Design and Validation of a Brief Questionnaire for Assessing the Dietary Habits of Adults

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ABSTRACT

Aim: The quick dietary assessment tools are needed as a guidance for counseling the mass population so as to reduce the risk of non-communicable chronic diseases. The study's primary aim is to develop a questionnaire for assessing dietary habits applicable in practice. **Method**: A questionnaire consisting of 17 items, used in similar studies, was applied on the sample of 1027 participants (54% male) ages between 21 and 65. The items were formulated in such a way as to reveal, as clearly as possible, the nutritional habits of the participants regarding meal time, frequency of meals, the consumption of fruits and vegetables, the consumption of fast food, etc. **Results**: After verification of scale reliability and factor validity, 10 items that met all the statistical criteria were retained in the instrument (named EDH-Q). The questionnaire has a high validity and reliability. The two components (two independent scales) have been extracted – Time and Jobs Management factor and Knowledge and Self-Control factor. The dietary habits of participants of different age and sex groups did not differ significantly. **Conclusion**: EDH-Q is a good tool for mass testing of dietary habits. It can be used by doctors, nutritionists and nurses during consultations and promotions of healthy eating habits. The study results show that there is more space for employee education and self-discipline in regards to improving dietary habits than time or jobs management.. ***Hellenic J Nutr Diet 2020, 12(1-2):14-21***

Key words: *Dietary assessment; Nutrition screening; Factor analysis; Public health*

Introduction

Healthy eating is a powerful tool for prevention the development of chronic, non-communicable diseases such as obesity, diabetes, hypertension, cardiovascular disease, and cancer.[1,2] Extensive evidence indicates that healthy eating can be defined as any diet characterized by high intakes of vegetables, fruits, whole grains, legumes, nuts and seeds, and by low or no intake of foods with added sugar, processed meats and sugar-sweetened beverages.[1-3] However, healthy eating is hard to achieve for the majority of the population. The consistent evidence indicates that only a small portion of the population adheres to the recommended dietary guidelines.[4-6] Current dietary trends are strongly affecting the mortality risk for a number of non-communicable diseases, with the rate of 11 million deaths in 2017.[7] If current trends continue, the bad nutrition will be the leading risk factor for premature death.[8,9]

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Valid dietary assessment tools are needed to facilitate dietary counseling for employed adults. Considering the fact that nutrition counseling for these groups of respondents typically occurs in clinical settings and time and resource limitations, dietary assessment tools in this setting should be quick. The previous research has used different instruments to assess dietary habits. Most of them are questionnaires or interviews based on the current and proper nutrition guides.[1,10-13] The common features of these instruments are the lack of standardization and extensive length. The findings obtained through their application require the subsequent description and do not offer the simple numerical information that is understandable on the first reading. The aim of this study is to develop one such easily applicable tool. Through its application, the quality of dietary habits were assessed based on the employees performing sedentary office work in a few public companies.

Methodology

The study was approved by the ethics committee

of the Faculty of Sport and Tourism (protocol number: EN-04/2019). The data (descriptive statistical parameters) used to support the findings of this study are included in the article. The source data (SPSS table with the original measurements) used to support the findings of this study are available from the corresponding author upon request.

Sample

The survey was conducted on 1027 employed adults (53.55% male) from two largest Serbian cities (Belgrade and Novi Sad, typical urban cities in the Balkan area). The participants aged from 21 to 64 were divided into four subgroups: youth, young adults, middle adults and older adults (Table 1). Most respondents are employees in public companies (local government, post office, utility companies) or in banks and the insurance companies. Participants were randomly selected and the only criterion was to answer the survey questions voluntarily and honestly. Everyone was informed of the survey's aim and completed the questionnaire anonymously.

