

**The associations between orthorexia nervosa and the sociocultural attitudes: the mediating role of basic psychological needs and health anxiety**

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**Conflict of interest:** On behalf of all authors, the corresponding author states that there is no conflict of interest

**Funding:** The first author was supported by a Horizon Postdoctoral Fellowship from Concordia University in the preparation of the manuscript. The project was also supported by a research grant from the Faculty of Education and Psychology of Eötvös Loránd University.

This document is a pre-publication version of the following manuscript:

Tóth-Király, I., Gajdos, P., Román, N., Vass, N., & Rigó, A. (In Press, Accepted: 30 November 2019). The associations between orthorexia nervosa and the sociocultural attitudes: the mediating role of basic psychological needs and health anxiety. *Eating and Weight Disorders*. doi: 10.1007/s40519-019-00826-1

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**Abstract**

**Purpose:** Given the range of negative correlates associated with orthorexia nervosa (ON), it is important to identify factors that might contribute to the elevated ON tendencies. Based on the tripartite model of influence, we tested whether sociocultural attitudes towards appearance (i.e., thin and muscular internalization as well as family, peer and media pressure) could contribute to ON. We hypothesized that these attitudes could exert their effect through the intervening processes basic psychological need fulfillment and health anxiety.

**Methods:** The hypotheses were tested on a sample of 710 young adults ( $M_{\text{age}} = 21.79$ ,  $SD_{\text{age}} = 2.31$ ). Participants completed validated questionnaires measuring the constructs of interest.

**Results:** According to the structural equation modeling results, ON was predicted by thinness and muscular internalization as well as media pressure. Need fulfillment and health anxiety partially mediated these relationships. Family and peer pressure were not related to ON.

**Discussion:** The present results suggest that internalization of appearance ideas and media pressure contribute to ON through need fulfillment and health anxiety. These findings also provide novel insight into the nature of ON.

**Level of evidence:** Level V (descriptive cross-sectional study)

**Keywords:** Basic psychological needs; Health anxiety; Media; Orthorexia nervosa (ON); Sociocultural attitudes; Tripartite influence model.

Despite currently not being present in the various diagnostic manuals, orthorexia nervosa (ON) is an emerging and discussed topic in the public media and in the scientific literature as well [1,2]. ON has been described as a condition characterized by excessive preoccupation and fixation with healthy food and proper nutrition without any specific focus on managing body weight [3]. People with ON usually have self-defined dietary restrictions that they strictly follow and they only consume food that is considered to be healthy. While it is still questionable to interpret the excessive preoccupation with healthy food itself as a pathology or problematic behavior (whose context and magnitude might also be important), ON-related studies have shown that it could have pathological implications such as being related to other eating disturbances or obsessive-compulsive signs [4]. As with other behaviors, ON tends to first manifest as a normal and harmonious health concern that might slowly turn into an obsessive one [5].

So far, studies have mostly focused on identifying prevalence rates which ranged from 6% to more than 80% [6] with some providing more conservative estimates [7]. The accuracy of these results might be questionable due to the fact that the items used in the ORTO-15 (one of the most popular measures of ON that was inspired by Bratman's Orthorexia Self-Test) have not been officially validated and were not created with the aim of assessing prevalence. As a result of these psychometric issues and inaccuracies, the definition and diagnostic criteria of ON is still an ongoing discussion [8]. Still, some individual factors have been identified that might be related to ON. For instance, ON has been associated with perfectionism and negative body attitudes [9], vegetarian/vegan diet [10], educational level [11], harm avoidance, self-directedness and transcendence personality factors [12], obsessive-compulsive tendencies [13], motivations for healthy eating [14], psychological distress [15], and so on. At the same time, the recent review of McComb and Mills [16] highlighted that positive reinforcement for clean eating from others might be an important social determinant of ON. In the present study, positive reinforcement was interpreted in the form of sociocultural pressure towards appearance.

### **Social Environment and Eating Behaviors**

According to the well-established tripartite influence model of body image disturbance [17], the social environment consists of agents (e.g., family, peers, and media) who aim to influence and control the perception of appearance ideals. Indeed, these social agents are thought to show favor towards particular appearance ideals and body images (e.g., thin for women, muscular for men) and pressure the individual to attain a certain desired body type. As a result, people often need to rely on specific weight control and dietary methods to reach these ideals. Perceived sociocultural pressure towards appearance and ideal internalization (i.e., the cognitive endorsement of appearance ideals) has already been linked with eating disturbances [18]. As awareness of healthy eating and lifestyle increased in recent years and has become a major message for health organizations [19,20], it appears to be relevant to investigate how the sociocultural pressure towards a healthy diet/healthy lifestyle might be related to ON. On the other hand, sociocultural pressure towards appearance might also be a relevant predictor of ON tendencies. As per its definition, being healthy is considered to be one of the main motivations of ON; still, studies showed that body image dissatisfaction [9] and weight control might [14] also have a relevant role.

While the role of the media has always been substantial in forming people's perceptions, particularly with respect to their health and body image [21,22], studies showed that the more proximal social agents of family and peers also have an influence on one's body image and subsequent eating behavior [23,24]. It is reasonable to hypothesize that the sociocultural pressures towards appearance and the internalization of appearance ideals might orient one towards focusing more on the specific ingredients of food as well as on adhering to a stricter diet to achieve these ideals (i.e., the characteristics of ON). Overall, the tripartite model appears to be well-suited for the present investigation in exploring the role of the social environment on ON. Some direct evidence has been provided about the positive association between media pressure towards losing weight and ON tendencies [25] as well as social media use (i.e., Instagram) and ON [26]. Moreover, higher internalization of sociocultural attitudes towards appearance was also associated with ON [27]. To deepen our understanding of how sociocultural attitudes towards appearance might be related to ON, we tested the role of psychological need fulfillment and health anxiety as explanatory mechanisms.

