaire data to ensure anonymity. The study was approved by the institutional review board.

RESULTS

Epidemiological and clinical relevance of ON

Our sample included a large number of women (79.8%) and subjects with higher education (93.7% A-levels, 33.3% students). With a mean age of 29.4 ± 11.2 years (range: 18–75 years, median: 25 years) and mean body mass index of 23.1 ± 4.2 (range: 15.2–50.8, median 22.1 kg/m^2), our sample was, as might be expected, rather young and of normal weight.

Average DOS scores were 17.87 ± 5.45 (range: 10–37) with women showing higher mean levels as compared to men [18.14 ± 5.43 vs. 16.79 ± 5.44, $t(220.8) = -2.67$, $p = .008$, Cohen's $d = 0.249$]. $N = 27$ (3.8%) cases showed significant orthorexic eating behavior, that is, DOS sum scores ≥30. As shown in Table 1, there was no difference between ON and non-ON subjects with regard to gender distribution, age, and other sociodemographic and anthropometric measures. However, ON subjects evaluated their subjective social status as comparably lower. Similarly, they reported lower well-being, lower satisfaction with life, and

Table 1. Sociodemographic, anthropometric, and well-being and distress measures split by ON group

$N = 713$	Non-ON ($n = 686$)	ON ($n = 27$)	Statistics	p value	Effect size
Gender [male (n %)]	138 (20.1)	6 (22.2)	Fisher's exact test	.807	OR = 1.13 [95% CI: 0.45, 2.86]
Age (years)	29.4 ± 11.2	28.9 ± 10.6	$t(28.4) = 0.26$	.800	$g_{Hedges} = -0.047$
Relationship status (n %)					
Single	261 (38.0)	15 (55.6)	Fisher–Freeman–	.262	$V_{Cramer} = 0.084$
Permanent relationship	276 (40.2)	7 (25.9)	Halton = 5.05		
Married	133 (19.4)	4 (14.8)			
Divorced	12 (1.7)	1 (3.7)			
Widowed	4 (0.6)	0 (0.0)			
Children (n, %)					
0	567 (82.7)	21 (77.8)	$t(28.0) = -0.39$	.702	$g_{Hedges} = 0.078$
1	51 (7.4)	3 (11.1)			
2	48 (7.0)	2 (7.4)			
3	16 (2.3)	1 (3.7)			
4	2 (0.3)	0 (0.0)			
5	2 (0.3)	0 (0.0)			
Education (n %)					
High-school level	3 (0.4)	0 (0.0)	$U = 9{,}008.5$	.568	Kendall's τ-$b = 0.021$
College level	41 (6.0)	1 (3.7)			
University (A-) level	642 (93.6)	26 (96.3)			
Employment (n %)					
Student/unemployed	230 (33.5)	8 (29.6)	Fisher–Freeman–	.157	$V_{Cramer} = 0.102$
Full time	151 (22.0)	2 (7.4)	Halton = 7.36		
Part time	117 (17.1)	5 (18.5)			
Mini job	127 (18.5)	7 (25.9)			
Non-regular job	51 (7.4)	4 (14.8)			
Parental leave	10 (1.5)	1 (3.7)			
Subjective social status	5.9 ± 1.6	5.2 ± 1.6	$t(28.0) = 2.26$	.032	$g_{Hedges} = -0.443$
Body mass index	23.2 ± 4.2	22.5 ± 4.7	$t(27.6) = 0.77$	.447	$g_{Hedges} = -0.170$
Weight status (n %)					
Underweight (<18.5)	38 (5.5)	2 (7.4)	$U = 8{,}184.0$	.207	Kendall's τ-$b = -0.045$
Normal weight (18.5–24.9)	473 (69.0)	21 (77.8)			
Overweight (25.0–29.9)	125 (18.2)	3 (11.1)			
Obesity (≥30)	50 (7.3)	1 (3.7)			
Well-being and distress					
WHO-5 (0–100)	52.2 ± 18.7	38.1 ± 18.4	$t(28.2) = 3.90$	.001	$g_{Hedges} = -0.754$
Life satisfaction (1–10)	7.2 ± 1.8	5.9 ± 2.1	$t(27.5) = 3.23$	.003	$g_{Hedges} = -0.745$
RS-13 sum score (13–91)	68.9 ± 11.4	65.9 ± 12.1	$t(27.9) = 1.28$	.210	$g_{Hedges} = -0.265$
PSS-10 (0–40)	17.1 ± 6.4	22.0 ± 5.7	$t(28.7) = -4.39$	<.001	$g_{Hedges} = 0.769$

