

## Bulgarian Adaptation of the Long Form of the Eating Attitudes Test for Adolescents Aged 14-18

Liubomir Djalev<sup>1</sup> & Ivan Yordanov<sup>2</sup>

### Abstract

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The study aimed to make an adaptation of the long form of the Eating attitudes test for the Bulgarian population of adolescents between 14 and 18 years of age. This includes examination of the scale structure of the adaptation, the reliability of the scales and their predictive potential to identify individuals with eating disorders. The participants were 441 secondary school students from 8th to 12th grade. The factor structure of the data was examined using hierarchical factor analysis, reliability was investigated by analysing the internal consistency of the items and the threshold values were selected by ROC curve analysis. A hierarchical three-factor model of the data was accepted. In the reliability study, the scales and the overall test showed good internal consistency, with alpha coefficients 0.83, 0.79, 0.72 and 0.86 respectively. With the exception of the third scale, they proved to be good predictors, which, through the selected threshold values, showed satisfactory diagnostic accuracy. The Bulgarian version of the EAT-40 is a reliable tool for assessing the relevant symptoms and psycho physiological features of adolescents with eating disorders. It can also be successfully used to discriminate diseased from normal cases in non-clinical samples.

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**Key words:** eating disorders, EAT-40, hierarchical factor analysis, reliability, ROC curve analysis, screening of eating attitudes

### 1. Introduction

What attitudes are is a complex question with many possible answers in the field of social knowledge and empirical research. Nevertheless, after prominent works of Allport, most psychologists consider attitudes within the tradition set by him. Hogg & Vaughan (2005, p. 150) suggest a unifying perspective according to which an attitude is “a relatively enduring organization of beliefs, feelings, and behavioral tendencies towards socially significant objects, groups, events or symbols”. Thus, the eating attitudes are such relatively enduring organizations and behavioural tendencies towards food and its use. These attitudes influence people's food choices, nutritional behaviours and even health status, especially among young people. During adolescence, the physical appearance is of great importance in self-esteem and self-respect of young people. Many students of this age may have obsessive thoughts about their weight and make considerable efforts to shape a body with ideal proportions. Among the leading socio-cultural factors that form, reinforce or modify attitudes to a thin and physically properly shaped body are the fashion industry and even the mass media. Achieving this ideal is almost always associated with the adolescent eating behaviour and dieting (Tomori & Rus-Makovec, 2000). In the early 70's of the last century, many fundamental psychological and behavioural characteristics of anorexia nervosa as one of the typical representatives of eating disorders become clear, but still there wasn't precise and accurate method to diagnose the disorder. In 1973 Sladecreateda 22-item instrument for measuring anorexic behaviour, which addressed three dimensions of the disorder – “Resistance to eating”, “Methods of disposing of food”, and “Overactivity”.

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<sup>1</sup> Department of Cognitive Science and Psychology, New Bulgarian University, Bulgaria, Sofia 1618, r. d. “Ovcha kupel”, 21 “Montevideo” Str., office 403, E-mail: [ldjalev@nbu.bg](mailto:ldjalev@nbu.bg), Phone: +359(0889)393 256

<sup>2</sup> Department of General, Experimental and Genetic Psychology, Faculty of Philosophy, Sofia University “St. Kliment Ohridski”, Bulgaria, Sofia 1000, 15 “Tsar Osvoboditel” Blvd., Southern wing, floor 3, office 60, E-mail: [yordanov.ivan.yordanov@abv.bg](mailto:yordanov.ivan.yordanov@abv.bg), Phone: +359(0988)764 530

This measure was designed for specialists working in clinical conditions and for diagnosing by observation. The results of 12 patients with anorexia (experimental group) and another 12 with psychotic disorders (control group) were reported. The author found a significant between-group difference in measured behaviours. Despite the convenience of Slade's scale for clinical assessment of patients, it had some limitations (Slade, 1973; Garner & Garfinkel, 1979). During this period, some important new specifics of eating disorders have been objectively identified and described, such as imbalance between body image and intra-body sensations. Other idiosyncratic attitudes and behaviours, related to eating, are often observed. Many nutritionists and researchers also report frequent psychological symptoms such as sleep disturbances and amenorrhea which may accompany anorexia nervosa (Garner & Garfinkel, 1979).