TABLE 1. Structure of the sample

Age (years)	Male	Female	Total
Youth (≤24)	54	57	111
Young Adults (25-39)	337	292	629
Middle Adults (40-59)	143	114	257
Older Adults (≥60)	16	14	30
Total	550	477	1027

Instrument design

For the purpose of this research, a questionnaire was designed to evaluate the Employees Dietary Habits (EDH). The survey-instrument was developed by adapting a few existing surveys that tested nutritional knowledge and dietary behavior.[14-17] The initial questionnaire was designed from scratch and contained 17 items formulated in such a way as to display the nutritional habits of the participants regarding meal time, frequency of meals, consumption of fruits and vegetables, consumption of fast food, etc. (Table 2). The respondents expressed their attitude by selecting the appropriate value on a 5-point Likert-type scale. Scalar value of 1 signified rarely and score of 5 signified often in regards to the manner of behaviour. Cronbach's Alpha was higher than the recommended theoretical value[18] of 0.7 and showed that the initial

TABLE 2. Results of Scale reliability analysis for initial questionnaire of 17 items

no	Statements (Variables)	Cronbach's Alpha if Item Deleted	Mean	SD
V1	I have three meals during the day	0.695	4.12	1.160
V2	I usually buy breakfast at the bakery	0.685	3.52	1.310
V3	I try to keep my diet varied and balanced	0.679	3.49	1.110
V4	I experience trembling during the day because of hunger	0.690	3.96	1.203
V5	I use breaks at work mostly as coffee breaks	0.701	3.22	1.376
V6	I do not have enough time for a regular lunch during the day	0.688	3.35	1.298
V7	I eat fruit regularly	0.684	3.29	1.268
V8	I like to drink Coke, beer, energy drinks...	0.691	3.52	1.330
V9	Fast food "street food" is a good solution for my daily diet	0.680	3.99	1.102
V10	I consider the number of calories consumed during the day	0.714	2.18	1.252
V11	I often do not eat until dinner	0.683	3.95	1.218
V12	Fresh vegetables dominate my daily menu	0.685	2.85	1.167
V13	I balance the meals composition with my physical activity	0.695	2.56	1.239
V14	When I like some food, I eat as much as I can	0.710	3.34	1.240
V15	I only eat once a day and it suits me	0.692	4.08	1.220
V16	I drink 6-8 glasses of water every day	0.689	3.22	1.423
V17	I prepare food as recommended by experts	0.704	2.47	1.260
	Chronbach's Alpha	**0.709**	**3.36**	0.581

instrument had good internal reliability.

Among the 17 statements in the questionnaire, 9 refer to negative dietary habits (items: 2, 4, 5, 6, 8, 9, 11, 14 and 15). Prior to the calculating procedure, it was necessary to conduct an inversion of scalar values for each of these items (the following values were recorded: 1 to 5, 2 to 4, 4 to 2 and 5 to 1). In this way, logically speaking, higher scalar values show better dietary habits, while lower values indicate worse habits.

Statistical analysis

The questionnaire validity was assessed by Factor analysis (model: Principal Components Analysis, PCA), using Direct Oblimin method of rotation and Kaiser Normalization. Two-Way ANOVA[19] was applied in order to test the impact of sex and age on the differences between the Mean values in different subgroups. All the conclusions were realized with the 0.05 level of significance ($p < 0.05$). Portable IBM SPSS v.21 application was used for complete statistical analysis (License Stats Prem: 761b17dcfd1bf20da576 by Hearne software).

Results

The factor analysis of the principal components (PCA) was conducted on the collected data using the initial 17-item questionnaire. The assessment of the data suitability for factorization preceded the explanation of the components. Many coefficient values of 0.3 or higher were recorded by reviewing the correlation matrix. The Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO) was 0.767, which is higher than the recommended minimum theoretical value[20] of 0.6. Bartlett's test of sphericity[21] also indicated the statistical significance of the obtained factor model (Chi-Square=2688.596; p=0.000). This statistics proved good factorability of the correlation matrix.

The principal component analysis, which was obtained after Oblimin rotation, revealed five components with Eiegenvalues over 1. The obtained Scree plot shows that the scree point was right after the third component. Based on Kattel's criterion,[22] it was decided to retain only two components that were above the scree point. This decision was supported by the results of a parallel analysis[23] that used the matrix with 17 variables, 107 subjects and 100 replications,[24] because only the first two characteristic values were lower than the corresponding empirical Eiegenvalues.