Note. Number (and percentage in brackets) provided for categorical/dichotomous variables, means, and standard deviations provided for continuous variables. ON: orthorexia nervosa; WHO-5: World Health Organization Well-Being Index; RS-13: Resilience Scale; PSS-10: Perceived Stress Scale; t: 2-sample t-test; U: Mann–Whitney U test; OR: odds ratio; CI: confidence interval.

higher current stress levels than their non-ON counterparts; resilience scores were comparable.

Comorbid symptoms of ON

Group comparisons showed significant more pronounced pathological eating in ON (except the two WREQ subscales *susceptibility to external cues* and *emotional eating*). EDE-Q8 mean scores above 2.5 indicated clinically relevant symptoms of an eating disorder in 77.8% ($n = 21$) of ON cases but in only 28.9% ($n = 198$) of non-ON subjects ($p_{\text{Fisher's exact test}} < .001$). Neither the number of non-smokers ($n = 610$, 88.9% vs. $n = 21$, 77.8%; $p_{\text{Fisher's exact test}} = .113$) nor the degree of physical dependence to tobacco smoking differed between groups. Similarly, AUDIT scores and current addictive drug use were comparable between ON and non-ON subjects. ON subjects reported higher anxiety and depressive symptoms with PHQ-9 sum scores indicative of at least moderate depression (values ≥ 10) in 48.2% of ON (as compared to 22.2% in non-ON). Questions on current psychotherapy and psychotropic drug use were more often affirmed in ON. Obsessive and compulsive behaviors were more pronounced in ON and more than about 30% of ON subjects fulfilled criteria for clinically relevant obsessive–compulsive symptoms (as compared to 11.2% in non-ON; Table 2).

Separate regression models showed that, except addictive behaviors, each of our assumed comorbid mental health indicators predicted the DOS sum scores (Table 3). Analysis of concordance between orthorexic behaviors and pathological eating (Table 4) confirmed a substantial conceptual overlap of some but not all DOS items with EDE-Q8 subscales. The WREQ subscales *susceptibility to external cues* and *emotional eating* were also linked, although to a lesser extent. In more detail, pathological eating subscales were strongly related to the five DOS items asking for rules on nutrition, cognitive narrowing, social constraints, as well as guilty consciences and depressed mood in response to