## **2. Research methodology**

### **2.1. Purpose of the study**

The aim of this study was to make an adaptation of the long form of Eating attitudes test (EAT-40), developed by Garner & Garfinkel (1979), to the Bulgarian socio-cultural context. This adaptation of the measure is intended for the population of adolescents aged 14-18 years. The Eating attitudes test is the most commonly used instrument for assessing eating disorders that include obesity, bulimia nervosa, anorexia nervosa and other disorders characterized by experiencing strong emotions with specific attitudes and behaviours related to weight and nutrition. More commonly used is the short form of the test (EAT-26), which also has high psychometric qualities (Garner et al., 1982). The results of the test should not be used as a basis for diagnosing eating disorders, but could serve as a first step in individual or group screening of eating attitudes. Despite the extensive use of the test for research purposes and in clinical practice not only by foreign but also Bulgarian authors (see Boyadzhieva and Ganchev, 1993), this instrument is still not adapted for use in this country.

### **2.2. The long form of Eating attitudes test (EAT-40)**

Developing this test, the authors aimed to create a reliable instrument, which will be used to assess a wide spectrum of behaviours and attitudes connected to anorexia and bulimia. The test should be easy, fast to administer and to process the results, and to have a predictive ability (Garner & Garfinkel, 1979). The development of the test went through several phases, the first of which was designed to select quality items to form the initial version of the test. After an extensive review of the relevant clinical literature, the authors created a version with 35 items, which cover the anorexic behaviours and attitudes described in the literature. The initial version of the test was administered to two independent samples: women who met the criteria for diagnosis "anorexia nervosa" (experimental group), and a control group of women without anorexia. After an item analysis, the authors identified 23 items which showed good concurrent validity – the test results were a good predictor of the clinical diagnosis. During the second phase of the test development designed to evaluate its prognostic validity a small part of poor items was removed and replaced with new ones; other items were reformulated and, along with the good items, a second version of the EAT was formed, now including 40 items. The authors conducted a second pilot study with two new samples, independent of those of the first one. The second version was also a good predictor of the participants' membership of the experimental or the control group. The authors determined a score of 30 as a threshold value to discriminate between the two groups. This border value corresponds to 13% of the participants in the control group, who, according to the test results, may have an eating disorder (false positive). The authors revealed the scale structure of the test by factor analysis, the results of which showed the presence of 7 factors: (1) Food preoccupation, (2) Body image for thinness, (3) Vomiting and laxative abuse, (4) Dieting, (5) Slow eating, (6) Clandestine eating and (7) Perceived social pressure to gain weight. Despite the small number of participants in the sample, far from the optimal for factor analysis (Nunnally, 1978), the results can be seen as supportive of the assumption that the test measures several groups of symptoms, i. e. in support of its content validity. The researchers studied the reliability of the test as a whole, not the separate scales. For the group of participants with anorexia nervosa, the Cronbach's  $\alpha$  was 0.79, and for both groups it was 0.94. Despite the relatively small number of items, the test is characterized by high internal consistency. In order to clarify the discriminative validity of the test, the authors correlated the control group's results with a few other instruments. Among them was the Restraint scale, developed by Herman & Polivy (1975, as cited in Garner & Garfinkel, 1979), which measures the individuals' degree of commitment to dietary eating. Pearson's coefficient of correlation was low ( $r = 0.28$ ,  $p > 0.05$ ), which indicates weak and statistically non-significant relation between the two variables. Test results also showed non-significant correlation with extraversion ( $n = 26$ ,  $r = 0.30$ ,  $p > 0.10$ ) and neuroticism ( $n = 26$ ,  $r = 0.10$ ,  $p > 0.10$ ) of the Eysenck's personality questionnaire.

These results indicate that the EAT measures specific symptoms found more often in patient's population with anorexia nervosa than in other populations. Overall, the results of the analyses suggest that EAT-40 is an objective and valid tool for measuring the symptoms frequently observed in patients with anorexia nervosa. Cross-validating procedures with two independent samples (patients with anorexia nervosa and control group), as well as correlation with other instruments, show that it measures behaviours and attitudes typical of the population with anorexia nervosa.

### 2.3. Bulgarian translation of the EAT-40

The translation and adaptation of the test was done with the agreement of D. Garner, one of the authors of the test. The translation of the items and other elements of the test from English into Bulgarian was made by two independent translators – psychologists. Then the two translations were compared and, in case of differences, the decisions for the items' wording were taken by agreement between the translators. Prior to the adoption of the final version of the Bulgarian translation, a specialist in English language and professional translator from English was also consulted.