### **Potential Mediating Processes: Basic Psychological Need Fulfillment and Health Anxiety**

To better understand the associations between sociocultural attitudes towards appearance and

healthy eating, the present study relied on the global and specific explanatory mechanisms of basic psychological need fulfillment and health anxiety, respectively, that might account for the association between sociocultural attitudes and ON. The theory of need fulfillment is one of the fundamental tenets of the well-articulated self-determination theory (SDT; [28]) and maintains that there exist three basic psychological needs (autonomy: being the origin of personal control and choice; competence: feeling effective in life; relatedness: having reciprocal relationships with others) whose fulfillment is conducive of psychological health, growth, and optimal functioning. Need fulfillment so far has been associated with a diverse range of positive outcomes [e.g., 29,30] across different life domains [31,32], making it ideal in understanding one's experiences.

Although not directly examined in relation to ON, indirect evidence underscores the importance of need fulfillment in relation to binge eating and other eating-related disorders. Specifically, cross-sectional studies showed that unfulfilled needs are related to binge eating as well as unhealthy weight control behaviors [33-35]. Moreover, decreases in need fulfillment were related to increases in binge eating symptoms among adolescents over a 6-month period [36] as well as on a daily basis [37]. The available literature discussed above suggests that people might have increased tendencies of ON in a need unfulfilled state. From this perspective, ON might be interpreted as a potential compensatory mechanism for the need deficit state. One's need fulfillment is greatly impacted by the social environment [38,39] and experiencing social pressure towards appearance as well as a high expectation about one's appearance could undermine the fulfillment of all three needs, thus contributing to ON tendencies.

Apart from need fulfillment, health anxiety could be a specific, eating-related mediating mechanism. Worrying about one's health might be adaptive to a certain degree [40], but an overly cautious attitude might bias the interpretation of normal body signals [41]. It is reasonable to assume that sociocultural attitudes towards appearance might encourage people to pay more attention to their bodies to achieve the desired ideal which, in turn, could increase people's ON tendencies. As far as the authors know, only one study examined and reported positive associations between ON and health anxiety [14] and indirect results are also scarce [42], suggesting that there might be a relevant gap in the literature in general.

### **Research Questions and Hypotheses**

The primary purpose of this study was to examine the associations between sociocultural attitudes towards appearance and ON and whether need fulfillment and health anxiety could represent explanatory mechanisms in this relation in a sample of young adults. Based on above-mentioned scientific literature, we expected sociocultural attitudes towards appearance (both internalization and pressure) to be directly related to ON. We also expected both need fulfillment and health anxiety to mediate this relationship by being negatively and positively related to sociocultural attitudes, respectively. Finally, ON was expected to be negatively related to need fulfillment, but positively to health anxiety.

Our decision to focus on young adults was rooted in two reasons. First, eating disorders are thought to start developing in early adulthood [43] and are thought to be the most prevalent in this age group [44]. This life period might also be critical as young adults gradually become more and more independent of their parents and start making their own decision with respect to their eating behaviors. Second, several studies [45,46] reported negative associations between age and ON and showed that ON was more prevalent among younger adults.

## **Methods**

### **Procedure and Participants**

This cross-sectional quantitative study was conducted in accordance with the Declaration of Helsinki and with the explicit approval of the University Research Ethics Committee of the Eötvös Loránd University (Hungary). Young adults were recruited from the corresponding university and through different online forums, groups and websites specialized in healthy lifestyle and eating (e.g., vegetarian, vegan, fitness groups) with the data gathering occurring between September 2018 and February 2019 using an online questionnaire system. They did not receive any compensation for participation. First, they were informed about the aims of the study and were ensured about their anonymity. If they were willing to participate, they had to check a box to provide explicit consent; otherwise, they were excluded. Participants filled out self-reported questionnaires assessing ON, sociocultural attitudes, health anxiety and need fulfillment as well as demographic data.

A total of 765 respondents were recruited; since this study focused on young adults, we filtered out those participants ( $n = 55$ ) who did not correspond to this category (i.e., not being aged between 18 and 30). As a result, 710 individuals remained in the sample (80.7% female;  $M = 21.79$ ,  $SD = 2.31$ ). They reportedly lived in the capital city (52.7%), non-capital cities (34.8%) or country towns (12.5%). The average BMI of the participants was 22.13 ( $SD = 4.01$ ) with 13.4% of the participants being underweight, 70.3% having normal weight, 12% being overweight, and 3.2% being obese. The majority (89.3%) did not have any illnesses at the time of the data gathering, 9.3% were diagnosed with an illness (e.g., diabetes, hypertension, hyperlipidemia, colitis ulcerosa, peptic ulcer, Chron's disease, etc.), while the rest did not have knowledge of such diagnoses. In addition, 34.4% of the participants followed a diet in the preceding year and 23.5% followed a diet at the time of the data gathering.

### Materials

**Orthorexia nervosa.** The tendency to ON and people's attitudes towards healthy eating was measured with the 11-item (e.g., "When eating, do you pay attention to the calories of the food?";  $\alpha = .82$ ) Ortho-11-Hu [47] which is the Hungarian version of the ORTO-15 [48]. Respondents were able to answer on a 4-point scale (1 = always, 4 = never). For ease of interpretation, items were reverse scored, such that higher values on these ORTO-11-Hu items represent higher levels of ON symptomatology. Previous validation studies [e.g., 47] supported the factorial validity and internal consistency of the Hungarian version.