Table 2. Comorbid mental health symptoms split by ON group

$N = 713$	Non-ON ($n = 686$)	ON ($n = 27$)	Statistics	p value	Effect size
Set 1: Pathological eating					
WREQ external cues	2.7 ± 0.9	2.7 ± 1.2	$t(27.2) = -0.19$	.885	$g_{\text{Hedges}} = 0.037$
WREQ emotional eating	2.2 ± 1.1	2.3 ± 1.3	$t(27.5) = -0.26$	.796	$g_{\text{Hedges}} = 0.053$
EDE-Q8 restraint eating	1.8 ± 1.8	4.7 ± 1.8	$t(28.2) = -8.34$	<.001	$g_{\text{Hedges}} = 1.632$
EDE-Q8 eating concern	0.8 ± 1.1	3.2 ± 1.6	$t(27.0) = -7.79$	<.001	$g_{\text{Hedges}} = 1.652$
EDE-Q8 weight concern	2.1 ± 1.9	3.7 ± 2.1	$t(27.7) = -3.88$	<.001	$g_{\text{Hedges}} = 0.835$
EDE-Q8 shape concern	2.1 ± 1.9	4.0 ± 1.9	$t(28.1) = -5.06$	<.001	$g_{\text{Hedges}} = 0.996$
EDE-Q8 mean	1.7 ± 1.4	3.9 ± 1.5	t(27.9) = −7.38	<.001	$g_{\text{Hedges}} = 1.528$
Set 2: Addictive behaviors					
Fagerström sum score	0.4 ± 1.0	0.9 ± 1.8	$t(26.7) = -1.67$	.108	$g_{\text{Hedges}} = .550$
AUDIT sum score	3.7 ± 3.1	3.9 ± 5.1	$t(26.8) = -0.24$	.811	$g_{\text{Hedges}} = .074$
Current addictive drug use (yes, %)	40 (5.8)	2 (7.4)	Fisher's exact test	.669	OR = 0.77 [95% CI: 0.18, 3.38]
Set 3: Affective psychopathology					
PHQ-9 sum score	6.7 ± 4.8	11.5 ± 6.4	$t(27.2) = -3.81$	.001	$g_{\text{Hedges}} = 0.978$
HADS depression	4.0 ± 3.4	7.5 ± 4.0	$t(27.5) = -4.50$	<.001	$g_{\text{Hedges}} = 1.025$
HADS anxiety	5.9 ± 3.6	9.4 ± 3.8	$t(27.8) = -4.68$	<.001	$g_{\text{Hedges}} = 0.977$
Any current mental disorder	86 (12.5)	11 (40.7)	Fisher's exact test	<.001	OR = 4.80 [95% CI: 2.15, 10.68]
Current psychotherapy (yes, %)	48 (7.0)	8 (29.6)	Fisher's exact test	.001	OR = 5.60 [95% CI: 2.33, 13.45]
Current psychotropic use (yes, %)	33 (4.8)	4 (14.8)	Fisher's exact test	.046	OR = 3.44 [95% CI: 1.13, 10.53]
Set 4: Obsessive and compulsive behavior ($n = 1$ non-ON missing)					
Y-BOCS obsessive symptoms	1.8 ± 3.7	4.5 ± 5.7	$t(26.9) = -2.38$	.024	$g_{\text{Hedges}} = 0.697$
Y-BOCS compulsive symptoms	1.1 ± 3.0	3.9 ± 5.2	$t(26.7) = -2.71$	.012	$g_{\text{Hedges}} = 0.882$
Y-BOCS sum score	3.0 ± 6.3	8.4 ± 10.5	$t(26.7) = -2.64$	.014	$g_{\text{Hedges}} = 0.834$
OCD (n %)					
No OCD (Y-BOCS ≤15)	608 (88.8)	19 (70.4)	$U = 7{,}516.0$	.003	Kendall's τ-$b = 0.110$
Pathological OCD (Y-BOCS 15–29 or compulsive/obsessive subscale ≥10)	75 (10.9)	7 (25.9)			
Severe OCD (Y-BOCS ≥30)	2 (0.3)	1 (3.7)			

Note. Number (and percentage in brackets) provided for categorical/dichotomous variables, means and standard deviations provided for continuous variables. ON: orthorexia nervosa; WREQ: Weight-Related Eating Questionnaire; EDE-Q8: Eating Disorder Examination-Questionnaire brief version; AUDIT: Alcohol Use Disorders Identification Test; PHQ-9: Patient Health Questionnaire; HADS: Hospital Anxiety and Depression Scale; Y-BOCS: Yale–Brown Obsessive–Compulsive Scale; OCD: obsessive–compulsive disorder; t: 2-sample t-test; U: Mann–Whitney U test; OR: odds ratio; CI: confidence interval.

Table 3. Syndrome overlap of orthorexic behavior and mental health symptoms

Linear regression				
Criterion: DOS	Standardized β	R^2	Statistics	*p* value
Set 1: Addictive behaviors				
Fagerström	0.030	.003	$F(3, 709) = 19.88$	.572
AUDIT	−0.012			
Current addictive drug use	−0.041			
Set 2: Pathological eating				
WREQ external cues	−0.094**	.378	$F(8, 706) = 71.47$	<.001
WREQ emotional eating	−0.024			
EDE-Q8 restraint eating	0.362***			
EDE-Q8 eating concern	0.386***			
EDE-Q8 weight concern	−0.141*			
EDE-Q8 shape concern	0.089			
Set 3: Affective psychopathology				
PHQ-9 sum	0.090	.073	$F(6, 706) = 9.30$	<.001
HADS anxiety	0.223***			
HADS depression	−0.092			
Current psychotherapy	0.045			
Current mental disorder	−0.030			
Current psychotropic drug use	−0.002			
Set 4: Obsessive and compulsive behavior				
Y-BOCS obsessive symptoms	0.079	.061	$F(2, 709) = 22.83$	<.001
Y-BOCS compulsive symptoms	0.181**			