The same PCA procedure was repeated for the two-component solution. Among the received commonalities, 2 values (for variables 3 and 16) were less than 0.3, while 5 items (variables 2, 5, 7, 8 and 14) gave the significant factor loadings to both components. All those 7 items were eliminated from the system, and then PCA was repeated with the retained 10 variables. The newly obtained solution was very stable and confirmed the fulfillment of basic statistical assumptions for the application of factor analysis (KMO=0.717; Chi-Square=1341.318; p=0.000). The Scree plot obtained (Figure 1) confirmed that retaining the two components was the correct decision. This two-component solution explained a satisfactory 42.525% of the total variance (the contribution of the first component was 23.684%, and the second 18.841%). All 10 communalities were over 0.3, which met the recommended statistical criterion.[25] Each of the 10 retained variables gave the significant factor loadings only to one of the two principal components (Table 3). All this proves the validity of the two-factor model. A very low inter-factor correlation (R=-0,017) supports this as well.

The pattern matrix (Table 2) clearly shows the 6 variables that saturated the first factor (variables No 1, 4, 6, 9, 11 and 15 in Table 1) and 4 variables that saturated the second factor (variables No 10, 12, 13 and 17). By analyzing the content of the variables that saturated the first factor, it can be noticed that they are predominantly related to the work time management and daily obligations. Thus, the first EDH component was labeled as Time and Jobs Management factor (TJM). The second component is saturated predominantly by the variables related to the knowledge of proper diet

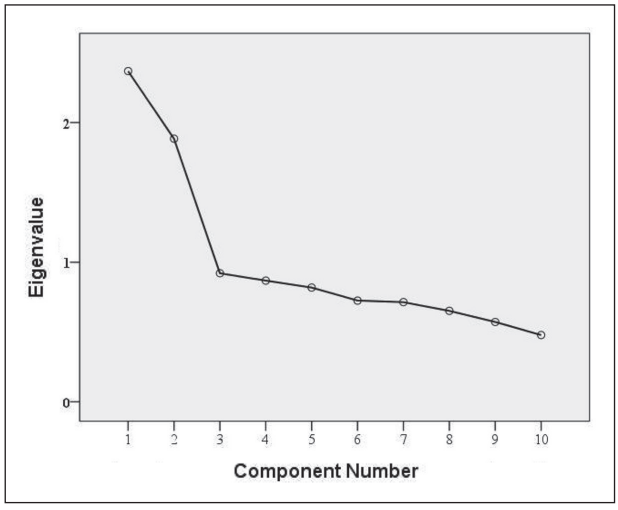

Figure 1. Scree plot for results obtained of finale questionnaire.

TABLE 3. Factorial structure obtained by PCA with Oblimin rotation

	Loading on (Pattern Matrix)		
Statement	**Factor 1**	**Factor 2**	**Communalities**
No 11	0.741	-0.071	0.556
No 15	**0.637**	-0.114	0.421
No 4	**0.584**	-0.050	0.344
No 1	**0.583**	-0.014	0.341
No 9	**0.559**	0.137	0.329
No 6	0.552	0.093	0.312
No 13	0.080	**0.716**	0.518
No 12	0.176	**0.674**	0.481
No 17	-0.056	**0.671**	0.454
No 10	-0.239	**0.660**	0.498

principles and their practical application. Thus, the second component was labeled as Knowledge and Self-Control factor (KSC).

The results of the factor analysis show that the EDH questionnaire consists of 2 separate scales (the first measures TJM and the second KSC factor). The sum of the 4 claims that form the KSC factor can be interpreted directly considering that the higher value indicates that the respondents have better dietary habits. However, the score inversion given by the 6 statements that formed the TJM factor also allows the direct interpretation of the sum. After the scalar scores inversion, the higher sum will logically indicate that the respondents better organize their daily diet and harmonize it with their job. The theoretical maximum value of the TJM is 30 and the KSC maximum is 20. For easier comparative analysis, the factor sums can be converted into percentages. In our case, the TJM mean of the complete sample is 23.45 which is 78.17% of the maximum, and the KSC mean is 10.06 or 50.3% of the maximum (Table 4).

The end result of each factor is the sum of the scalar marks (6 values for the first and 4 for the second factor). The theoretical maximum sum for the first Factor is 30 and 20 for the second. Descriptive parameters (Mean and Std. Deviation) were calculated from scalar values used by the participants to express their opinion. For each subgroup, formed based on the age and sex, as well as for the complete sample, average scores (Mean) were calculated (Table 3). The results of the ANOVA (Table 5) revealed that age and sex individually, as well as interactively, did not significantly influence the