**Sociocultural attitudes towards appearance.** The 22-item Sociocultural Attitudes Towards Appearance Questionnaire-4 (SATAQ-4 ; [18]) was administered to assess sociocultural attitudes along five factors: thin (5 items, e.g., "I want my body to look very lean";  $\alpha = .88$ ) and muscular (5 items, e.g., "I think a lot about looking muscular";  $\alpha = .89$ ) internalization as well as family (4 items, e.g., "I feel pressure from family members to improve my appearance";  $\alpha = .84$ ), media (4 items, e.g., "I feel pressure from the media to improve my appearance";  $\alpha = .92$ ) and peer pressures (4 items, e.g., "I feel pressure from my peers to look in better shape";  $\alpha = .85$ ). Responses were provided on a 5-point scale (1 = definitely disagree, 5 = definitely agree). Previous studies [e.g., 18] using U.S. and international samples supported the factor structure, reliability and convergent validity of the scale.

**Basic psychological need fulfillment.** The Hungarian version [49,50] of the 24-item Basic Psychological Need Satisfaction and Frustration Scale [51] was administered to measure need fulfillment. The instrument contains six factors with four items per factor representing need satisfaction and need frustration  $\times$  autonomy (e.g., "I feel a sense of choice and freedom in the things I undertake" or "I feel forced to do many things I wouldn't choose to do"), competence (e.g., "I feel capable at what I do" or "I feel like a failure because of the mistakes I make"), and relatedness (e.g., "I feel that the people I care about also care about me" or "I feel the relationships I have are just superficial";  $\alpha = .93$  for the total score). Items were rated on a 5-point scale (1=Not true at all for me; 5=Very true for me). Tóth-Király et al. [49,50] reported that the scale had adequate factorial validity, generalizability over gender groups, scale score reliability, and criterion validity.

**Health anxiety.** Participants' concerns with their health and their body vigilance was measured with the Hungarian version [52] of the Short Health Anxiety Inventory [53]. Four statements are provided for each item from which participants can select one that best reflects their experiences. The instrument includes two subscales: a 14-item health anxiety (e.g., "I spend most of my time worrying about my health";  $\alpha = .87$ ) and a 4-item negative consequences (e.g., "A serious illness would ruin every aspect of my life";  $\alpha = .77$ ) subscale; the present study only focused on the health anxiety subscale. Responses are rated on a 4-point scale (1 = no symptoms, 4 = very severe symptoms). The Hungarian validation [52] found that the scale had satisfactory factor structure and internal consistency as well as adequate convergent validity.

### Statistical Analyses

All analyses were performed with Mplus 8 [54] and the robust maximum-likelihood estimator. Prior to the main analyses, we conducted separate factor analyses for the individual instruments to ascertain their psychometric properties. Given the complexity of the hypothesized model, we opted to save these preliminary measurement models as factors scores and use those as input for the main analyses. Factor scores have the advantage, compared to manifest scale scores, of providing partial control for measurement error by allocating more weight to the items with lower error variances [55]. The use of factor scores is becoming increasingly popular [56,57], further supporting our decision.

The main analyses involved the construction of the hypothesized path model [58] in which sociocultural attitudes towards appearance predicted need fulfillment and health anxiety which in turn predicted ON; sociocultural attitudes towards appearance also predicted ON directly. Model evaluation was based on several goodness-of-fit indices along their excellent or adequate cut-off values [59]: the Comparative Fit Index (CFI;  $\geq .95$  excellent,  $\geq .90$  adequate), the Tucker–Lewis index (TLI;  $\geq .95$  excellent,  $\geq .90$  adequate), the root-mean-square error of approximation (RMSEA;  $\leq .06$  excellent,  $\leq .08$  adequate) with its 90% CI, and the standardized root mean square residual (SRMR;  $\leq .05$  for excellent,  $\leq .10$  for adequate).

## Results

### Preliminary Analyses

In order to make this part concise and relevant to the overarching goal of the investigation, detailed results about the preliminary measurement models are reported in Appendix 1 of the online supplements. Overall, all measurement models had adequate fit (see the upper part of Table 1) and the factors were highly reliable in terms of Cronbach alpha and model-based omega composite reliability. With respect to need fulfillment, we were interested in the general factor that accounts for the highest amount of variance in participants' ratings; therefore, only the general factor was included in the subsequent analyses.

### Main Analyses

The fit of the model (see Figure 1) was perfect according to the goodness-of-fit indices given that the model was fully saturated with zero degrees of freedom (i.e., all structural paths were estimated; see the bottom part of Table 1). Our results provided support for the proposed model: ON was predicted by need fulfillment, health anxiety, thinness and muscular internalization as well as media pressure. Need fulfillment was only predicted by thinness and muscular internalization, while health anxiety was predicted by thinness internalization and media pressure. In the final model, the non-significant ( $p > .05$ ) paths were trimmed and only the significant ones were estimated (see Figure 2). The final model also had adequate fit to the data and the removal of the non-associated variables did not impact the regression coefficients substantially. The proportion of explained variance for ON was 47.4%. Mediation analyses are reported in Table 2 and show that both need fulfillment and health anxiety mediated the relationship between the predictors and the outcome as apparent by the 95% bias-corrected confidence interval not reaching zero for any of the indirect effects.