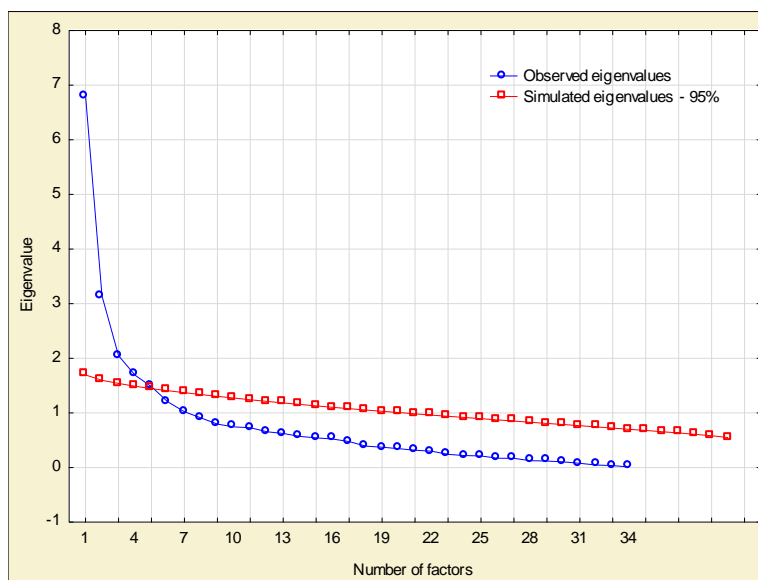
### 2.4. Participants

At the pilot testing stage, 441 participants were included in the normative sample. All of them were students from the 8<sup>th</sup> to 12<sup>th</sup> grade in 11 high schools, located in 4 towns in Bulgaria, including the capital city. The sample was well balanced by gender – the boys were 235 (53.29%), and the girls - 206 (46.71%). The age of the participants varied between 14 and 18 years, with a mean age of  $M = 15.97$  years ( $SD = 1.38$ ). There was some imbalance in the size of the age subgroups, with relatively fewer students being at the age of 15 (63 participants, 14.29%) and at the age of 18 (71, 16.10%). In each of the other three age groups (14, 16 и 17 years old), the students were between 22.22% и 24.04% of all the participants. A number of anthropometric data were also collected from the participants, i. e. the height (cm), the actual weight at the time of the study (kg), the highest weight in the last 6 months, the lowest weight in the last 6 months, the "ideal" weight that each participant would like to have. The body mass index (BMI) of each participant has also been calculated. Ethical approval for the study, after its detailed presentation, was obtained by the council of the Department of Psychology at Sofia University. Since it was conducted in various schools, the written permissions of the school principals and the school psychologists were also obtained. Because the participants are minors, informed written consent from the parents of the students, intended to participate in the study, was requested. Only those students, whose parents had given such consent were included in the study. It conforms to the provisions of the Declaration of Helsinki.

## 3. Results

### 3.1. Analysis of the scale structure of the test

Exploratory factor analysis was used to build the psychometric model of the test, in particular principal factors method. As a method of factorization, the principal axes method was applied, which was considered particularly suitable for developing psychological instruments (Kubinger, 2003). The initial application of the method led to the extraction of a large number of factors – the unrotated solution contained 34 factors, which cumulatively account for 68.04% of the total variance of the items. The extracted factors, understandably, had no equivalent explanatory power. The first 7 of them had eigenvalues greater than 1.00. The unrotated factor structure was characterized by a relatively strong first factor with eigenvalue of 6.81, which explains 17.03% of the total dispersion, followed by two factors with relatively less explanatory power, whose eigenvalues were respectively 3.14 (7.85%) and 2.05 (5.12%). Factors after the seventh had eigenvalues below 1.00, decreasing to 0.01 (0.02%) at the last factor. As a method for determining the optimal number of factors, a combined approach, including the Cattell's scree test (Cattell, 1966) and the Horn's method of parallel analysis (Horn, 1965) was applied. The commonly used Kaiser's rule is not applicable to this method of factor analysis; on the other hand, the Horn's method is considered by many researchers to be the best empirical method for determining the number of factors, which should be retained in the factor model (Hayton et al., 2004). The parallel analysis was performed using a macro, developed by O'Connor for the SPSS statistical package (O'Connor, 2000). To obtain the simulated eigenvalues by the Horn's method, 1000 random datasets with the same numbers of observations and variables as the real data were generated, and the 95<sup>th</sup> percentile of the distribution of the simulated eigenvalues of each factor was chosen as the acceptability threshold of the respective factor. The results of the application of the combined approach are presented in Figure 1.



