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Orthorexia Nervosa in Healthcare Professionals by Multivariate Statistical Method

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Abstract

Objective: In this multicenter survey aimed to determine the risk factors associated with Orthorexia Nervosa (ON) affected in Healthcare Professionals and to determine the clustering tendency of the variables by the dendrogram.

Design: Cross-sectional

Settings: This study has been conducted in four full-fledged hospitals in İstanbul between March and April 2018.

Participants: A total of 248 participants from different health professions that are actively working in hospitals participated in the study.

Variables Measured: ORTO 15 was used to evaluate orthorexia Nervosa, EAT-40 for abnormal eating behaviors, and MAUDSLEY for obsessive-compulsive symptoms.

Analysis: Multivariate statistical methods are used to increase internal validity and the accuracy of the analysis of the data.

Results: Binary Logistic regression analysis was conducted with reporting of odds ratio to establish the risk for ON in Healthcare Professionals. The results that were obtained from Binary Logistic Regression showed that profession (odds: 6.766), BMI (odds: 4.370), eating-out (odds: 3.111), monthly-income (odds: 3.077), and chronic disease (odds: 2.596) regularly have higher odds of being ON in Healthcare Professionals.

Conclusions and Implications: Finding and preventing risk variables determined for healthcare professionals with powerful methods will increase efficiency in the field of health and provide an even problem-free healthcare system.

Key words: Orthorexia Nervosa, Healthcare Professionals, ORTO-15, Hierarchical Cluster Analysis, Logistic Regression.

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Introduction

Using a combination of the Greek words “orthós” (meaning correct) and “órexis” (signifying appetite), orthorexia has been described as a new eating style. From the same etymological origin of orthorexia, it is clear that an interest in eating right or healthy should not be associated with a problematic approach to food. The problematic component of orthorexia: Orthorexia Nervosa is a condition that is characterized by healthy eating and describes the presence of body image disorders. The human body has a complex meaning and role in everyone's life and experience^{1,2}. Orthorexia Nervosa describes a pathological obsession with proper nutrition that is characterized by a restrictive diet, ritualized patterns of eating, and rigid avoidance of foods believed to be unhealthy or impure. Although prompted by a desire to achieve optimum health, it may lead to nutritional deficiencies, medical complications, and poor quality of life. Two-thirds of clinicians also indicated that the syndrome deserves more scientific attention³.

Orthorexia Nervosa and Eating Disorder Symptoms were studied with 636 Registered Dietitian Nutritionists in the United States. The prevalence of Orthorexia Nervosa and Eating disorders (EDs) were found respectively as 49.5% and 12.9% by using Orthorexia Nervosa Questionnaire (ORTO-15) and Eating Disorder Examination Questionnaire (EDE-Q)⁴.

The ratio of ON was determined to be 45.5% by using the ORTO-15 test in a cross-sectional study of 318 medical doctors residing in the Faculty of Medicine. Those who cook their food and shop themselves, who consume salads/fruits, who care about food quality, who cares about food content, and who choose a product score with a lower average score in ORTO-15 were found to be different from the other group. In the comparison between male and female doctors in the same study, the ratio of female participants choosing food was 38.9%, while this rate was 20.1% for male doctors. Female medical doctors are more careful than males in terms of their physical appearance and weight control. They found that less caloric food consumption in the female group was less than male doctor group⁵.

Malmberg et al.⁶ who described orthorexia Nervosa as an exaggerated fixation on healthy food, found that orthorexia Nervosa was lower in males and females with high levels of physical activity (45.1% versus 8.3%; $p < 0.001$). Ramacciotti et al.⁷ conducted an extensive study aimed at investigating the characteristics of Orthorexia Nervosa diffusion in the general population and especially emphasizing its relationship with Eating disorders and Obsessive-Compulsive Disorder. The prevalence of Orthorexia was found as 57.6% by using the ORTO-15 test in the general population. It has been reported that some precautions should be taken to prevent the spread of Orthorexia which may constitute an important risk factor for mental and physical health.