## Discussion

The aim of the present study was to contribute to the scientific literature about ON by examining the role of sociocultural attitudes towards appearance (i.e., thin and muscular internalization as well as social pressure from the family, peers and media) as predictors of ON via two potential mediating processes, namely basic psychological need fulfillment and health anxiety. Both internalization factors predicted ON directly; in addition, thinness indirectly through both mediators, while muscular internalization only through need fulfillment. Out of the three pressure dimensions, contrary to our expectations, only media pressure was a significant predictor, while family and peer pressures were not. These findings lead to a number of important implications.

### Sociocultural Sources of ON Tendencies

Our first key findings complement prior studies in the field of eating behaviors which showed that sociocultural risk factors are related to eating-related pathologies and problematic eating behaviors. For instance, disturbed eating has been related to elevated scores on all five sociocultural factors [18]. Higher degrees of internalization of thinness and muscularity suggest that people adopted the ideals of either thinness (i.e., having a slim body with low body fat) or muscularity (i.e., having a well-developed athletic body) to a higher degree and that they wish to attain these ideals. One potential way to achieve such goals is to regulate one's eating behaviors. By establishing a strict rule about what can or cannot be eaten (e.g., more vegetables or full grains instead of sugar), people might be able to achieve these appearance ideals more easily compared to those cases when they do not regulate their diet. Additionally, these appearance ideals might also be understood as reflections of an ideal, yet unrealistic lifestyle [60] which should be achieved for happiness. Although the definition of ON mostly refers to the internalization of being healthy and healthy eating being a value, it is possible that the internalization of appearance ideas is also present, only to a smaller extent.

As for social pressures towards appearance, studies highlighted the importance of examining multiple sources of social appearance pressure as these sources might have different effects. Based on

our findings, only pressure from the media was associated with ON tendencies. This aligns well with previous theoretical [22] and empirical [61] works showing that even brief exposure to manipulated media images could have an effect on one's body (dis)satisfaction and in turn eating behavior. In most cases, the social pressures towards appearance are likely to be unrealistic, potentially leading to a higher degree of body dissatisfaction and, as a consequence, a more radical diet that could undermine one's health. Again, similar to internalization, regulating eating behavior could be one of the tools that one has to reach a certain body type. While the zero-order correlations were statistically significant between ON and the other pressure sources (i.e., family and peers), these associations disappeared in the more complex model in which other factors were also taken into account. These results might be attributed to the fact that the participants were young adults who might not live with their families; thus, these pressures might have less influence on them. Still, future studies are needed to more thoroughly test the relative effect of these sources of social pressure.

### **The Relation of ON with Need Fulfillment and Health Anxiety**

A second key finding relates to the examination of need fulfillment and health anxiety as predictors of ON. Need fulfillment was negatively related to ON, indicating that the higher one's basic psychological needs of autonomy, competence and relatedness are satisfied, the lower the ON tendencies are likely to be. This finding is in line with prior studies focusing on need satisfaction and various eating behaviors [33]. Overall, it is probable that when one's needs are satisfied, they might not feel the pressure to engage in problematic/exaggerated eating behaviors which have been suggested as a potential compensatory mechanism against unfulfilled needs [36]. Similarly, high need fulfillment is associated with more autonomous regulation forms that are in turn conducive of fewer compensatory behaviors [62]. Conversely, having unfulfilled needs might orient people to overengage in eating-related behaviors to cope with their need deficit state [62]. However, this compensatory behavior is likely to be ephemeral.

Health anxiety was positively related to ON, suggesting that the more people worry about their health and bodily functions, the more they are likely to focus on establishing and following a strict diet as well as on doing more physical activity. The heightened self-awareness is positive only to a certain extent and people with health anxiety might be more likely to misinterpret bodily information even if no pathology is present. Although no study investigated their temporal directions, it is possible that ON manifests as a coping mechanism for health anxious people.

### **An Overarching Model of the Relations between ON and Sociocultural Attitudes**

As a third key finding, the hypothesized model provides novel insights into the nature of ON. Psychological need fulfillment partly accounted for the relationship between ON and internalization of thinness as well as ON and internalization of muscularity, though the directions of these associations were opposing: while need fulfillment was negatively predicted by the internalization of thinness, it was positively predicted by muscular internalization. Therefore, having internalized the ideals of thinness is likely to decrease people's need fulfillment, possibly because they feel that they are not efficient in maintaining their lifestyle (i.e., need for competence) or because they feel pressured to look and behave in a certain way and live up to the societal expectations (i.e., need for autonomy). However, these expectations might not be self-endorsed, eliciting need unfulfillment and a subsequent compensatory behavior that might be ON. By the same token, the internalization of thinness and the societal expectations might also be so high that anxiety about one's health and life could manifest not just due to the fear of not being able to match these expectations, but also because of seeing oneself and unattractive or unhealthy. As opposed to thinness internalization, muscle internalization appears to have a positive association with need fulfillment. Being firm, athletic, and muscular could increase one's basic psychological needs and doing physical activities on a regular basis might lead to feelings of success (i.e., need for competence) or free activity selection (i.e., need for autonomy).

Overall, the findings of the present study contribute to the existing knowledge in three ways. First, similar to other problematic eating behaviors, the present study reinforced the important role appearance ideals and body attitudes might have in relation to ON. While body image disturbance is not part of the definition of ON, future studies should examine the importance of the attitude towards one's body in the differential diagnosis. It is possible that various subgroups could be identified based on a combination of motivations among which body weight control and body image dissatisfaction might play a role. Second, our results suggest that lower levels of basic psychological need fulfillment, as a potential risk factor, might increase the risk of ON tendencies. Third, the heightened self-

perception that is health anxiety might also be considered as a risk factor for ON as eating is one of the health-related behaviors that is the easiest to control for the individual (relative to, for instance, exercising) which might lead to an increased sense of control.