**Figure 1. Observed and 95<sup>th</sup> percentile cutoff eigenvalues of the unrotated factors**

The two lines in the plot represent the two series of eigenvalues. The downward-sloping curve (in blue), which is “scree”-shaped represents the observed eigenvalues, obtained from the real data, and the more horizontal and almost flat one (in red) – the 95<sup>th</sup> percentiles of the distributions of the simulated eigenvalues. Cattell recommends that in the factor model should be retained as many factors as the number of observed eigenvalues to the left of the breaking point of the curve, where the decrease of eigenvalues appears to level off to the right of the plot. In Figure 1, the slope of the curve changes rather smoothly, without a clear “elbow”, although the graph shows that the change occurs in the zone between the third and sixth factor. Because of that feature, the Cattell’s test does not provide sufficiently reliable arguments to select an adequate data model. Horn’s numerical test suggests that in the model should be retained those factors whose observed eigenvalues exceed their respective simulated eigenvalues selected for thresholds, and only the first four factors meet fulfill this condition. In Figure 1, the two lines intersect just above the fifth factor. Therefore, the most appropriate number of factors to be retained in the model is four. Further analysis of the four-factor model revealed its substantial disadvantage – the weak explanatory power of the last fourth factor. It includes only 4 items, which have diverse meanings and represent different aspects of the dietary attitudes. Due to the lack of common semantic basis of the items, this factor’s interpretation is difficult, and the scale’s reliability is too low – Cronbach’s  $\alpha$  coefficient is 0.37. These peculiarities of the fourth factor conform to its marginal role in the latent structure. Returning to the Figure 1, the actual eigenvalue of this factor slightly exceeds the 95<sup>th</sup> percentile cutoff criterion, bringing it closer to the next factors, which function at a random level. That is why we rejected the four-factor model and turned to a three-factor one, whose factors have good, meaningful interpretation. The unrotated three-factor solution, similar to the initial one, was characterized by a relatively strong first factor and subsequent two weaker factors. Their eigenvalues (6.44, 2.79 and 1.69) and explanatory power (16.11%, 6.96% and 4.23%) were slightly lower compared to the factors in the first model, although the ratio between them remains almost unchanged. As a whole, the factors in this model accounted for a relatively small proportion of the total variance (27.29%).

One important issue, after defining the optimal factor structure, refers to the type of rotation of factors in the factor space to achieve a simple factor structure (Thurstone, 1935), which can be described as a final goal of the factor analysis. First, the assumption that the factors are oblique and correlated was verified. The analysis was performed by the statistical technique of the hierarchical factor analysis by which a structure with three primary factors and one second order factor was derived. The results of the analysis showed that derived primary factors were actually oblique despite that the correlations between them have different strengths. The moderate correlation between the first and the second factor ( $r = 0.62$ ) is noticeable, in contrast to the weak correlations between these factors and the third one ( $r = 0.11$  and  $r = 0.22$  respectively). Although there were correlations between the factors, we assumed that they are not high enough for factors to be aggregated into larger units, even the first two, and that the factors should be treated as separate ones. The factor eigenvalues, as well as the ratios between variability that they accounted for, were slightly changed - 11.22% of the first factor, 9.97% of the second and 6.10% of the third factor. The resulting factor

matrix is presented in Table 1.

**Table1. Factor loadings**

Item	Factor 1	Factor 2	Factor 3
10	<b>0.698</b>	0.099	0.038
37	<b>0.643</b>	0.223	-0.234
29	<b>0.607</b>	-0.000	-0.070
30	<b>0.568</b>	0.160	0.004
16	<b>0.547</b>	0.254	-0.109
38	<b>0.457</b>	0.317	0.112
9	<b>0.446</b>	-0.057	0.132
5	<b>0.441</b>	0.263	0.187
36	<b>0.413</b>	0.282	-0.096
40	<b>0.379</b>	0.284	0.163
22	<b>0.364</b>	0.362	-0.034
8	<b>0.347</b>	0.060	0.120
13	<b>0.325</b>	0.305	0.245
2	<b>0.325</b>	0.041	0.192
32	<b>0.310</b>	-0.025	-0.101
20	<b>0.211</b>	0.034	-0.059
1	<b>0.144</b>	-0.076	0.004
19	<b>-0.363</b>	-0.010	-0.009
34	-0.008	<b>0.648</b>	0.306
25	0.361	<b>0.643</b>	-0.168
7	-0.017	<b>0.575</b>	0.125
31	0.034	<b>0.548</b>	0.397
14	0.397	<b>0.546</b>	-0.150
6	0.015	<b>0.524</b>	0.256
15	0.465	<b>0.523</b>	-0.312
4	0.345	<b>0.452</b>	0.005
11	0.237	<b>0.442</b>	0.077
17	0.223	<b>0.399</b>	-0.007
3	0.088	<b>0.332</b>	0.227
28	-0.021	<b>0.261</b>	-0.038
39	-0.064	<b>0.174</b>	0.003
23	0.067	<b>0.099</b>	0.065
12	0.020	-0.034	<b>0.682</b>
24	-0.106	-0.051	<b>0.681</b>
33	0.071	0.254	<b>0.497</b>
18	-0.167	0.119	<b>0.354</b>
26	0.299	-0.074	<b>0.352</b>
27	-0.181	0.163	<b>0.299</b>
21	0.027	0.180	<b>0.207</b>
35	0.091	-0.183	<b>-0.200</b>