Maghetti et al.⁸ evaluated the prevalence of orthorexia in a large sample of healthcare professionals involved in nutrition education (1240 subjects). They found that orthorexia seems to be quite widespread, especially among biologists, free-lances, divorced, smokers, dieting, and thin individuals.

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When the results of current researchers are examined, it has been seen that the data were usually analyzed by univariate methods. However, multivariate statistical methods which consider the variation in all variables as a whole were used to obtain more sensitive and more powerful methods instead of univariate statistical methods⁹.

The purpose of this study was to determine the factors associated with Orthorexia Nervosa in Health Care Professionals variables and to determine the clustering tendency of the variables by the dendrogram. These tendencies could give predefined information to Orthorexia Nervosa in the early period. The Binary Logistic Regression method was also used to predict risk factors for Orthorexia Nervosa in Healthcare Professionals. New opinions and new comments on the subject by using the current multivariate statistical methods were discovered.

Materials and Methods

This study was conducted in Istanbul, Turkey between March and April 2018. Istanbul is a metropolitan city located in the western part of Turkey, connecting the Asian and European continents. The study has been conducted in four full-fledged hospitals, a university, and a public hospital from the European and Anatolian sides of Istanbul.

This multicenter cross-sectional study was conducted on 248 volunteer participants from different health professions that are actively working in hospitals. To determine the generalizability of the research, the sample size was calculated according to 95% power. Taking into account $\alpha = 0.05$, power = 0.95, and the occurrence probability of disease the required sample size was calculated as 245 with the R program¹⁰.

The study started with 256 participants, however, since the data of eight participants were missing they were excluded from the scope of the study and therefore the study was completed with 248 participants. The study sample consists of physicians, dieticians, nurses, physiotherapists, and assistant health personnel (emergency medical technician, physiotherapy technician, anesthesia technician). Despite working in the hospital, individuals without educational backgrounds were not included in the study, even though they were volunteers.

Written informed consent was received from each participant after the aims and methods of the study were explained. Health workers were given a questionnaire and by a face-to-face interview, information related to socio-demographic general interests was gathered.

For anthropometric measurements, a portable weighing device was used for weight measurement and portable height scale measurement (Tanita). Body Mass Index (BMI) values calculated with the obtained data were evaluated by taking the WHO criteria as a reference¹¹. According to this classification, those people with a BMI of <18.5 are classified as underweight, those with 18.5–24.99 are classified as being of normal weight, those with 25.0–29.99 are classified as overweight, those with >30 are classified as individuals with obesity. Subsequently, in this analysis, the BMI value 18.5–24.99 is considered to be of normal weight, and the other group includes the underweight, overweight and obese individual categories.

Three questionnaires with high validity scores were computed based on the results of the Orthorexia Nervosa of Healthcare Professionals. Orthorexia Nervosa Evaluation Scale (ORTO-15) was used to evaluate orthorexia Nervosa¹², Eating Attitude Test (EAT-40) was

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used to evaluate abnormal eating behaviors¹³, and MAUDSLEY Obsessive-Compulsive Questionnaire (MOCQ) was used to determine obsessive-compulsive symptoms¹⁴.

The ORTO-15 is the most widely used instrument to evaluate orthorexia Nervosa. First developed in 1997 by Donini, Italy, the original ORTO-15 test is a questionnaire aiming to diagnose orthorexia Nervosa, an intense obsession for healthy food¹². The test is composed of 15 questions with a four-point Likert scale with categories “always”, “often”, “sometimes”, and “never”. A score equal to 1 corresponds to an orthorexic susceptibility in the eating behavior, while a score equal to 4 points indicates normal eating habits. A cut-off of 40 points represents orthorexia Nervosa. While participants who scored below 40 in the ORTO-15 test are defined as individuals with orthorexia (having highly sensitive behavior), eating behavior reaches more normal standards as the score increases.