### **Limitations and Future Directions**

Despite the strengths of the present study (i.e., solid theoretical basis, relatively large sample size, sophisticated analyses), it had limitations as well which should be addressed. A cross-sectional design was used which does not allow for causal inferences. Future studies should, in the next step, use longitudinal designs to test the temporal ordering of the variables or experimental designs to establish causality. Daily diary studies might also be useful in examining the above-tested model in a more nuanced way. This study used self-reported questionnaires which could potentially be biased (e.g., social desirability or self-selection bias). More objective indicators of health and lifestyle could shed more light on the manifestation of ON (e.g., actual food intake, body-fat percentage, measured fitness level). The instrument to measure ON was derived from the ORTO-15 which is known to have psychometric issues; thus, conclusions should be drawn with caution. While the sample was relatively large, it was not representative; thus, generalizations to other groups should be made tentatively. Further replications are needed in different cultural and socioeconomic countries. Although the included correlates had theoretical foundations, other potential moderators and mediators might also have an important role, such as perfectionism, self-esteem, body dissatisfaction, or pressure towards healthy eating. The need to include other variables in future studies is also underscored by the fact that the indirect effects were small. Although the criteria for and the field of ON are still evolving [63], the present study might enhance our understanding of the nature of ON.

In conclusion, the current study suggests that various sociocultural attitudes towards appearance are differentially related to ON. Thinness and muscular internalization as well as media pressure predicted ON, while family and peer pressure did not. In addition, these associations were mediated by health anxiety and basic psychological need fulfillment. These results highlight the importance that the social environment and the appearance ideals might play in the development and maintenance of ON as well as two of its potential risk factors.

### **What is already known on this subject?**

So far, most empirical studies on orthorexia nervosa focused on how it is predicted by individual factors (e.g., perfectionism or motivations for healthy eating). However, less research focused on the potential social determinants of orthorexia nervosa, namely sociocultural attitudes towards appearance and the possible mediating processes (e.g., basic psychological need fulfillment and health anxiety) between sociocultural attitudes and orthorexia nervosa.

### **What this study adds?**

Thinness internalization, muscular internalization, and media pressure appear to predict orthorexia nervosa. Additionally, need fulfillment and health anxiety might be two potential mediators that could explain how sociocultural attitudes might relate to orthorexia nervosa. These findings suggest that more attention should be paid to these factors by researchers and practitioners alike to better understand and address the development and maintenance of orthorexia nervosa.

### **Compliance with Ethical standards**

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

**Ethical Approval.** All procedures performed in studies involving human participants were in accordance with the ethical standards of the Institutional Review Board of the Eötvös Loránd University and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

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

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**Table 1***Goodness-of-Fit Statistics for the Estimated Measurement and Predictive Models*

Model	$\chi^2$	df	CFI	TLI	RMSEA	RMSEA 90% CI	SRMR
Orthorexia nervosa	158.974*	41	.966	.955	.068	.057-.079	.045
Basic psychological need fulfillment	201.733*	129	.996	.991	.029	.021-.037	.013
Health anxiety	569.200*	134	.954	.947	.072	.066-.078	.053
Sociocultural attitudes	1238.517*	198	.968	.963	.092	.088-.097	.070
Predictive model (fully saturated)	0	0	1.000	1.000	.000	.000-.000	.000
Predictive model (trimmed)	4.478	2	.995	.968	.045	.000-.102	.018

*Note.*  $\chi^2$ : Chi-square test of exact fit; df: Degrees of freedom; CFI: Comparative fit index; TLI: Tucker-Lewis index; RMSEA: Root mean square error of approximation; 90% CI: 90% confidence interval of the RMSEA; SRMR: standardized root square residual; \* $p < 0.01$ .

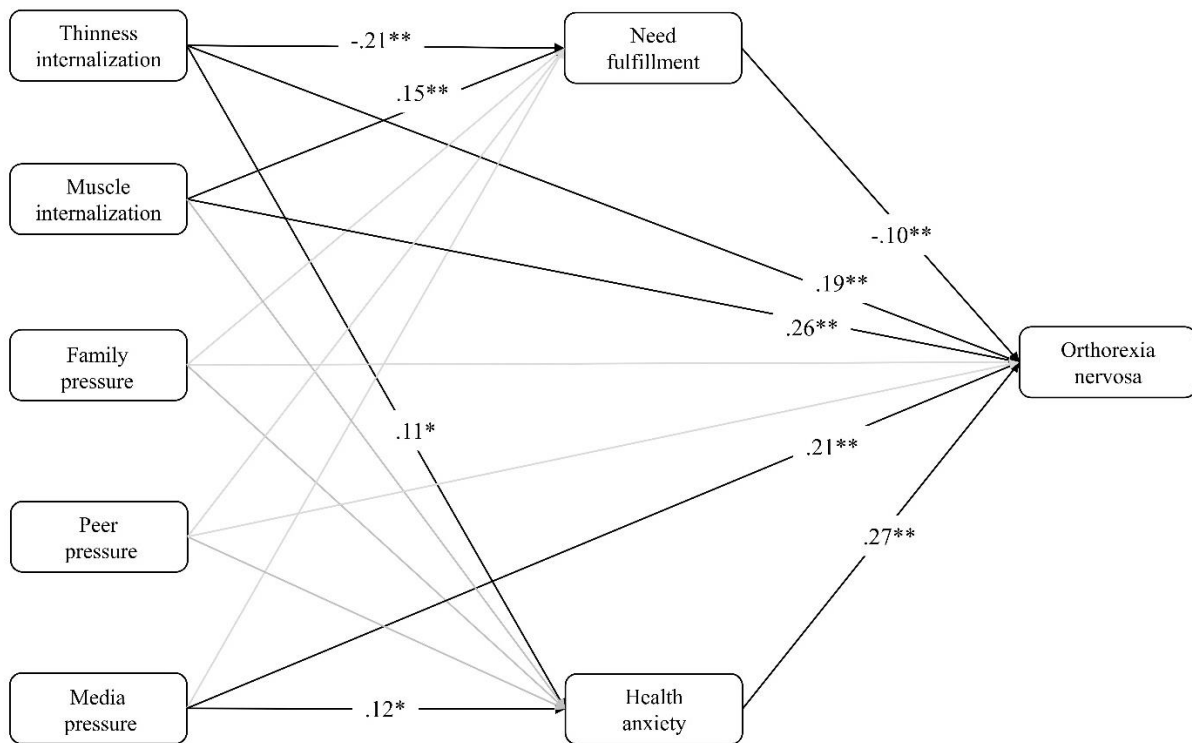
**Table 2***Mediation Analyses Including Total, Direct, and Indirect Effects for the Trimmed Model*