Note: Marked factor loadings are the highest of a given item on a given factor. The items are sorted in descending order by their factor loadings on the main factor.

The factor matrix contains a number of items which have contrast loadings on factors, with high values on one of the factors, and low values on the other two, which makes it possible to almost certainly determine to which factor they should be assigned. Examples of such items are 10, 12, 19, 24, 29, 30 and others.

On the other hand, there are items that have low factor loading on all factors or relatively high, similar loadings on two or three factors. Examples in this regard are item 23 with loadings on all factors below 0.10 or item 1, whose highest loading (on factor 1) is 0.14. An item with nearly equal loadings is 13, which has factor loadings on factors 1 and 2 respectively 0.33 and 0.31. It is not a coincidence that the factors on which some items have similar loadings are mainly the first and the second, between which, as noted, there is a moderate correlation. Generally, the factor matrix, although it does not represent a simple factor structure, is a sound base for determining the scale structure of the test. Initially we assigned items to the factors on the basis of their highest factor loading on the corresponding factor, according to the data, presented in Table 1. These factors, according to the proportions of the total variance they explain, form scales with uneven number of items. Factor 1 includes 18 items with numbers 1, 2, 5, 8, 9, 10, 13, 16, 19, 20, 22, 29, 30, 32, 36, 37, 38 and 40; factor 2 includes 14 items with numbers 3, 4, 6, 7, 11, 14, 15, 17, 23, 25, 28, 31, 34 and 39, and to factor 3 were assigned the remaining 8 items with numbers 12, 18, 21, 24, 26, 27, 33 and 35.

Almost all items assigned to a given factor have positive, acceptable loadings on that factor while among the rest of the items predominate those with negative loadings or those with positive, but low value. A small number of items have factor loadings on the main factor lower than 0.30, which is considered by some researcher as a lower boundary of acceptability (Riekert & Eakin, 2008). For the first factor, this is item 20 with factor loading 0.21, for the second – items 28 (0.26) and 39 (0.17), and for the third - items 21 (0.21) and 35 (-0.20). This initial assignment of the items is broadly similar to the scale structure of the short form of the questionnaire (EAT-26). The first factor includes a group of items which manifest different behaviours and attitudes connected with anorexia nervosa, such as careful selection of food and dieting. Most of the items in factor 2 are related to strong appetite, over-commitment to eating issues and, at the same time, attitudes and behaviours for decreasing body mass, and those in factor 3 are related to nutrition control. In addition, observed features of a part of the items in Table 1 as low loadings on the main factor or similar loadings on more factors, give us a reason to assume that this initial scale structure of the long form of the EAT would undergo certain changes when the psychometric properties of the items and scales are examined.

### 3.2. Analysis of the test results reliability

Since the validity of the questionnaire has been investigated and confirmed by the authors as well as in many other studies (see Garner & Garfinkel, 1979; Doninger et al., 2005; Pereira et al., 2008), we focused on achieving the highest possible level of reliability of the test results, using all of the available items in the original questionnaire. The reliability was examined by analysis of the internal consistency of the items at test and scale level. The initial assignment of the items in the three scales derived by the factor analysis was used as the basis of this procedure. In the reliability study, all items including those with low factor loadings on the main factor or with comparable loadings on two or more factors were covered. The reliability of the scores at scale and test level is represented in Table 2 below.