The scale (EAT-40) was published in 1979 for the first time. It is a 40-item scale, designed to detect the presence of abnormal eating attitudes. The main score is calculated with a rating on a 5-point Likert-type scale. The cut-off point is 30. Scores below and equal to 21 indicate low risk, scores between 21-29,9 indicate medium risk, and scores above and equal to 30 indicate high risk¹³.

MAUDSLEY Obsessive-Compulsive Questionnaire (MOCQ) is the most commonly used self-reporting questionnaire in true-false item format, and it was developed for evaluating the type of obsessive-compulsive symptoms among healthy individuals and patients with psychology groups. By adding 7 new questions to the original questionnaire, composed of 30 questions, the current form is obtained¹⁴. It has 4 sub-scales: control, slowness, suspiciousness, and cleanliness. The highest score available is 37 for the total obsession score: 9 for control, 11 for cleanliness, 7 for slowness, and 7 for suspiciousness subscale. For each item answered as “true” is worth a point.

Ethical Statement

The study was approved by the Ethics Committee of the Biruni University on 26.2.2018 with the number 2018/13-39. This study was carried out following the latest version of the Helsinki Declaration.

Statistical analysis

A multicenter cross-sectional study was planned at the beginning of the study to increase validity and reliability. In addition, it was planned to use multivariate statistical methods instead of univariate statistical methods to increase internal validity and the accuracy of the analysis in the evaluation of the data.

Mean and standard deviation (SD) were calculated for continuous variables. The normality of the variables was analyzed by the Kolmogorov Smirnov test. Khi-Square test for the univariate variable was used to analyze the frequencies of being Orthorexia Nervosa, according to different professions and BMI ranges.

The binary Logistic Regression method was used to determine the odds coefficients of the risk variables that affect the result of the ORTO-15 test that evaluates Orthorexia Nervosa by positive (≤ 40) and non-positive (> 40). A forward stepwise Binary Logistic regression was

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performed. As a result, the method was used to predict (an individual's probability of being ON) risk factors for Orthorexia Nervosa in Healthcare Professionals ⁹.

Hierarchical Cluster Analysis of modern multivariate statistical methods was employed to find the clustering tendency of the variables, especially with ORTO-15. The relationships between the variables were presented with a dendrogram that visually reveals the connection of the objects that seem to be similar. The dendrogram of the variables was found using the Common Linkage (between groups) and Ward's Hierarchical Clustering Model. The decided model should be the best according to the data structure and minimize the variability within clusters and maximize the variability between clusters.

Two-sided p values were considered statistically significant at $p \leq 0.05$. All statistical analyses were carried out by using R programming (version 3.6.2 (2019-12-12) – CRAN). This study can be repeated with a larger sample and a study that has male individuals.

Results

The study was carried out on 186 female and 62 male individuals aged ($\bar{x} \pm SD$): 33.31 ± 10.08 and 34.82 ± 11.42 years respectively. Descriptive statistics of the study participants are presented in Table 1.

Table 1. Basic descriptive statistics of the study participants

	Frequency n ($\bar{x} \pm SD$)	Percent (%)
Gender		
Female (BMI-kg/m ²)	186 (23.49±4.053)	75.00
Male (BMI-kg/m ²)	62 (24.60±3.223)	25.00
Marital status		
Married	119	0.480
Single	129	0.520
Education levels		
High school	31	0.125
Undergraduate	40	0.161
Graduate	65	0.262
Master or doctorate	83	0.335
Others	29	0.117
Cohabitants		

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Alone	32	0.129
With family	197	0.794
With friends	19	0.077
Chronic Disease		
Yes	43	0.173
No	205	0.827
Profession		
Dietitian	14	0.057
Physician	76	0.307
Nurse	74	0.298
Physiotherapist	10	0.040
Allied Health Professional	74	0.298

