

ORTHOREXIC MODALITIES IN PREDICTIVE MODELS OF FOOD ALTITUDE

ОРТОРЕКСИЧНІ МОДАЛЬНОСТІ У ПРЕДИКТИВНИХ МОДЕЛЯХ СТАВЛЕННЯ ДО ЇЖІ

This study is devoted to the analysis of the composition of categorical data in relation to orthorexic modalities. Four main types of orthorexic modalities were identified for convenience and future perspectives of scientific research in the field of personal schemas and attachment: exclusion (excluding certain foods: meat, animal products, dairy); emphasis (emphasizing certain types of foods: fats, proteins); balancing (balancing among all types of foods); and periodicity (controlling the frequency of food intake – fasting types).

Orthorexia nervosa was compared in different groups of respondents, including those who don't practice diets, observe fasting in different traditions, and prefer weight loss drugs. The ORTO-15 questionnaire was used to determine the severity of orthorexia nervosa. The study found categorical predictors of orthorexia nervosa, including attitudes towards food, war impact on eating behavior, and past experience with ED. Intergroup differences were revealed between respondents with orthorexia nervosa and those without, as well as between the groups of orthorexic modalities themselves, as per the average orthorexia scale value.

Attitude towards food is a predictor of orthorexia nervosa, with those treating food as a cleansing tool having the strongest orthorexia. Mediation analysis revealed that attitudes towards food influence the choice of orthorexic modality, increasing the intensity of orthorexia nervosa. This indirect influence accounts for 37.9% of the effect.

The war-induced changes in eating behavior increased orthorexic tendencies, while those without changes had the opposite effect. Orthorexic modality predicts nearly a quarter of anorexia nervosa diagnoses, with women more likely. It also affects attitudes towards food, with a 23% increase in ED likelihood.

Key words: orthorexia, orthorexia nervosa, orthorexic modalities, healthy eating, dieting, eating behavior, vegetarianism, intermittent fasting, eating disorder.

Стаття присвячена аналізу складу категоріальних даних щодо орторексичних модальностей. Для зручності та майбут-

ніх перспектив наукових досліджень у сфері особистісних схем та прив'язаностей було виділено чотири основні типи орторексичних модальностей: виключення (виключення певних продуктів: м'яса, продуктів тваринного походження, молочних продуктів); акцентування (акцентування на певних видах їжі: жирах, білках); балансування (балансування між усіма видами їжі); періодичність (контроль частоти прийому їжі – різні типи голодування).

Нервову орторексію порівнювали у різних групах респондентів, у тому числі у тих, хто не практикує дієти, дотримується посту в різних традиціях та надає перевагу медикаментозним засобам для схуднення. Для визначення ступеня тяжкості нервової орторексії використовувався опитувальник ORTO-15. Дослідження виявило категоріальні предиктори нервової орторексії, включаючи ставлення до їжі, вплив війни на харчову поведінку та минулий досвід з РХП. Виявлено міжгрупові відмінності між респондентами з нервовою орторексією та без неї, а також між групами самих орторексичних модальностей за середнім значенням шкали орторексії.

Ставлення до їжі є предиктором нервової орторексії, причому ті, хто ставиться до їжі як до засобу очищення, мають найсильнішу орторексію. Аналіз медіації показав, що ставлення до їжі впливає на вибір орторексичної модальності, збільшуючи інтенсивність нервової орторексії. Цей опосередкований вплив становить 37,9% ефекту.

Зміни в харчовій поведінці, спричинені війною, посилювали орторексичні тенденції, тоді як ті, що не зазнали змін, мали протилежний ефект. Орторексична модальність прогнозує майже чверть діагнозів нервової анорексії, причому частіше у жінок. Вона також впливає на ставлення до їжі, збільшуючи ймовірність розвитку РХП на 23%.

Ключові слова: орторексія, нервова орторексія, орторексичні модальності, здорове харчування, дієта, харчова поведінка, вегетаріанство, інтервальне голодування, розлад харчової поведінки.