	Total effect		Direct effect		Mediator	Indirect effect	
	$\beta$	95% CI	$\beta$	95% CI		$\beta$	95% CI
Thinness → Orthorexia	.284**	[.201, .366]	.215**	[.131, .294]	Need fulfillment	.032**	[.014, .056]
					Health anxiety	.037**	[.011, .066]
Muscular → Orthorexia	.249**	[.181, .317]	.265**	[.196, .334]	Need fulfillment	-.016*	[-.033, -.006]
Media → Orthorexia	.264**	[.192, .335]	.228**	[.158, .296]	Health anxiety	.036**	[.012, .066]

*Note.* Bootstrapped confidence intervals were based on 10,000 replications and were estimated with maximum likelihood estimation method given that bootstrapping is not available for the MLR estimator.;  $\beta$ : standardized regression weights; 95% CI: bias-corrected bootstrapped confidence intervals; \* $p < .05$ ; \*\* $p < .01$ .

**Figure 1**

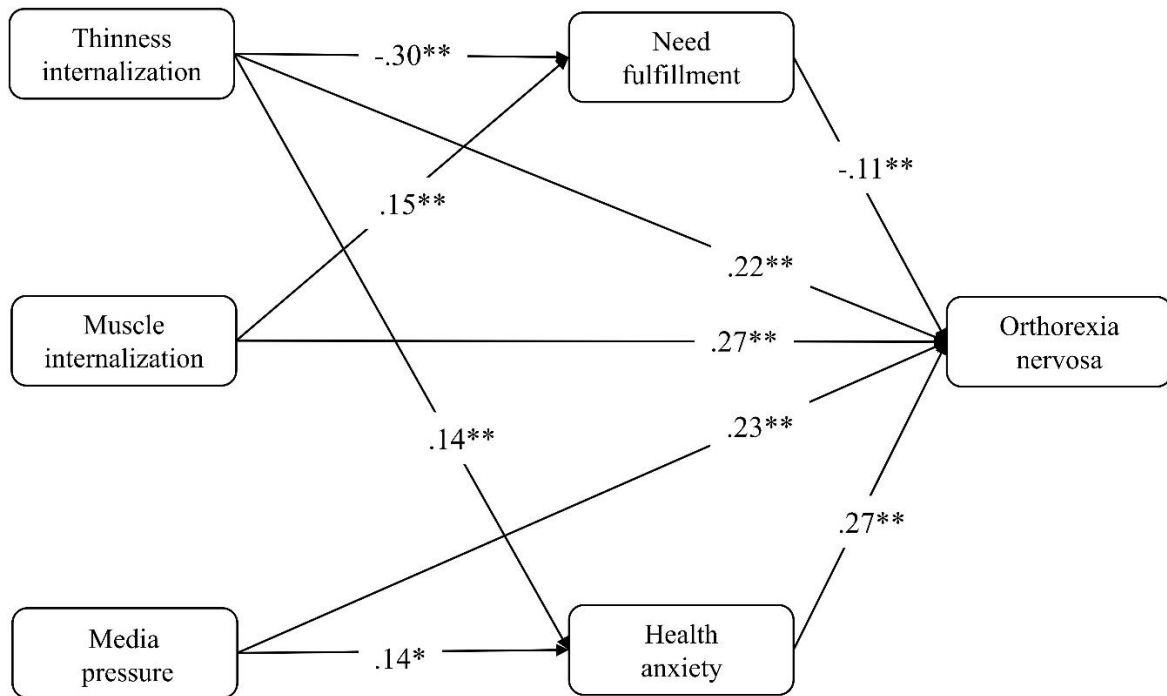
*The fully saturated model of sociocultural attitudes, need fulfillment, health anxiety and orthorexia nervosa*



*Note.* Correlations are not shown for the sake of simplicity. Coefficients represent standardized regression weights.; Grey arrows represent non-significant paths.; \*  $p < .05$ ; \*\*  $p < .01$ .

**Figure 2**

*The final trimmed model of sociocultural attitudes, need fulfillment, health anxiety and orthorexia nervosa*



*Note.* Correlations are not shown for the sake of simplicity. Coefficients represent standardized regression weights.; \*  $p < .05$ ; \*\*  $p < .01$ .



*Online Supplements for:***The associations between orthorexia nervosa and the social attitudes: The mediating role of basic psychological needs and health anxiety**

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We would also be happy to have some of these materials brought back into the main manuscript, or included as published appendices if you deem it useful. We developed these materials to provide additional technical information and to keep the main manuscript from becoming needlessly long.