**Table 2. Scale and test statistics of the initial configuration**

Scales	Statistics		
	Number of items	Average inter-item corr.	Cronbach's $\alpha$
Scale 1	18	0.17	0.76
Scale 2	14	0.21	0.79
Scale 3	8	0.15	0.59
Overall test	40	0.11	0.83

The reliability measures of the first two scales, as well as of the test as a whole, can be regarded as very good, since the values of the Cronbach's coefficient are higher than the accepted in psychometrics threshold level of 0.70 recommended by Nunnally (1978). However, the level of reliability of the third scale, as well as the mean correlations between the items at scale and test level are unacceptable. Briggs & Cheek (1986) specified the optimal boundaries of variation of the latter statistic of 0.20 - 0.40, and in this study only the correlation between items in scale 2 ( $r = 0.21$ ) was within this interval. The relatively low correlations between the items in the first two scales, as well as in the test, are "compensated" by the larger number of the items in them, and thus they can reach acceptable levels of reliability. Conversely, the low reliability of scale 3 is due to the unfavorable combination of the lower mean correlation and the fewer items in it. Taking into consideration the given number of items in the questionnaire, the possible way to improve measurement qualities is by increasing the correlations between the items. In the further analyses two formal psychometric properties of the items were examined at scale and test level – item-total correlation (discriminative index) and their contribution to the reliability, and an informal criterion - the semantic homogeneity of the items in

the separate scales.

On the basis of these properties, the initially structured scales have undergone some modifications: (1) the items with high negative item-total correlation were reversed; (2) the items with low negative or positive correlations, leading to a decrease in the reliability of the respective scale, were removed from it; (3) the items with a negligibly low or negative contribution to the reliability of a given scale, which are semantically homogeneous with the items in another scale and increase its reliability, were moved to it. Although the changes affected relatively small number of items, more consistent, meaningful and reliable scales were designed.

After the improvements we made, the length of the first scale was reduced by 2 items, so the final version contains 16 items. Among them, high loadings on the respective factor and also high item-total correlations have items 10 “Particularly avoid food with a high carbohydrate content (i.e. bread, rice, potatoes, etc.)”, 37 “Engage in dieting behavior”, 29 “Avoid foods with sugar in them”, 30 “Eat diet foods”, etc. The items in this scale are psychometrically and semantically consistent – Cronbach’s coefficient  $\alpha$  has a satisfactory value of 0.83 (average inter-item  $r = 0.25$ ), which is higher than the initial one. Based on these signs, the first scale could be interpreted as “Dieting”. The composition of the second scale was also changed, so its final version contains 13 items. Strong item-total correlations have items 34 “Give too much time and thought to food”, 25 “Am preoccupied with the thought of having fat on my body”, 7 “Have gone on eating binges where I feel that I may not be able to stop”, 31 “Feel that food controls my life” etc. In spite of reduced size of the scale, it keeps its reliability level due to the increased item consistency ( $\alpha = 0.79$ , average inter-item  $r = 0.24$ ). The content of the items gives the reason for this scale to be defined as “Bulimia and food preoccupation”. The third scale was also subject to changes and its final composition contains 6 items. Among them the items of considerable importance are 12 “Feel that others would prefer if I ate more”, 24 “Other people think that I am too thin”, 33 “Feel that others pressure me to eat”, etc. The reliability of this scale is increased to  $\alpha = 0.72$  (average inter-item  $r = 0.22$ ). The common semantic core of the items in this scale is to bring the nutrition issues out of the personal sphere, to look in the eyes of others about the way they perceive one’s own eating habits and their attitude to pressure to change these habits. The meaning of this scale could be described as “Perceived social pressure on dietary behaviour”. The total scale, after deleting five items (1, 20, 21, 23 and 39), also increased its reliability ( $\alpha = 0.86$ ), due to the increased average correlation between the items retained in the test ( $r = 0.16$ ). After the improvements we made, the final version of the Bulgarian adaptation of the long version of the Eating attitudes test consists of 35 items assigned to three scales. Some of its main features are presented in Table 3.

**Table 3. Scale and test statistics of the final configuration**

Scales	Number of items	Items	Average inter-item corr.	Cronbach’s $\alpha$
1. “Dieting”	16	2, 4, 5, 8, 9, 10, 16, 17, 19R, 22, 29, 30, 32, 36, 37, 38	0.25	0.83
2. “Bulimia and food preoccupation”	13	3, 6, 7, 11, 13, 14, 15, 25, 28, 31, 34, 35, 40	0.24	0.79
3. “Perceived social pressure on dietary behaviour”	6	12, 18, 24, 26, 27, 33	0.22	0.72
Overall test	35	All	0.16	0.86

### 3.3. Determination of threshold values

For the application of the test in clinical practice it is useful to set thresholds to quickly and effectively predict problematic cases regarding their eating behaviour. For the determination of the threshold values, a sub-sample of participants, for whose health and nutritional status there were unambiguous data in their health records, was derived from the main sample. On the basis of this indicator, the students were divided into two diagnostic groups: (1) students without nutritional disturbances or whose eating habits did not show an eating disorder (category “participants undiagnosed with eating disorders”) at the time of the study; (2) students who were treated at the time of the study in hospital or out-of-hospital conditions. All participants in the second group were diagnosed with codes F.50 - F.55 (Eating disorders) of the ICD-10 classifier produced by the World Health Organization (category “participants diagnosed with eating disorders”). The total size of the sub-sample was 92 participants, of which the number of undiagnosed students was 68 (73.91%) and of the diagnosed - 24 (26.09%). Of these, 66 (71.74%) were girls and 26 (28.26%) boys, with mean age  $M = 16.40$  years ( $SD = 1.09$ ). For the determination of the threshold values, the Receiver Operating Characteristic (ROC) curve analysis was applied.