TABLE 4. Descriptives for the factors scores obtained in different subgroups

			Factor 1		Factor 2	
Age group	**Sex**	**N**	**Mean**	**SD**	**Mean**	**SD**
Youth	Male	54	**23.39**	4.306	**9.94**	3.993
	Female	57	**23.33**	4.257	**10.65**	3.404
	Total	111	**23.36**	4.261	**10.31**	3.702
Young Adults	Male	337	**23.85**	4.457	**9.81**	3.202
	Female	292	**23.20**	4.669	**10.19**	3.353
	Total	629	**23.55**	4.564	**9.98**	3.276
Middle Adults	Male	143	**22.92**	4.220	**9.92**	3.413
	Female	114	**23.58**	4.109	**10.37**	3.578
	Total	257	**23.21**	4.176	**10.12**	3.487
Older Adults	Male	16	**23.69**	4.990	**10.56**	2.607
	Female	14	**24.14**	3.570	**9.71**	3.268
	Total	30	**23.90**	4.318	**10.17**	2.914
Complete sample	Male	550	**23.56**	4.404	**9.87**	3.321
	Female	477	**23.33**	4.457	**10.27**	3.406
	Total	1027	**23.45**	4.428	**10.06**	3.365

SD = Standard Deviation

TABLE 5. Results of ANOVA obtained for the data from Table 3

	Factor 1			Factor 2		
Impact	**F**	**p**	**Partial Eta Squared**	**F**	**p**	**Partial Eta Squared**
Age * Sex	1.410	0.238	0.004	0.423	0.736	0.001
Age	0.253	0.856	0.202	0.734	0.597	0.423
Sex	0.038	0.850	0.004	0.288	0.594	0.006

differences between the Means. The low values of the realized level of significance (p) prove that the old and the young, as well as men and women, have similar dietary habits. The coefficient of variation (SD/Mean) was low for both factors (for TJM 0.189 and for KSC 0.334), proving the homogeneity of all participants' scores and increasing the conclusion probability.

Discussion

The simple brief instrument for screening nutritional habits was obtained by surveying numerous employees of different age and social characteristics. Such a large and randomly selected sample is the main strength of this research because it provides a possibility of high generalization of the results. At the same time, such a large number of participants reduced the accuracy of the assessment. In a mass research of this type, the chance of obtaining insincere answers always increases. The potentially high subjectivity of the participants is the main limitation of this study and it is necessary to check the reliability of the instrument in practice.

Good metrics (scale reliability and validity) of the EDH questionnaire were proved by the adequate statistical procedures (Cronbach's alpha and explorative factor analysis). Compared to the instruments used in the previous studies,[26-28] the EDH questionnaire is much more simple to use and to interpret the results, and it is primarily intended for mass use and quick screening. The nutritionists and nurses can use it during consultation and for promotion of healthy eating habits.

The data regarding the structure of the extracted components were significant for the final explanation of the questionnaire's validity. The first factor (TJM) is predominantly related to the management of work time and daily obligations, and the second (KSC) to the knowledge of proper diet principles. The results of the factor analysis show that the EDH questionnaire consists of 2 separate scales (the first measures the TJM and the second the KSC factor). The sum of the 4 claims that form the KSC factor can be interpreted directly because a higher value indicates that the respondents have better dietary habits. However, the inversion of the scores given by the 6 statements that formed the TJM factor also allows their sum to be interpreted directly. After the scalar scores inversion, the higher sum will logically indicate that the respondents better organize their daily diet and adjust it with their job. The theoretical maximum value of the TJM is 30 and the KSC maximum is 20. For easier comparative analysis, the factor sums can be converted into percentages. In our case, the TJM mean of the complete sample is 23.45, which makes 78.17% of the maximum, while KSC mean is 10.06 or 50.3% of the maximum. Based on these data, it can be concluded that there is more space for the education of the employees and self-discipline regarding the improvement of dietary habits than time and job management.

The total scores of both factors have the same logic of interpretation which allows them to be summed up. Practically, summing up two subscales can provide a unique scalar rating of the quality of dietary habits (TJM total score + KSC total score = EDH total). The theoretical maximum of EDH total is 50, which allows for easy interpretation. In our case, EDH total is 33.51 and shows good habits emerging (mark 3). The dietary habit ratings have been suggested for practical application in the Appendix. At the same time, these two scales can be used separately and provide an insight into the source of poor nutritional habits. Sometimes these are exclusively problems at work (a lot of obligations, lack of time, lack of a long-term plan of activities, etc.). Sometimes the main cause of low marks is ignorance of the healthy eating principles (poor education) or bad life habits. Sometimes the employee knows the principles of healthy eating well, but the conditions at work do not allow him to apply them. Therefore, future users are recommended to use two independent scales (TJM and KSC) separately in practice.