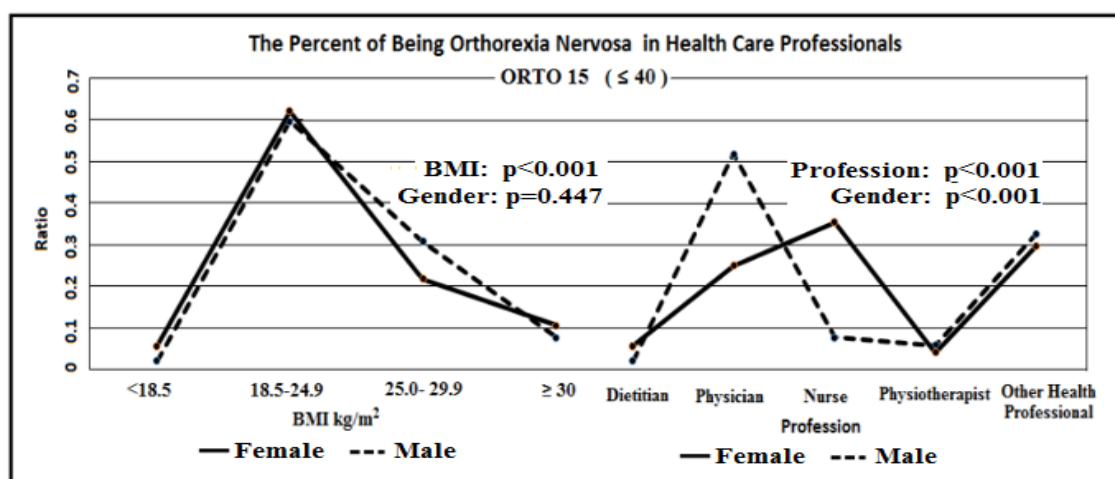
BMI: Body Mass Index

$\bar{x}$: Mean value

SD: Standard Deviation

n: Number of individuals

The study participants (male and female) were diagnosed with Orthorexia Nervosa by ORTO-15 test, using a 40-point threshold according to BMI and their professions. According to ORTO-15, the distribution rates (%) of those who were Orthorexia Nervosa for both sexes were presented in Figure 1.



BMI: Body Mass Index. The diagnosis of Orthorexia Nervosa was based on the ORTO-15 test, using the established 40-point threshold.

Figure 1. The distribution of Orthorexia Nervosa according to gender, BMI and Professions.

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When the results of Figure 1 are examined, although there was no difference in distribution between male and female ($p=0.447$), the ratio of Orthorexia Nervosa according to the BMI were found significant difference in both groups ($p<0.001$). On the other hand, the ratio of Orthorexia Nervosa according to the profession was also found to be significantly different in both groups ($p<0.001$).

Binary Logistic regression results for risk variables of Orthorexia Nervosa in Health Care Professionals are presented in Table 2.

Table 2. Binary Logistic regression results for risk variables of Orthorexia Nervosa in Healthcare Professionals

Risk variables	β	S.E	Odds	95% CI	Wald	P
Eating out	1.135	0.421	3.111	1.363-7.100	7.268	<0.001
BMI	1.475	0.496	4.370	1.653-11.55	8.843	<0.001
Profession	1.912	0.507	6.766	2.504-18.28	14.22	<0.001
Monthly income	1.124	0.391	3.077	1.429-6.621	8.263	<0.001
Chronic disease	0.954	0.298	2.596	1.447-4.655	10.24	<0.001