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Introduction. The global trend for healthy eating, in the form of its radical pathology – orthorexia nervosa – is considered as a psychological phenomenon in this article. The purpose of the article is to substantiate the existence of four types of orthorexic modalities and to study the influence of various factors on them. Four main types of orthorexic modalities were identified for convenience and future perspectives of scientific research in the field of personal schemas and attachment: exclusion, emphasis, balancing, and periodicity. The essence is that the orthorexic modality of exclusion is aimed at excluding certain foods or their groups from the diet (meat, animal products,

dairy, gluten or sugar, etc.). The emphasis modality, on the contrary, aims to include certain types of foods in the diet and emphasize them (fats in a keto diet, or proteins in a protein diet, as well as emphasis on grains in a paleo diet, etc.) The balancing modality is the focus on calculating protein, fat, and carbohydrate quotas in order to find a balance among all types of foods (calculation of the nutritional value of food, calorie intake per day, sports “drying” or “gaining mass,” etc.) The periodicity modality means that the main goal of orthorexic eating behavior is to control the frequency of food intake (e.g., intermittent fasting and other types of fasting). In addition to the representatives of the groups of different

orthorexic modalities, for control purposes, data were collected for comparison from respondents who do not fall into any orthorexic modality. These include subsamples of respondents who indicated that they do not practice any diets and eat whatever they want and whenever they want, as well as respondents who observe fasting in different regional traditions and those who prefer weight loss drugs.

The problem of orthorexia nervosa has a wide range of different studies. For example, in the study (Rzeszutek, M., Kowalkowska, J., Dragan and others) the purpose was to investigate the predictive significance of adverse childhood experiences (ACEs) and the differences between orthorexia nervosa and healthy orthorexia dimensions in a sample of Polish people, and to see how experiential avoidance levels, embodiment, and alexithymia function as mediators in this relationship [1]. The other study showed the final-trimester pregnant women were obsessed with eating healthily and felt negatively about the changes in their bodies. Pregnancy outcomes and the health of the unborn child may be greatly impacted by eating disorders [2]. Also mindful eating orthorexia nervosa showed a negative correlation, but the scores of the Intuitive Eating Scale–2nd edition showed no correlation [3]. It was shown that interestingly, orthorexia nervosa may give anorexics a sense of control and act as a coping technique [4]. The other study showed that the percentage of patients with type 2 diabetes who are also overweight or obese and who are at risk of developing eating disorders or ON following liver donation is demonstrated for the first time by this study. The complex relationship between weight status and eating disorders may be

highlighted by the strong correlation between body mass index and the chance of having eating disorders [5].

Materials and methods. The ORTO-15 questionnaire was used to determine the orthorexia nervosa in different groups of respondents, depending on the type of attitude toward food. In all groups (including the control group), the mean values on the orthorexia nervosa scale were compared, and regression and mediation analysis of models were performed, which included categorical predictors of orthorexia nervosa in the form of attitudes toward food, the impact of war on eating behavior and the presence of past experience with ED.

Discussion. All of these subsamples were initially assessed using the ORTO-15 orthorexia questionnaire. In our sample (n=469), the reliability of the one-dimensional scale of the ORTO-15 questionnaire was confirmed by the results of the Cronbach's α (0.73) and MacDonal's Ω (0.73) reliability coefficients, which are sufficiently satisfactory for further work with the data and the right to draw statistical conclusions. Table 1 shows the results of each subsample in the form of mean (M), standard deviation (Sd), and standard error (Se), according to the ORTO-15.

According to the reference values of the ORTO-15 developers [6], a diagnosis of orthorexia nervosa is made if the respondent scores less than 40 points. Sometimes, a cutoff score of 35 points can also be used. Thus, in any case, four modalities fall into the category of orthorexia nervosa. The two groups that definitely do not fall into the category of orthorexia nervosa are respondents who indicated that they preferred to use weight loss drugs and those who eat what they want and do not think about it.