Note. DOS: Duesseldorf Orthorexia Scale sum score; AUDIT: Alcohol Use Disorders Identification Test; WREQ: Weight-Related Eating Questionnaire; EDE-Q8: Eating Disorder Examination-Questionnaire brief version; PHQ-9: Patient Health Questionnaire; HADS: Hospital Anxiety and Depression Scale; Y-BOCS: Yale–Brown Obsessive–Compulsive Scale; R^2: coefficient of determination, that is, variance in criterion explained by predictors; *F*: *F*-tests to test the overall significance for the regression model.
***$p < .001$. **$p < .01$. *$p < .05$.

Table 4. Concordance between orthorexic behavior and pathological eating

Pearson's *r*	WREQ external cues	WREQ emotional eating	EDE-Q8 restraint eating	EDE-Q8 eating concern	EDE-Q8 weight concern	EDE-Q8 shape concern	R^2	Statistics *F* (*df* = 6, 706)	*p* value
DOS 1: Healthy food	−0.031	0.030	0.292***	0.233***	0.088*	0.088*	.119	15.86	<.001
DOS 2: Rules on nutrition	0.007	0.136***	0.462***	0.312***	0.278***	0.278***	.229	34.96	<.001
DOS 3: Only healthy is enjoyable	0.008	0.065	0.269***	0.324***	0.189***	0.189***	.124	17.00	<.001
DOS 4: Social constraints	−0.039	0.017	0.358***	0.362***	0.187***	0.187***	.195	28.58	<.001
DOS 5: Sense of pride	0.036	−0.027	0.180***	0.163***	0.087*	0.087*	.049	6.07	<.001
DOS 6: Guilty consciences	0.196***	0.282***	0.523***	0.611***	0.436***	0.436***	.410	81.7	<.001
DOS 7: Social exclusion	0.032	0.067	0.206***	0.280***	0.146***	0.146***	.087	11.19	<.001
DOS 8: Cognitive constriction	0.090*	0.116**	0.523***	0.523***	0.316***	0.316***	.353	64.14	<.001
DOS 9: Rigidity	−0.061	−0.007	0.278***	0.283***	0.160***	0.160***	.129	17.36	<.001
DOS 10: Depressed mood	0.233***	0.301***	0.529***	0.614***	0.436***	0.436***	.423	86.41	<.001

Note. Self-chosen labels for single DOS items are used. Please see Barthels et al. (2015a) for further details. DOS: Duesseldorf Orthorexia Scale sum score; WREQ: Weight-Related Eating Questionnaire; EDE-Q8: Eating Disorder Examination-Questionnaire brief version; R^2: coefficient of determination, that is, variance in criterion explained by predictors; *F*: *F*-tests to test the overall significance for the regression model.
***$p < .001$. **$p < .01$. *$p < .05$.

eating unhealthy ($R^2 = .195$–$.423$). Lowest associations were seen with the two DOS items representing the social consequences and subjects' sense of pride at their determination for healthy eating ($R^2 = .048$ and .087, respectively).

Because of this overlap between DOS scores and pathological eating and because about 78% of ON subject could be classified as having relevant symptoms of an eating disorder, we examined whether ON contributed to the

explained variance in our well-being and distress variables over and above pathological eating. A two-step regression analysis indicated that the variance explained by pathological eating was generally small (between 10% for WHO-5 and 17% for PSS-10; Table 5). No additional variance was explained by orthorexic behaviors, that is, we saw no change in R^2 when the DOS sum score was added in a second step. The only exception was PSS-10, where DOS scores contributed weak but significant to the explained variance (0.6%, $p = .021$).