**Appendix 1: Estimation and results pertaining to the preliminary measurement models**

As detailed in the main text of the manuscript, prior to testing the hypothesized model, preliminary factor analyses were conducted to ascertain the measurement properties of the instruments and to extract factor scores that were used in the main analyses. Compared to scale scores, factor scores are better at preserving the underlying nature of measurement models and at providing partial control for measurement errors by giving more weight to the items with lower measurement errors (Kam, Morin, Meyer, & Topolnytsky, 2016; Morin, Meyer, Creusier, & Biétry, 2016).

Orthorexia nervosa (ON) was modeled with a one-factor confirmatory factor analytic (CFA) solution which also included three a priori correlated uniquenesses (CU) between items 7-8, 7-9 and 8-9. The inclusion of these CUs was based on the previous Hungarian validation (Varga et al., 2014). Health anxiety was modelled via a two-factor CFA model with one factor referring to health anxiety, while the other factor referring to the negative consequences. Sociocultural attitudes were modeled with a five-factor CFA model representing the five factors of thin and muscular internalization as well as family, peer and media pressure with one CU between items 6 and 10. Finally, basic psychological needs were modeled with the bifactor exploratory structural equation modeling (bifactor ESEM) framework that encompassed a global need fulfillment factor and six specific factors representing the combinations of autonomy/competence/relatedness with satisfaction/frustration. This decision was rooted in the accumulating number of studies (Brunet et al., 2016; Garn et al., 2018; Gillet et al., 2018, 2019; Sánchez-Oliva et al., 2017; Tóth-Király et al., 2018) showing that in order to get a more accurate representation of the constructs of interest, one should take into account the two sources of construct-relevant psychometric multidimensionality when the construct in question is multidimensional (Morin, Arens, & Marsh, 2016).

All analyses were conducted with Mplus 8.1 (Muthén & Muthén, 1998-2017) and the weighted least squares mean- and variance-adjusted (WLSMV) estimator that is more suitable to the ordinal nature of Likert scales used in this study (Finney & DiStefano, 2013). To interpret fit of the measurement models, commonly reported goodness-of-fit indices were examined: the chi-square test ( $\chi^2$ ), the comparative fit index (CFI), the Tucker-Lewis Index (TLI), the root mean square error of approximation (RMSEA) and standardized root mean square residual (SRMR). CFI and TLI was deemed adequate or excellent if values were higher than .90 and .95, respectively. Conversely RMSEA was deemed acceptable and excellent with values smaller than .08 and .06, respectively. SRMR is acceptable below .10 and good below .05 (Marsh, Hau, & Grayson, 2005). We also report Cronbach's alpha of internal consistency (Nunnally, 1978) and the model-based composite reliability indices (McDonald, 1970). The latter was calculated from the standardized factor loadings and the error variances associated with the items of the instruments. We opted to use this index due to the issues associated with Cronbach's alpha (Rodriguez, Reise, & Haviland, 2016; Sijtsma, 2009).

Overall, the measurement models had adequate fit to the data. Parameter estimates can be seen in Tables S1-S4 of the separate models. All factors were well-defined by their target factor loadings. Table S5 includes the various reliability indices and the inter-factor correlations. All factors were highly reliable in terms of Cronbach's alpha and model-based omega composite reliability. Subsequently, these factor scores were saved and served as input for testing the hypothesized path model in the main study.

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**Table S1***Standardized parameter estimated for the Ortho-11-Hu*

	Factor ( $\lambda$ )	$\delta$
Orthorexia nervosa		
Item 1	.582**	.661
Item 2	.533**	.716
Item 3	.826**	.318
Item 4	.663**	.560
Item 5	.748**	.441
Item 6	.525**	.724
Item 7	.557**	.690
Item 8	.458**	.790
Item 9	.523**	.726
Item 10	.752**	.435
Item 11	.267**	.929

*Note.*  $\lambda$ : Factor loading;  $\delta$ : Item uniqueness; \*\*  $p < .01$ .