Table 1

Descriptive statistics for orthorexic modalities and control groups on the ORTO-15 questionnaire

| Subsamples | n | M | Sd | Se |
|--|----|-------------|------|-------|
| 1 – (modality of exclusion) vegetarianism / veganism / raw foodism / Ayurvedic diet / gluten-free / sugar-free | 50 | 33.6 | 3.27 | 0.462 |
| 2 – (modality of emphasis) keto diet / paleo diet / protein diet | 52 | 35 | 3.70 | 0.513 |
| 3 – (modality of balancing) proper nutrition of protein-fat-carbohydrates norms calculated or a specialized sports diet for muscle gaining or fat drying | 40 | 32.1 | 4.19 | 0.662 |
| 4 – (modality of periodicity) intermittent fasting / other fasting system | 48 | 35 | 3.50 | 0.505 |
| 5 – practicing fasting (of any religious tradition: Christian, Vedic, Islamic or other) | 37 | 38.1 | 2.70 | 0.443 |
| 6 – medical diet due to an illness (allergy or other) | 46 | 37.1 | 3.46 | 0.510 |
| 7 – weight loss drugs | 40 | 41.6 | 2.98 | 0.472 |
| 8 – eat what they want | 60 | 41 | 4.20 | 0.542 |
| 9 – intuitively know what to eat | 74 | 36.8 | 4.09 | 0.475 |
| 10 – no option is suitable | 22 | 37.3 | 4.09 | 0.871 |

For the case described above, intergroup comparisons were conducted to determine the strength of the effect size, using the Kruskal-Wallis method for unpaired samples, categorical data, or data with non-normal distribution (because the Shapiro-Wilk test was $p < 0.05$, in our case for the orthorexia nervosa scale). It was found that the groups of orthorexic modalities and the control group statistically significantly differed from each other on the scale of orthorexia nervosa at $\chi^2 = 172$; $p < 0.001$ and the effect size $\varepsilon^2 = 0.367$. Pairwise comparisons, in this case, allowed us to establish more detailed differences in which subsamples they exist. For example, it was determined that the following subsamples differ significantly: exclusion modalities from those who practice fasting, follow a medical diet, take weight loss drugs, eat whatever they want without restrictions, eat intuitively, and those for whom none of the options are suitable. The inclusion modality differs from the balancing modality, the practice of fasting, weight loss drugs, and eating without restriction. The balancing modality differs from all the others except the inclusion modality. The periodicity modality is different from fasting, preparations, and eating without restrictions. Those who practice fasting are different from those who take weight loss drugs and eat without restrictions. And those who follow a therapeutic

diet are different from those who take weight loss drugs and eat without restrictions. Those who take drugs for weight loss differ from those who eat intuitively and from those who do not fit any option. Those who eat without restrictions differ from those who eat intuitively and from those who do not fit into any of the options.

The data was then analyzed for other categorical variables, questionnaires that clarified the following: age, gender, education level, changes in eating behavior after the full-scale invasion, the severity of the impact of war stress, experience with an eating disorder, and prejudice towards food.

Prejudice towards food as a categorical variable included several options: 1) food is a pleasure; 2) a means of maintaining beauty and youth; 3) "fuel" for the body; 4) a tool for cleansing the body, or simply 5) it can be harmful or useful. The phenomenon is visualized in Figure 1.

The boxplot shows the difference in median values in the subsamples and the different nature of the distribution among them. The average values for this distribution are shown in Table 2.

According to the results presented in Table 2, it can be seen that orthorexia nervosa is present in all groups, however, if we focus on the value of 35 points, it is definitely present in the fourth subsample, which includes respondents who