The previous studies[29-31] show that only 9% of adults meet the dietary recommendations for vegetable intake and only 12% meet the recommendations for

fruit.[30] The most frequently consumed vegetable is fried potatoes, which makes >40%.[31] This information is confirmed by the findings of our study. The average scalar value is 2.85 and shows that employees do not use fresh fruit sufficiently during work days.

There is some literature to suggest that meals eaten at home are more healthy than those eaten away from home (e.g. less processed foods and more fresh vegetables).[32] During the last few years, approximately 53.2% of US adults consumed sandwiches and fast food on any given day.[33] Among these consumers, nearly a quarter of total daily calorie intake and about a third of total fat, saturated fat, cholesterol, and sodium intake came from sandwich consumption. Male, young and middle-aged adults, sedentary office-employees, and overweight (obese) adults were more likely to consume fast food.[33] The data in our study are consistent with these findings. The item which records data regarding fast food consumption resulted in high loading for Time and Jobs Management factor.

A frequently mentioned barrier to preparing healthy and nutrient dense meals is lack of time. Work, leisure time, commuting and watching television can all conflict with engaging in activities associated with a healthy diet.[34] Kalenkosi and Hamrick[35] have termed the phrase *time poverty* to refer to lack of discretionary time. The discretionary time is defined as the total daily minutes minus time spent on personal care, market work, household work, child care and adult care. Previous reports have indicated that 20% of respondents were categorized as *time poor*. Those who report feeling rushed were more likely to be women, single parents, and they experience work-family conflicts. In our study, age and sex did not significantly influence the self-assessment of dietary habits.

Authorship Declaration

Authors independently conducted study design, data collection and manuscript preparation. Authors declare that the content has not been published elsewhere.

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Conflicts of Interest

The authors declare that there is no conflict of interest with any financial organization regarding the material discussed in the manuscript.

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Appendix

EDH Questionnaire

This is an instrument used to evaluate certain aspects of your daily diet. It is necessary to carefully read each statement and express your opinion by circling the suitable number on the scale from 1 to 5. A score 1 means that it rarely happens, and score 5 signifies that something happens often. It is not necessary to think for a long time. It is important to work quickly and be honest, as there are no right or wrong answers.

No	Statement	Rarely → → → → →				Often
1.	I usually do not eat until dinner during the work days	1	2	3	4	5
2.	I balance the meals composition with my physical activity	1	2	3	4	5
3.	I only eat once a day and it suits me	1	2	3	4	5
4.	Fresh vegetables dominate my daily menu	1	2	3	4	5
5.	I experience trembling during the day because of hunger	1	2	3	4	5
6.	I prepare food as recommended by experts	1	2	3	4	5
7.	I have three meals during the day	1	2	3	4	5
8.	I consider the number of calories consumed during the day	1	2	3	4	5
9.	Fast food/street food is a good solution for my daily diet	1	2	3	4	5
10.	I do not have enough time for a regular lunch during the day	1	2	3	4	5

Scoring Instructions

Time and Jobs Management factor (TJM): Add the scores on items 1, 3, 5, 7, 9 and 10. Prior to the procedure of calculating it is necessary to conduct an inversion of scalar values for each item, except item No. 7 (recode following values: 1 to 5, 2 to 4, 4 to 2 and 5 to 1). Final TJM result is Sum of scores of 6 items. Maximum TJM is 30 and Minimum is 6.

Knowledge and Self-Control factor (KSC): Add the scores on items 2, 4, 6 and 8. Final KSC result is Sum of scores of 4 items. Maximum KSC is 20 and Minimum is 4.

EDH total result is Sum of TJM and KSC. Maximum EDH is 50 and Minimum is 10.

An author's suggestion of dietary habits ratings

Very Bad Habits (mark 1): EDH <20
Bad Habits (mark 2): EDH = 21 to 30
Good Habits Emerging (mark 3): EDH = 31 to 40
Good Habits (mark 4): EDH = 41 to 45
Very Good Habits (mark 5): EDH over 45.