Of note, $n = 8$ ON cases could not be classified as being high in restraint eating/eating concern but low in weight concern/shape concern (median split). Thus, about one third of our ON cases scored comparatively low on the two EDE-Q8 subscales reflecting major characteristics of an eating disorder as currently diagnosed. Interestingly, five out of six male ON cases showed this response pattern.

Nutritional behaviors and healthy lifestyle features in ON

Comparing ON cases and non-ON cases in terms of nutritional and health behavior variables showed similar general physical activity levels and a comparable agreement to our question on regular medical checkups (Table 6). Even though ON subjects more often performed a restrictive eating style and showed higher adherence to the Mediterranean diet, group comparisons were non-significant.

Main predictors of orthorexic eating behavior

Our final stepwise linear regression analysis aimed to identify the most significant predictors of orthorexic behaviors. Table 7 provides an overview of remaining variables. In addition to eating-related variables (pathological eating, eating style, and Mediterranean diet), most variance in the DOS sum scores could be accounted for by

Table 5. Proportion of variance in well-being and distress explained by pathological eating and orthorexic behaviors

	Change in R^2	Statistics	p value
Criterion: Life satisfaction			
Step 1: Pathological eating	.116	$F(6, 706) = 11.51$	<.001
Step 2: DOS	.001	$F(1, 705) = 1.01$	.316
Criterion: WHO-5			
Step 1: Pathological eating	.106	$F(6, 706) = 13.92$	<.001
Step 2: DOS	<.001	$F(1, 705) = 0.03$	.870
Criterion: RS-13			
Step 1: Pathological eating	.104	$F(6, 706) = 13.70$	<.001
Step 2: DOS	<.001	$F(1, 705) = 0.13$	.716
Criterion: PSS-10			
Step 1: Pathological eating	.171	$F(6, 706) = 24.19$	<.001
Step 2: DOS	.006	$F(1, 705) = 5.39$	.021

Note. DOS: Duesseldorf Orthorexia Scale sum score; *pathological eating* refers to the Weight-Related Eating Questionnaire and Eating Disorder Examination-Questionnaire subscales; WHO-5: World Health Organization Well-Being Index; RS-13: Resilience Scale; PSS-10: Perceived Stress Scale; R^2: coefficient of determination, that is, variance in criterion explained by predictors, F: F-tests to test the overall significance for the regression model.

Table 6. Nutritional behaviors and lifestyle features split by ON group

$N = 713$	Non-ON ($n = 686$)	ON ($n = 27$)	Statistics	p value	Effect size
Physical activity (n, %)					
Inactive	83 (12.1)	5 (18.5)	Fisher–Freeman–Halton = 3.32	.328	$V_{Cramer} = 0.068$
Moderately inactive	86 (12.5)	2 (7.4)			
Moderately active	155 (22.6)	3 (11.1)			
Active	362 (52.8)	17 (63.0)			
Medical screening (1–5)	3.5 ± 1.1	3.4 ± 1.2	$t(27.9) = 0.29$	.773	$g_{Hedges} = -0.063$
3.5 ± 1.1 (median: 4)					
Nutritional behaviors					
Eating style (n, %)					
Vegan	38 (5.5)	4 (14.8)	Fisher–Freeman–Halton = 4.89	.155	$V_{Cramer} = 0.083$
Vegetarian	96 (14.0)	2 (7.4)			
Semi-vegetarian	116 (16.9)	6 (22.2)			
Omnivore	436 (63.6)	15 (55.6)			
MEDAS sum score ($n = 1$ missing)	6.2 ± 1.9	7.0 ± 1.9	$t(28.3) = -1.99$	.056	$g_{Hedges} = 0.375$

Note. Number (and percentage in brackets) provided for categorical/dichotomous variables, means, and standard deviations provided for continuous variables. ON: orthorexia nervosa; MEDAS: Mediterranean Diet Assessment Tool; t: 2-sample t-test.