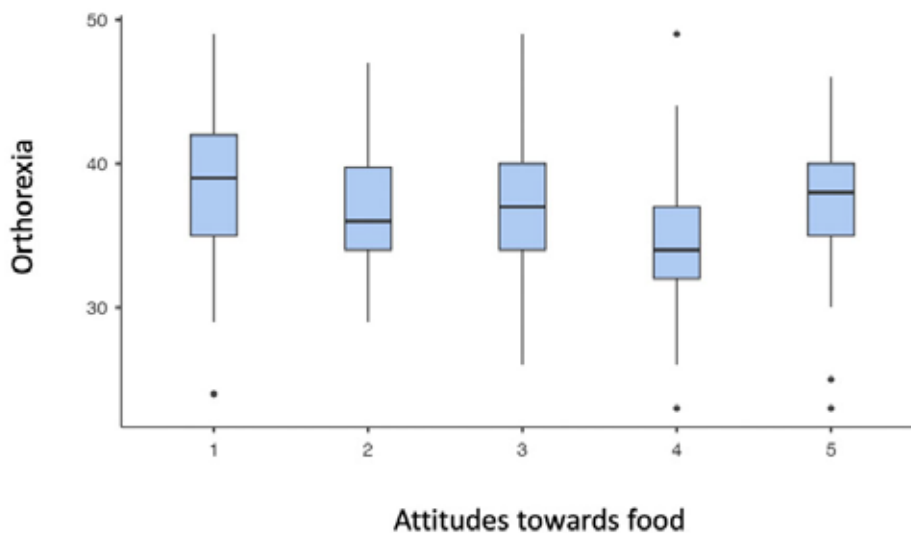


Fig. 1. Boxplot for ORTO-15 results regarding attitudes towards food

Table 2

Means for the ORTO-15 questionnaire regarding the type of attitude to food

| Groups | n | M | Se | Sd |
|---|-----|------|-------|------|
| 1 – food is a pleasure | 107 | 38.2 | 0.453 | 4.68 |
| 2 – food is a tool for maintaining beauty and youth | 86 | 36.7 | 0.418 | 3.88 |
| 3 – food is a "fuel" for the body | 140 | 36.8 | 0.408 | 4.83 |
| 4 – food is a tool for cleansing the body | 61 | 34.6 | 0.576 | 4.50 |
| 5 – food can be harmful or useful | 75 | 37.1 | 0.471 | 4.08 |

define food as a tool for cleansing the body. According to the Shapiro-Wilk criterion, the distribution in the subsamples on the orthorexia scale meets the criteria of normality ($p > 0.05$), so for intergroup comparison, we can use the method of parametric statistics for unpaired comparisons – analysis of variance (ANOVA). The comparison showed that the groups differ ($p < 0.01$), but the effect size is very small $\epsilon^2 = 0.06$.

To deepen the analysis of this phenomenon, a scatter plot with regression lines between orthorexic modalities (and control groups) in relation to their scores on the orthorexia scale and type of attitude toward food was constructed (Figure 2). The diagram shows that the regression direction in different groups is diametrically opposite (from positive to negative). The construction of a regression model with these three indicators, with the equation in the form: dependent variable – “orthorexia”,

predictor – “attitude to food”, covariate – “orthorexic modality”, allowed us to establish that $R^2 = 0.17$ ($p < 0.001$). Table 3 shows the detailed parameters of the model estimation.

More detailed estimates of the model parameters (Table 3) show that the value of the regression coefficient for the independent variable (estimate) in the table is 34.04 on the orthorexia scale, while the intercept or value of the dependent variable (attitude toward food) for respondents who have zero value on the independent variable is zero. In other words, the table shows that the level of orthorexia nervosa increases (the value on the orthorexia scale falls by -1.2, which indicates an increase in orthorexic tendencies) in those who treat food as a source of calories for the body, rather than as a source of pleasure. Thus, attitudes toward food are a statistically significant predictor of orthorexia nervosa.

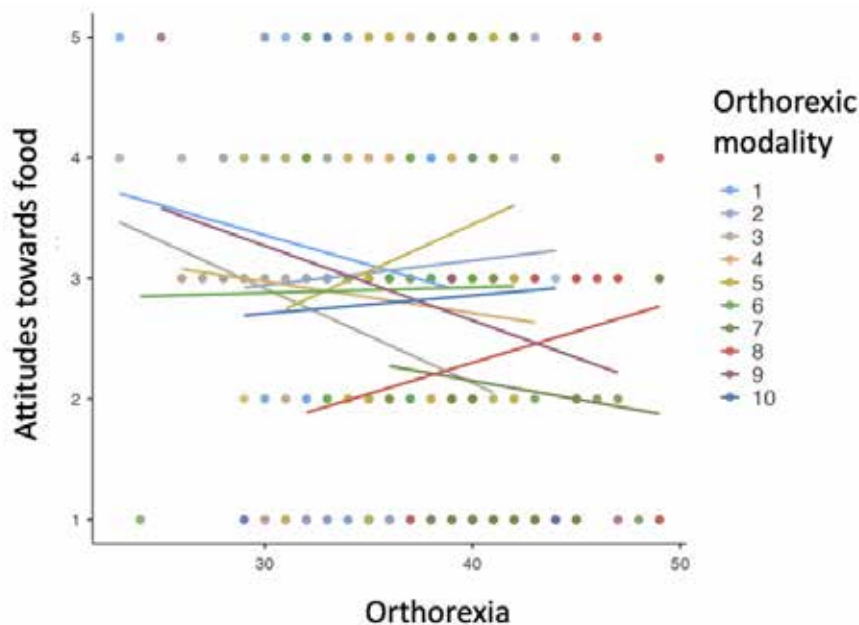


Fig. 2. Diagram of distribution in orthorexic modalities in relation to their scores on the orthorexia scale and type of attitude to food