BMI: Body Mass Index

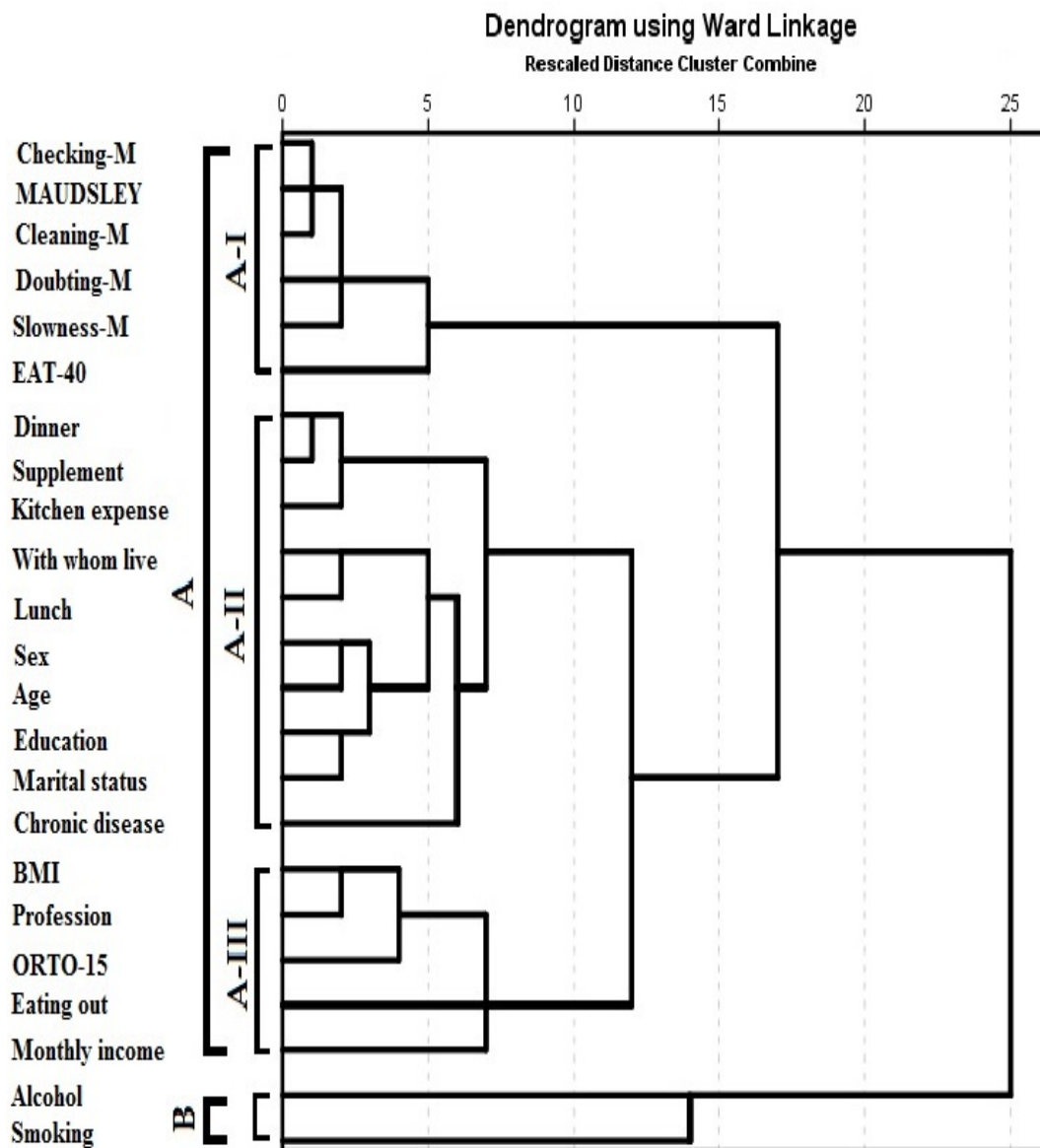
β :Unknown parameter vector

Based on Table 2, there are five significant risk variables for the Binary Logistic regression models. It has been derived five odds ratios with high and significant values for these risk variables of Orthorexia Nervosa in Healthcare Professionals ($p=0.001$).

Hierarchical Cluster Analysis of modern multivariate statistical methods was employed to find the clustering tendency of the variables, especially with the scales ORTO-15, MAUDSLEY, and EAT-40 that were included in the study.

According to cluster analysis, the dendrogram includes two main clusters and three sub-clusters represented in Figure 2.

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Checking-M: Checking-MAUDSLEY, Cleaning-M: Cleaning- MAUDSLEY,
Doubting-M: Doubting- MAUDSLEY, Slowness-M: Slowness-MAUDSLEY
EAT 40: Eating Attitude Test
ORTO: Orthorexia Nervosa Evaluation Scale

Figure 2. The dendrogram for the variables by using “Hierarchical Cluster Method”

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Main Cluster A: Included three sub-clusters; A-I, A-II, and A-III.