Table 7. Most significant predictors of orthorexic behavior (stepwise linear regression and forward method)

Criterion: DOS	standardized β	Change in R^2	Statistics	*p* value
Model 1: Pathological eating				
WREQ External cues	−0.097**	.380	$F(6, 704) = 71.84$	<.001
WREQ Emotional eating	−0.025			
EDE-Q8 Restraint eating	0.364***			
EDE-Q8 Eating concern	0.385***			
EDE-Q8 Weight concern	−0.133*			
EDE-Q8 Shape concern	0.081			
Model 2: Eating style	−0.233***	.054	$F(1, 703) = 66.37$	<.001
Model 3: MEDAS	0.173***	.026	$F(1, 702) = 33.95$	<.001
Model 4: Y-BOCS compulsive symptoms	0.098**	.009	$F(1, 701) = 11.59$	.001
Model 5: Subjective social status	−0.067*	.004	$F(1, 700) = 5.57$	.019

Note. DOS: Duesseldorf Orthorexia Scale sum score; WREQ: Weight-Related Eating Questionnaire; EDE-Q8: Eating Disorder Examination-Questionnaire brief version; MEDAS: Mediterranean Diet Assessment Tool; Y-BOCS: Yale–Brown Obsessive–Compulsive Scale; R^2: coefficient of determination, that is, variance in criterion explained by predictors, *F*: *F*-tests to test the overall significance for the regression model. ***$p < .001$. **$p < .01$. *$p < .05$.

compulsive behaviors and subjective social status. Neither well-being or distress variables nor other mental health symptoms (affective symptoms and addictive behaviors) provided any further predictive value and were thus not added to the final model.

DISCUSSION

Summary of main findings

Mean DOS sum scores in our sample were comparable to previously published values (Barthels et al., 2015a). Employing the proposed cut-off value of 30 resulted in $n = 27$ (3.8%) ON cases. Average orthorexic tendencies appeared higher in women, but ON cases were equally distributed between men and women. Decreased psychological well-being and higher perceived stress among those with ON suggest the clinical relevance of this condition. With regard to distinguishing ON from other mental health symptoms, the results suggest a substantial co-occurrence with pathological eating with about 78% of ON subjects (as compared to 29% in non-ON) showing above-threshold symptoms of an eating disorder. In addition, 48% of ON subjects (as compared to 22% in non-ON) could be considered to suffer from at least moderate depression and 30% showed considerable obsessive–compulsive symptoms (as compared to 11% in non-ON). On the contrary, addictive behaviors were no characteristic feature of ON. This was also true for other nutritional behaviors and healthy lifestyle features where we found no difference between ON and non-ON. Importantly, we found a strong correlation between orthorexic behaviors and pathological eating as well as no contribution to explaining any more variance in psychological well-being that goes beyond pathological eating. Together, these results suggest (a) that there is a strong correlation between ON and existing mental health conditions and (b) that much of the variance in our well-being and distress variables explained by orthorexic behaviors is explained already by existing pathological eating scales.

Claim 1a: Is ON of epidemiological significance? Yes, but . . .

The results indicated a notable proportion of subjects to fulfill proposed cut-off scores. Numbers are comparable to previously published case numbers (Barthels et al., 2015a; Dunn et al., 2017), and missing differences in regard to demographic factors and BMI between cases and non-cases resembled most recent research in this area. In more detail, age, gender, education, and weight status have been discussed to be related to ON. While Bratman and Knight (2000) considered ON to be more prevalent among men, the majority of existing studies hint toward similar numbers in men and women (e.g., Dunn et al., 2017; Luck-Sikorski et al., 2018). This was also true in this study, despite, women's average DOS scores were slightly higher than scores in men. Whether there are gender-related differences in symptomatology, etiology, and pathophysiology is hardly understood. However, it seems reasonable to assume that men and women differ in specific orthorexic behaviors and correlates (e.g., healthy eating vs. shape concern). With respect to age, small positive as well as small negative associations with orthorexic eating behavior have been shown (e.g., Barthels et al., 2015a; Bratman & Knight, 2000; Dell'Osso et al., 2016; Depa, Schweizer, Bekers, Hilzendegen, & Stroebele-Benschop, 2017; Donini et al., 2004; Dunn et al., 2017; Missbach et al., 2015). While the impact of age seems thus negligible, population representative studies will have to provide a more conclusive picture. Interestingly, ON cases in this study reported on lower subjective social status. Numerous reports linked subjective status to different health outcomes (Adler et al., 2000; Euteneuer, 2014) and our findings extend this knowledge onto orthorexic eating behaviors. However, our results need to be cautiously interpreted. ON cases herein also reported on lower psychological well-being, higher perceived stress, and more depressive mood, factors that strongly correlate with subjective social status. In addition, our data corroborate previous epidemiological data showing ON and anthropometric measures to hardly correlate (Arusoğlu et al., 2008; Dittfeld et al., 2016; Donini et al., 2004;