Table 3

Regression analysis for orthorexic modalities in relation to their scores on the orthorexia scale and the type of attitude towards food

Model coefficients
 $R^2 = 0.17$ ($p < 0.001$)

| Predictor | Estimate | SE | t | p |
|-------------------------------------|----------|--------|--------|-------|
| Intercept | 34.0483 | 0.6515 | 52.260 | <.001 |
| Attitude towards food type (group): | | | | |
| 2 – 1 | 0.0816 | 0.6390 | 0.128 | 0.898 |
| 3 – 1 | -1.2050 | 0.5379 | -2.240 | 0.026 |
| 4 – 1 | -1.3433 | 0.7295 | -1.841 | 0.066 |
| 5 – 1 | -0.5893 | 0.6334 | -0.930 | 0.353 |
| Orthorexic modality | 0.6277 | 0.0764 | 8.214 | <.001 |

Assessing the significance of mediation interactions in the orthorexia-attitude to food-orthorexic modality model

| | | | Label | Estimate | SE | p |
|-----------------------|---|---------------------|-------|----------|--------|--------|
| Attitude towards food | → | Orthorexic modality | a | -0.269 | 0.0970 | 0.006 |
| Orthorexic modality | → | Orthorexia | b | 0.620 | 0.0680 | < .001 |
| Attitude towards food | → | Orthorexia | c | -0.272 | 0.1440 | 0.05 |

For the case of the same variables, a mediation analysis was conducted to determine the strength of the indirect effect of the type of attitude toward food as a predictor on the orthorexia scale when determining the orthorexic modality as a mediator in this equation. Thus, it was found that the indirect influence accounted for 37.9%, with all interactions ($p < 0.05$), as shown in Table 4.

In the context of current realities, it is impossible not to study the influence of the stress factor from the invasion of Ukraine by Russian troops on the eating behavior of Ukrainians. Therefore, the following regression model (Table 5) was built taking into account the influence of two factors: changes in eating behavior due to the war and orthorexic modality on the values obtained by respondents on the scale of orthorexia nervosa. The levels of the categorical variable of changes in eating behavior due to the war were determined by the respondents as follows: 1 – “No”, 2 – “Almost no”, 3 – “Small changes”, 4 – “Yes”. The model shows that respondents differ significantly in groups 3 and 1, those who claim to have noticed small changes and those who have not noticed them. Those who have noticed changes in eating behavior due to the war have increased orthorexic tendencies, while those who have not noticed

changes have the opposite. In terms of orthorexic modality, almost all groups differ significantly from each other, except for the case between groups 1 and 3, where orthorexia increases (but $p > 0.05$), while in the rest it decreases (at $p < 0.05$).

Moreover, a causal network model (by SEM statistical method) for the categorical factors of orthorexia was created on a sample of 77 respondents (of same dataset), evaluating the previous results of the study [7] within the framework of the ethnocultural aspects of orthorexia nervosa. It was found in the study that orthorexic modality predicts almost a quarter ($R^2 = 0.24$) of orthorexia nervosa; gender (for example, the rank from 1 – ‘male’ to 2 – ‘female’) and orthorexia have an inverse regression relationship, which means that women are more likely to have this diagnosis. Orthorexic modality accounts for 15% of the attitudes toward food. The presence of experience with ED (as the rank increases from 1 – “no” to 2 – “yes”) has an inverse regression relationship with attitudes toward food ($R^2 = -0.23$), which means that respondents with an attitude toward food as a fuel are 23% more likely to have ED.