The purpose of this analysis is to determine a criterion (threshold) value of the scale of the test variable against which a particular status of the individuals to be predicted - those with a score above the threshold to fall into one group, and those with lower score - in another. One of the uses of this method is in medicine, where it is necessary to make specific decisions based on certain classifiers. It is also used in clinical epidemiology to determine the accuracy of different diagnostic tests - for example, determining a given state of the individual- ill or healthy, infected or clean, etc. (Fawcett, 2006). The Bulgarian version test scores were used as test variables for predicting the categorization of the participants. The method allows the simultaneous testing of multiple predictive models, i. e. a different number of variables, so in this study the predictability of four models have been subjected to verification, in which the three scales were used as test variables as well as the overall test results. The state variable, that contains the categories into which individuals actually fall at the time of measurement of the test variables was the health status of the participants. The positive category in which high-scorers on any test variable were expected to fall into was “participants diagnosed with eating disorders”.

**Table 4. Results of the ROC curve analysis**

Test variable	Area under the curve	Std. error	Asymptotic significance <sup>a</sup>	Asymptotic 95% confidence interval	
				Lower bound	Upper bound
Scale 1	0.81	0.05	.00	0.71	0.91
Scale 2	0.79	0.06	.00	0.68	0.90
Scale 3	0.57	0.07	.33	0.44	0.70
Overall test	0.83	0.05	.00	0.73	0.93

Note: a. Under the nonparametric assumption. b. Null hypothesis: true area = 0.50

The accuracy of the prediction that can be made through the test variables is related to the area under the corresponding ROC curve. Among the separate scales, scale 1 was characterized with the largest area, and scale 3 with the smallest area. The largest area among the four tested models was that under the curve of the overall test score. The estimates of the areas under three of the curves, representing the tested models, were statistically significant at  $\alpha = 0.05$ , with relatively small standard errors ranging from 0.05 to 0.07, and narrow confidence intervals, the upper limits of which are impressively high. Only the estimate of the area under the scale 3 curve was statistically non-significant and therefore the corresponding score should not be used as a test variable. When selecting different cut-off points, the ratio between the fractions of correct and the incorrect decisions is changed. In general, selecting a higher criterion value reduces the false positive, but also reduces the true positive rate. Obviously, the selection of a threshold point should be a result of a certain compromise in seeking an optimal balance between the two types of decision strategies – to maximise the true positive or to minimise the false positive rate. We applied the method according to which the point of the ROC curve, closest to the point with coordinates (0, 1), i. e. to the upper left corner of the corresponding plot, is determined as the threshold value. The criterion values for the test variables selected in this procedure were as follows. For the first scale “Dieting”, a cut-off score of 42.50 was determined (sensitivity = 0.83 and 1 – specificity = 0.32). For the second scale „Bulimia and food preoccupation”, a threshold value of 32.50 points was set (sensitivity = 0.63, 1 – specificity = 0.12). Finally, for the overall test, a cut-off score of 102 was selected (sensitivity = 0.75, 1 – specificity = 0.16).

#### 4. Discussion

The main goal we set in this study was to adapt the long form of the Eating attitudes test (EAT-40) to the Bulgarian socio-cultural environment among the adolescents in high school aged 14-18. Our intention was to achieve the highest possible measurement quality of this version of the test using all available resources of items in the original EAT-40. These tasks involved determination of the scale structure of the Bulgarian version, the scales’ reliability, and the threshold values. The exploratory factor analysis, applied as a technique for revealing the scale structure of the test, as well as the subsequent methods for determining the optimal measurement model, showed few possible solutions with 4 or few factors. Two models were analysed – four- and three-factor ones, of which the three-factor solution was preferred due to the better interpretation of the factors in it. The first scale in the Bulgarian version, which we interpreted as “Dieting”, reflects a way of eating related to dietary food consumption, avoiding foods with high sugar and carbohydrate levels; with self-control of eating, which implies the knowledge of the calorie content of the consumed food, with the strong will to achieve and maintain a low weight, including through different types of physical activity. The second scale “Bulimia and food preoccupation” reflects the focusing on the food and nutrition as well as increased appetite, but also compensatory actions to avoid gaining weight, such as vomiting and taking laxatives, as



well as the feeling of guilt and discomfort after eating.