Sanlier, Yassibas, Bilici, Sahin, & Celik, 2016). The research indicating higher prevalence rates in underweight (Dell'Osso et al., 2016; Gezer & Kabaran, 2013) as well as overweight (Asil & Sürücüoğlu, 2015; Bundros et al., 2016; Fidan, Ertekin, Işikay, & Kırpınar, 2010; Hyrnik et al., 2016; Missbach et al., 2015) was not reflected in our data.

Overall, our findings, other general population surveys, and data from high-risk populations showed that ON is an important phenomenon with equal distribution among men and women, among different age groups and educational backgrounds, and among different weight categories. However, more research is necessary that goes beyond special populations and that extends onto other economic and ethnic groups.

Claim 1b: Is ON of clinical significance? Yes, but . . .

In line with assumptions on the psychological sequelae of orthorexic behaviors (Hayes et al., 2017), ON cases reported lower well-being and life satisfaction, and higher perceived stress than non-ON cases. On the contrary, resilience, that is, psychosocial stress resistance, was comparable between groups. However, these findings need to be viewed with one major restriction. ON was not able to add further explanation of variation in well-being in a model where pathological eating was also considered as a predictor. Thus, there is only little evidence in our data for ON to be of clinical relevance, that is, to cause significant distress, beyond known concepts of mental disorders.

Claim 2: Do ON criteria demarcate a difference between orthorexic behaviors and other known mental health problems? No . . .

Our data showed ON to considerably overlap with pathological eating, with 80% of ON cases showing clinically relevant eating disorders symptoms (Barthels et al., 2017a, 2017c). Similar to most previous research, eating concern and restrained eating in particular predicted orthorexic behaviors (Barthels, Meyer, Huber, & Pietrowsky, 2017b; Kinzl, Hauer, Traweger, & Kiefer, 2005, 2006). Weight and shape concern as well as emotional eating seemed of minor relevance (Brytek-Matera, Donini, et al., 2015; de Souza & Rodrigues, 2014; Oberle & Lipschuetz, 2018; Tremelling, Sandon, Vega, & McAdams, 2017). In an effort to better understand these associations between specific orthorexic behaviors and pathological eating, multiple regressions revealed a strong link between pathological eating and half of the DOS items. On the contrary, the two DOS items examining the subjects' personal pride in their determination to healthy eating and whether subjects are socially excluded due to their nutritional standards do not seem to be represented in the pathological eating subscales. Clinically relevant depressive symptoms in about half of our ON sample (Luck-Sikorski et al., 2018) and 30% of ON cases showing pathological obsessive–compulsive symptoms (Arusoğlu et al., 2008; Bundros et al., 2016; Hayes et al., 2017; Oberle et al., 2017) further challenge the conceptualization of ON as a distinct clinical disorder. Of note, compulsive symptoms exceeded obsessive symptoms in predicting orthorexic behaviors. It must be pointed out, however, that the examined psychopathological measures only accounted for about 40% of variance in orthorexic behaviors, leaving a large portion of variance unexplained. Importantly, comorbidity is highly prevalent in mental health conditions, often related to shared personality traits and similar underlying neurobiological processes (e.g., Insel et al., 2010; Pollack & Forbush, 2013). On the basis of symptoms, we can only determine whether the characteristics that distinguish ON from other disorders are of clinical relevance. According to our data, this was hardly the case. Our findings raise initial doubts about ON being substantially distinct from established eating disorders. From a therapeutic perspective, making a distinction between ON and other eating disorders may however be useful as the underlying motivation for specific food choices and eating behaviors differ. Specifically, questions on personal pride and social exclusion showed lowest associations with pathological eating scales.