Conclusion. The study of orthorexic modalities was made on 469 respondents, including both

Table 5

Regression model of changes in eating behavior under the influence of war stress

Model coefficients
 $R^2 = 0.37$ ($p < 0.001$)

| Predictor | Estimate | SE | t | p |
|---|----------|-------|---------|--------|
| Intercept | 34.2064 | 0.665 | 51.4075 | < .001 |
| Changes in eating behavior due to the war (groups): | | | | |
| 2 – 1 | 0.0490 | 0.628 | 0.0781 | 0.938 |
| 3 – 1 | -1.0402 | 0.490 | -2.1217 | 0.034 |
| 4 – 1 | -0.8775 | 0.480 | -1.8298 | 0.068 |
| Orthorexic modality: | | | | |
| 2 – 1 | 2.0843 | 0.742 | 2.8081 | 0.005 |
| 3 – 1 | -1.4590 | 0.793 | -1.8401 | 0.066 |
| 4 – 1 | 1.9716 | 0.762 | 2.5890 | 0.010 |
| 5 – 1 | 4.1959 | 0.839 | 5.0032 | < .001 |
| 6 – 1 | 3.3257 | 0.790 | 4.2082 | < .001 |
| 7 – 1 | 7.6353 | 0.850 | 8.9780 | < .001 |
| 8 – 1 | 7.2601 | 0.724 | 10.0313 | < .001 |
| 9 – 1 | 3.0753 | 0.679 | 4.5266 | < .001 |
| 10 – 1 | 3.6731 | 0.946 | 3.8838 | < .001 |

representatives of the four orthorexic modalities (exclusion, emphasis, balancing, and periodicity) and controls, were analyzed for intergroup differences in the mean value of the ORTO-15. A causal network was analyzed on the basis of various categorical variables, and mediation analysis was conducted between the model components.

It was found that, according to the average value of the orthorexia nervosa scale in our sample, all four modalities were diagnosed with orthorexia nervosa, while the control groups did not. A more detailed comparison made it possible to clarify that: respondents with the exclusion modality differ from those who practice fasting, follow a therapeutic diet, take weight loss drugs, eat whatever they want without restrictions, eat intuitively, and those for whom none of the options fit. The inclusion modality differs from the balancing modality, the practice of fasting, weight loss drugs, and eating without restriction. The balancing modality differs from all the others except the inclusion modality. The periodicity modality is different from fasting, preparations, and eating without restrictions. Those who practice fasting are different from those who take weight loss drugs and eat without restrictions. And those who follow a therapeutic diet are different from those who take weight loss drugs and eat without restrictions. Those who take drugs for weight loss differ from those who eat intuitively and from those who do not fit any option. Those who eat without restrictions differ from those who eat intuitively and from those who do not fit any option. Thus, it was found that there are intergroup differences both between respondents who have a diagnosis of orthorexia nervosa and those who do not, and, in addition, there are intergroup differences between the groups of orthorexic modalities themselves.

The data was analyzed in relation to age, gender, level of education, changes in eating behavior after the war in Ukraine started, the strength of the impact of war stress, experience with an eating disorder, and prejudice towards food. It was found that the attitude towards food (as a tool for cleansing the body) is a predictor of orthorexia nervosa, with respondents who treat food as a cleansing tool for the body having the strongest orthorexia. Even more detailed regression models revealed that orthorexia nervosa is stronger in those who treat food as a source of calories for the body rather than a source of pleasure. Mediation analysis allowed us to determine the strength of the indirect effect of the type of attitude to food as a predictor on the scale of orthorexia values in determining the orthorexic modality as a mediator. Thus, it was

found that the indirect influence accounted for 37.9%. Thus, attitudes toward food influence the choice of orthorexic modality, which together increases the intensity of orthorexia nervosa.

In addition, it was determined that those respondents who noted changes in eating behavior due to the war have increased orthorexic tendencies, while those who did not experience changes have the opposite.

Causal network, which included all the variables studied in this section, allowed us to establish that orthorexic modality (vegetarianism, intermittent fasting, proper nutrition, intuitive nutrition, fasting, medical and other control groups) predicts almost a quarter of the diagnosis of anorexia nervosa; women are more likely to be diagnosed with anorexia nervosa; orthorexic modality affects the type of attitude towards food; respondents with an attitude towards food as fuel have a 23% increase in the likelihood of ED.

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