Sub Cluster A-I: Included the variables of MAUDSLEY (Checking-M, Cleaning-M, Doubling-M, Slowness-M and EAT-40).

Sub Cluster A-II: Included the variables of dinner, supplement, kitchen expense, with whom the individual lives, lunch, sex, age, education, marital status, chronic disease.

Sub Cluster A-III: Included the variables of BMI, profession, ORTO-15, eating out, monthly income.

Main Cluster B: Alcohol, smoking.

Discussion

Orthorexia Nervosa is a new syndrome and studies related to this syndrome have increased in recent years¹⁵. In addition, healthcare personnel may be at risk in terms of nutritional behavior due to their training in nutrition and working conditions. In the current study, data were evaluated to explore whether Orthorexia Nervosa predicted in Healthcare Professionals correlates with the demographic variables of gender, BMI, and profession. Orthorexia Nervosa has been studied in terms of its relationship with different sexes and BMI, with results being inconsistent^{16, 17}.

When BMI was taken into consideration, the distribution of Orthorexia Nervosa in females and males was similar to the ORTO-15 test. However, there was a significant difference between the frequencies of being Orthorexia Nervosa, according to different BMI ranges. The results from past research have reported no significant gender differences in total Orthorexia Nervosa symptomatology^{16,18-20}. However, the results of some researches claim that BMI is one of the key factors affecting an individual's orthorexic tendency^{21,22}. These results supported the result of the current study found for the differences between frequencies of being Orthorexia Nervosa, according to different BMI.

The ratio of Orthorexia Nervosa according to the BMI of females who participated in the study, it was found that 5.65% has BMI <18.5 kg/m², 62.10% has BMI 18.5-24.9 kg/m², 21.77% has BMI 25.0-29.9 kg/m², 10.48% has BMI ≥30 kg/m² respectively. For males, these rates were found close to the female. It was found that 1.92% has BMI 18.5 kg/m², 59.62% has BMI 18.5-24.9 kg/m², 30.77% has BMI 25.0-29.9 kg/m², 7.69% has BMI ≥30 kg/m² respectively. Godefray et al.²³ optimized the empirical assessment of Orthorexia Nervosa symptoms and investigated their relationship with BMI in their study. In the end, ON was not generally associated with high or low BMI, and in particular that rigid dieting might only reduce BMI to a very limited extent. However, Ferreira et al.²⁴ regarding ON's differences in BMI, sample 1 was divided into four groups; underweight, normal weight, pre-obesity, and obesity, and no significant differences between the groups were found. Nevertheless, the group with higher levels of orthorexic tendencies was the underweight group. Previous results regarding BMI's relationship with ON have been inconsistent. Their results might indicate that ON is equally present in all BMI categories, which might indicate that ON is uncorrelated to weight.

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The relationship between ON and sex is covered in many studies. In some studies, sex differences were significant, with women presenting higher levels of orthorexic tendencies than men. A systematic review of sex differences in orthorexic behaviors found that pathologically healthful eating is slightly more pronounced in women ¹⁷.

In this study on healthcare professionals, Orthorexia Nervosa was slightly higher in males. However, the fact that the study was aimed at healthcare professionals and there were fewer male healthcare professionals may have affected this result. Although studies related to Orthorexia Nervosa are frequently conducted for different populations of the society, there are few studies on healthcare professionals. In some studies, it has been estimated that health professionals are at higher risk in terms of Orthorexia Nervosa due to their profession or education ²⁵⁻²⁷.

The ratio of Orthorexia Nervosa according to the profession was found to be significantly different in both gender groups. The ratio of Orthorexia Nervosa according to the profession of females who participated in the study was found to be 5.65% for dietitians, 25% for physicians, 35.48% for nurses, 4.03% for physiotherapists, and 29.84% for allied health professionals. For males, these ratios were found to be significantly different from females. It was found that 1.92% were dietitians, 51.92% were physicians, 7.69% were nurses, 5.77% were physiotherapists and 32.69% were allied health professionals.