In sum, considering ON a distinct diagnostic category seems debatable. Pathological eating, affective pathology, and obsessive–compulsive symptoms (in this sequence) significantly overlapped with ON. Unexplained variance in orthorexic eating behavior calls for intensified research and more sophisticated modeling efforts, that is, an improved conceptualization and measurement of ON.

Claim 3: Can ON be distinguished from health-related lifestyle features? Yes . . .

Other nutritional behaviors and a healthy lifestyle were found to be associated with ON (Dittfeld, Gwizdek, Jagielski, Brzęk, & Ziora, 2017; Turner & Lefevre, 2017). In contrast to previous research, ON was no more prevalent in specific forms of (restrictive) eating habits (as compared to Barnett, Dripps, & Blomquist, 2016; Barthels et al., 2018; Dell'Osso et al., 2018; Luck-Sikorski et al., 2018; Valera, Ruiz, Valdespino, & Visioli, 2014) and there was no association with current physical activity levels in this study (as compared to Brytek-Matera, Donini, et al., 2015; Oberle et al., 2018; Rudolph, Göring, Jetzke, Großarth, & Rudolph, 2017). Considering our samples' rather homogenous composition in regard to socioeconomic status (SES) and sociocultural context, conclusions can only be drawn to a certain extent. Studies in more diverse samples and studies, which employ culture-sensitive assessment tools, are highly warranted.

Limitations

Some factors limit the generalizability of the results and need to be addressed in future studies. The number of subjects with ON was rather small ($n = 27$) and statistical procedures are based on unequal sizes of groups. In addition, we were not able to perform clinician-administered interviews to achieve precise clinical diagnoses and assess functional impairments in important areas of life. Rather, we employed validated questionnaires providing only estimates of symptom severity. It might have been useful to also perform a qualitative investigation with relevant ON cases. This would have allowed for a better grasp of ON characteristics. Similarly, assessment of orthorexic eating

behavior can still be brought into question and further work needs to be carried out in order to also consider, for example, the sociocultural context of eating or medical reasons for restrictive eating behaviors. In addition, the Y-BOCS is a tool originally performed as a semi-structured interview. Our online survey treated this tool as a standardized questionnaire without the possibility to communicate unclear issues and gaps in understanding. This limits the validity of our findings in respect to obsessive and compulsive symptoms. In this regard, future studies are advised to employ tools such as the 39-item Padua Inventory – Revised (Van Oppen, Hoekstra, & Emmelkamp, 1995) or the 72-item short form of the Hamburg Obsession Compulsion Inventory (Klepsch, Zaworka, Hand, Lünenschloss, & Jauernig, 1991) to more appropriately differentiate between worry, obsessions, and compulsions. Moreover, due to our recruitment strategies, data mainly are based on a young and moderate to high SES sample. Future studies should make greater efforts to include subjects representing the general population, that is, covering the full range of age and SES, or include ethnic minorities. Finally, investigating a rather healthy sample precluded us from examining the comorbidity of ON with other mental health disorders. Comparing ON cases and patients with other mental disorders will further shed light on unique and co-occurring traits and underlying pathological processes.

CONCLUSIONS

In view of the claims made, this study provides evidence for orthorexic behaviors to be of epidemiological relevance. On the contrary, this study is not able to confirm the claim that ON has additional clinical relevance. There was no further explained variance in well-being and distress when pathological eating has already been accounted for. In addition, given our results, the general validity of the current approach to consider ON a distinct diagnostic entity is challenged. The current findings are in favor of ON being a behavioral pattern that correlates strongly with existing categories of mental health and that is not able to improve our prediction models of well-being and distress. At present, ON seems to best reflect a subclinical and asymptomatic form of an eating disorder. Given our data, we propose that those subjects who are spiraling into clinically relevant orthorexic behaviors should be characterized as having a pathological attitude toward eating, as being compulsive, and as being at risk for poor well-being and depression. Substance-related addiction and other healthy lifestyle features played no or only a minor role in characterizing ON. Raising awareness about this behavioral complex will help clinicians to make informed decisions about diagnosis and therapeutic approaches.

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