The third scale "Perceived social pressure on dietary behaviour" is related to bringing the nutrition issues out of the personal sphere and linking them to others' opinions about one's eating habits and preferences. This scale implicitly contains the disturbing question "What do the others think about my weight and figure, about my physical appearance?" Its meaning is also determined by the perceived attitude of the others to exert pressure to change these habits and preferences in the direction of increasing (normalizing) one's own weight. Garner and Garfinkel (1979), introducing the EAT-40 to the reader's auditory, emphasize above all the measures for its validity and reliability observed on the basis of the raw scores. The authors provide information, albeit scarce, about its scale structure. They extracted 7 factors, which measure specific groups of symptoms of anorexia nervosa. However, the dimensionality of the factor space of the Bulgarian version differs sharply from that of the original test, although the interpretations of some of the factors in the two versions are similar. In a later study of the factor structure of the long form of the test (EAT-40), in which they provided rationale for the development of its short form (known as EAT-26), Garner et al. (1982) also reach the same three-dimensional factor space. EAT-26 and the Bulgarian long version are quite similar in terms of the content and interpretation of the respective scales. A similar scale structure, with the same dimensionality and interpretation of the factors, is obtained by Pereira et al. (2008) in the Portugal adaptation of the EAT-40.

Actually, similar to EAT-26 are the interpretations of the first two scales in the Bulgarian version. Differences, however, are observed in the third scale. Garner and co-authors define it as "Oral control" and interpret its meaning from two perspectives – as self-control of eating, and as perceived pressure from others to gain (normalization of) weight. In the third scale of the Bulgarian version, only the second perspective is presented. It seems that, for Bulgarian adolescents, their public image, the desire to look attractive, as well as the opinions of others regarding nutrition, are of such importance that they lead to the formation of an independent dimension in their attitudes. It is very likely that it is related to the dimension of "public self-consciousness" in the theory of Feinstein et al. (1975), regarded as the individual's attention to the way he or she is perceived and treated by others. The first perspective – the self-control, has not "disappeared" from the Bulgarian version, but through the relevant items has been "dissolved" in the first scale which reflects the dietary regimen. Obviously for the Bulgarian adolescents, the self-control over eating is an integral part of their attitudes towards a specific dietary regimen, avoiding high-energy foods, and paying attention to the calorie content of food. The hierarchical factor analysis revealed an interesting relationship between the factors – they are oblique, with a moderate correlation between the first two factors. It is high enough to be ignored, but insufficient to treat the factors as identical. This is evidence, that the symptoms and the psycho physiological features that each of these scales describe, have a close relationship. The results give grounds to assume that attitudes to eating in the Bulgarian population have a hierarchical structure with a general factor. It is indicative that the highest factor loadings on the common second-order factor have the items assigned to the first two scales, especially to "Bulimia and food preoccupation" scale. In other words, bulimia and the pursuit of a thinner body form the core of eating disorders in Bulgarian adolescents. The third factor is almost equally distant from the first two, with which it is poorly related. Therefore, the attitudes of Bulgarian adolescents towards eating, even more their eating habits, have a very weak interrelation with the pressure of others to normalize the weight.

The reliability indicators of the first two scales of the Bulgarian version, as well as that of the overall scale, are at a high level. A little lower, but above the accepted threshold, is the internal consistency of the third scale. Since the average inter-item correlation between the items in this scale is slightly lower, but comparable with the corresponding indications in the first two scales, it can be assumed that its lower reliability is due to the smaller size of this scale. In determining the predictive potential of the test to identify adolescents with eating problems, three of the scales were found to have the necessary qualities. The third scale "Perceived social pressure on diet behavior" could not be used for prediction. The overall test was outlined as the best predictor. It is characterized by the highest degree of accuracy because of the largest area under the corresponding ROC curve and the most favorable ratio between the two types of positive rates.

## 5. Conclusions

Eating attitudes test is a reliable, valid and economical instrument for assessing the eating disorders in non-clinical population. More widespread is the short form of the test (EAT-26), translated into many languages. This study partly fills the gap in the scientific literature about the psychometric features of the long form of the test (EAT-40). The Bulgarian version demonstrates scale structure similar or close to the original short version and to different national adaptations. It is a reliable tool for assessing the relevant symptoms and psycho physiological features of adolescents suffering from eating disorders.

## 6. References

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