In previous studies on healthcare professionals in Turkey, Bosi et al. ⁵ a total of 45.5% of the residence medical doctor involved in the research was scored below 40 in the ORTO-15 test. Female medical doctors were more careful than men. Similarly, Sanlier et al. ²⁸ among university students studying in different vocational fields, the number of participants with orthorexia among women was higher than that among men, and ORTO-15 scores were not associated with BMI classification and field of study. In another study ²⁹, the orthorexia Nervosa tendencies of university students who received and did not receive nutrition education were investigated, and the orthorexic tendencies of students who did not receive health education were found to be higher than those who received health education.

When the results of current researchers are examined, it has been seen that the data were usually analyzed by univariate methods. However, multivariate statistical methods consider the variation in all variables as a whole and obtain more precise and more powerful results than univariate statistical methods. In the current study, unlike other publications, the variables that affect Orthorexia Nervosa in Healthcare Professionals were evaluated by Binary Logistic Regression and Hierarchical Cluster Analysis of Multivariate Statistical Methods.

Binary Logistic regression analysis is used to estimate the predicted probability of having Orthorexia Nervosa in Healthcare Professionals. Binary Logistic regression analysis was conducted with reporting of odds ratio to establish the risk for Orthorexia Nervosa in Healthcare Professionals. The results that were obtained from Binary Logistic Regression show that profession (odds: 6.766), BMI (odds: 4.370), eating out (odds: 3.111), monthly-income (odds: 3.077), and chronic disease (odds: 2.596) are risk factors for Orthorexia Nervosa in Healthcare Professionals.

The dendrogram of all variables that were found also includes the questionnaires that were used such as MAUDSLY, EAT 40, and ORTO-15 and discover the clustering tendency of the variables and see how these clusters can converge by using Hierarchical Cluster Analysis

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of Multivariate Statistical Methods. Discovering the clustering of tendency variables and seeing how these clusters can converge provided an opportunity to approach and plan new hypotheses for the researchers and also the readers. The all variables that were included in the study variables created two main clusters. The first cluster includes most variables with three sub-clusters. However, the second cluster includes only two variables; the amount of smoking and alcohol. Smoking and alcohol use for healthcare workers are at a minimum level, they put these two variables in a separate cluster. Mean and median values of smoking and alcohol use are 0.865 packet x year, and zero (median value), 1.273 gr/day, and zero (median value) respectively.

When the clustering tendency of ORTO-15, which tests our hypothesis in the research, is examined; it was clustered with the profession, BMI, eating out, monthly income. It was noteworthy that this outcome is the same variables that were found also as a risk variable by Logistic Regression Method. The questionnaire EAT-40 was found at the same cluster of MAUTSLEY and with its variables. The third sub-cluster identified the specific properties of a worker of health professional such as dinner, supplement, kitchen expense, with whom the individual lives, lunch, sex, age, education, marital status, chronic disease. This clustering tendency of variables makes a new clinical insight to create a new hypothesis on Orthorexia Nervosa predicted in Healthcare Professionals.

As a result, based on the multivariate analysis of Clustering and Binary Logistic Regression results, the variables for Orthorexia Nervosa in Healthcare Professionals were determined. It has also discovered the risk variables by Binary Logistic Regression and the relationships between variables with dendrogram by using hierarchical cluster analysis. New opinions and new comments related to the subject were discovered by using the current multivariate statistical methods. Certainly, finding and preventing risk variables determined for healthcare professionals with powerful methods will increase efficiency in the field of health and provide an even problem-free healthcare system.

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Author contributions

Although B. D., an expert in the field of nutrition and dietetics, and Y.C., an expert in biostatistics in statistical methods and analysis, are dominant; both authors contributed to the design, evaluated the quality of the data, commenting on the results, and present the manuscript and for making reasonable decisions together. All authors approved the manuscript prior to submission.

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