**Table S2***Standardized parameter estimates for the Basic Psychological Need Satisfaction and Frustration Scale*

	N-Fu ( $\lambda$ )	A-S ( $\lambda$ )	R-S ( $\lambda$ )	C-S ( $\lambda$ )	A-Fr ( $\lambda$ )	R-Fr ( $\lambda$ )	C-Fr ( $\lambda$ )	$\delta$
Autonomy satisfaction (A-S)								
Item 1	<b>.498**</b>	<b>.377**</b>	.079*	.214**	-.205**	-.002	.104*	.505
Item 7	<b>.649**</b>	<b>.616**</b>	.039	.008	-.031	.051	-.007	.195
Item 13	<b>.649**</b>	<b>.577**</b>	-.010	-.011	.021	.051	.000	.243
Item 19	<b>.733**</b>	<b>.241**</b>	-.071	-.071*	.001	.178**	.167**	.335
Relatedness satisfaction (R-S)								
Item 3	<b>.506**</b>	.074*	<b>.487**</b>	.053	-.066	-.214**	-.077	.442
Item 9	<b>.522**</b>	.020	<b>.681**</b>	-.026	.137**	-.188**	.033	.207
Item 15	<b>.525**</b>	-.024	<b>.700**</b>	-.077**	.087**	-.053	.085**	.210
Item 21	<b>.652**</b>	-.005	<b>.357**</b>	-.096**	-.020	-.305**	.180**	.312
Competence satisfaction (C-S)								
Item 5	<b>.690**</b>	.017	-.067**	<b>.632**</b>	.060*	.030	-.133**	.097
Item 11	<b>.750**</b>	.021	-.048	<b>.205**</b>	.124**	.145**	-.026	.356
Item 17	<b>.678**</b>	.218**	-.028	<b>.238**</b>	.019	.162**	-.030	.408
Item 23	<b>.714**</b>	-.015	-.070*	<b>.293**</b>	.082**	.141**	-.153**	.349
Autonomy frustration (A-Fr)								
Item 2	<b>-.268**</b>	-.069*	.027	-.039	<b>.556**</b>	.001	-.009	.612
Item 8	<b>-.551**</b>	-.100**	.040	.113**	<b>.489**</b>	.028	.036	.430
Item 14	<b>-.527**</b>	.000	.073*	.036	<b>.651**</b>	.064*	.071*	.283
Item 20	<b>-.586**</b>	.009	.094*	.098*	<b>.356**</b>	-.020	-.015	.511
Relatedness frustration (R-Fr)								
Item 4	<b>-.596**</b>	-.012	-.109**	.018	.045	<b>.503**</b>	.055	.375
Item 10	<b>-.593**</b>	.062	-.299**	.082*	.052	<b>.456**</b>	.121**	.324
Item 16	<b>-.658**</b>	.125**	-.156**	.095**	-.013	<b>.551**</b>	-.019	.214
Item 22	<b>-.614**</b>	.038	-.316**	.091*	.031	<b>.323**</b>	-.115**	.395
Competence frustration (C-Fr)								
Item 6	<b>-.688**</b>	.033	.112**	-.346**	.037	.073*	<b>.290**</b>	.302
Item 12	<b>-.663**</b>	.081**	.036	-.039	.036	.010	<b>.490**</b>	.310
Item 18	<b>-.711**</b>	.009	.217**	-.147**	.002	-.048	<b>.238**</b>	.366
Item 24	<b>-.741**</b>	.064*	.020	.035	.069*	.056	<b>.365**</b>	.304

*Note.* Fu: Global (G-Factor) representing need fulfillment; S-Factors: Specific factors from the bifactor model; S: Need satisfaction; Fr: Need frustration; A: Need for autonomy; C: Need for competence; R: Need for relatedness;  $\lambda$ : Factor loading;  $\delta$ : Item uniqueness; Target factor loadings are in bold.; \* $p < .05$ ; \*\* $p < .01$ .

**Table S3***Standardized parameter estimates for the Short Health Anxiety Inventory*

	H-A ( $\lambda$ )	NC ( $\lambda$ )	$\delta$
Health anxiety			
Item 1	.691**		.523
Item 2	.430**		.815
Item 3	.040		.998
Item 4	.767**		.412
Item 5	.903**		.185
Item 6	.736**		.458
Item 7	.658**		.568
Item 8	.747**		.443
Item 9	.664**		.559
Item 10	.588**		.655
Item 11	.791**		.375
Item 12	.850**		.278
Item 13	.628**		.605
Item 14	.386**		.851
Negative consequences			
Item 15		.800**	.360
Item 16		.631**	.602
Item 17		.868**	.247
Item 18		.643**	.587

*Note.*  $\lambda$ : Factor loading;  $\delta$ : Item uniqueness; H-A: health anxiety; NC: negative consequences; \*\*  $p < .01$ .

**Table S4***Standardized parameter estimates for the Sociocultural Attitudes Towards Appearance Questionnaire-4*

	T-I ( $\lambda$ )	M-I ( $\lambda$ )	F-P ( $\lambda$ )	P-P ( $\lambda$ )	M-P ( $\lambda$ )	$\delta$
Thinness internalization						
Item 3	.816**					.333
Item 4	.759**					.424
Item 5	.845**					.286
Item 8	.834**					.305
Item 9	.885**					.216
Muscular internalization						
Item 1		.788**				.379
Item 2		.899**				.193
Item 6		.659**				.566
Item 7		.955**				.089
Item 10		.688**				.526
Family pressure						
Item 11			.945**			.107
Item 12			.872**			.240
Item 13			.909**			.174
Item 14			.663**			.560
Peer pressure						
Item 15				.866**		.250
Item 16				.963**		.073
Item 17				.918**		.158
Item 18				.818**		.331
Media pressure						
Item 19					.933**	.130
Item 20					.937**	.123
Item 21					.922**	.150
Item 22					.861**	.259

*Note.*  $\lambda$ : Factor loading;  $\delta$ : Item uniqueness; T-I: thinness internalization; M-I: muscular internalization; F-P: family pressure; P-P: peer pressure; M-P: media pressure; \*\*  $p < .01$ .

**Table S5***Reliability indices and pairwise correlations between the examined variables (based on factor scores)*

	$\alpha$	$\omega$	1	2	3	4	5	6	7
1. ON	.82	.85	—						
2. NF	.93	.96	-.29**	—					
3. HA	.87	.91	.42**	-.33**	—				
4. TI	.88	.92	.55**	-.22**	.21**	—			
5. MI	.89	.90	.41**	.01	.05	.51**	—		
6. FP	.84	.91	.36**	-.19**	.17**	.43**	.21**	—	
7. PP	.85	.94	.39**	-.21**	.20**	.46**	.25**	.74**	—
8. MP	.92	.95	.45**	-.20**	.22**	.52**	.11*	.33**	.40**

*Note.*  $\alpha$ : Cronbach's alpha;  $\omega$ : McDonald's model-based omega composite reliability; ON: orthorexia nervosa; NF: need fulfillment; HA: health anxiety; TI: thinness internalization; MI: muscular internalization; FP: family pressure; PP: peer pressure; MP: media pressure.; \*  $p < .05$ ; \*\*  $p < .01$ .