




## Article

# Exploratory Factor Analysis, Criterion and Psychometric Properties of a Proposed Scale to Measure the Risk of Eating Disorders in Adolescents (PETCA)

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**Abstract:** This paper deals with the different risk scales of eating disorder in adolescents. The main objective is to create a scale to measure the risk of developing eating disorders using social and behavioral variables. The trial sample included 605 adolescents, aged 12–17 years ( $M = 14.27$ ;  $SD 1.44$ ), randomly selected from several centers who requested to participate in a health program. After using the principal component extraction method (PCA) with adequate internal consistency and reliability, and with a total explained variance of 60%, factor analysis showed five factors: satisfaction with body image, self-esteem, use of social networks, negative relationship with food, and image and social recognition. Pearson's correlation coefficients between our scale and reference scale (SCOFF) factors provided information on converging validity. However, the Cronbach's alpha values for dimensions 3 and 4 failed to reach the desired scores, and it was noted that not all dimensions had the same number of elements. Therefore, future interventions and proposals to develop a stronger scale are proposed. Despite the drawbacks, our findings provide a solid foundation for further analysis to find the most reliable method of analysis possible in this innovative area. We believe that this scale can help both health and education professionals to develop effective interventions.



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**Keywords:** eating disorder; adolescents; risk; psychosocial variables; danger scale

## 1. Introduction

In recent years, an exponential increase in eating disorders (EDs) has been observed [1–3]. The peak incidence is between 15 and 25 years of age [4,5] and is mostly in women [4,6]. Its etiopathogenesis is still unclear, although it is generally accepted that it is a multifactorial disorder and that it includes sociocultural, biological and personal factors [2,3,7,8]. However, some of them have changed according to time and social context [4,6].

The stage of adolescence and youth is the most dangerous for the manifestation of EDs because, as explained by Erikson [9–11] and other more contemporary authors such as Lucciarini [12], it is a time when an identity vacuum or crisis can occur, due to fears aroused by new situations and anxiety about symbolic dangers (above all, canons of beauty). For this reason, the search for acceptance and social positioning, how one sees oneself in front of others, is of great relevance. The search for social identity (how and with whom I want to be identified) becomes important, but not only with the people with whom one relates in person, as the use of the internet and social networks has become necessary to create this identity [13–15].

There are several factors that influence the psychosocial development of adolescents [11,12]: (1) community dimension; (2) conflict dynamics; (3) personal developmental period; (4) models received; (5) psychohistorical aspects; and (6) personal history. In short, genetic and social aspects (through socialization) act in a combined way in the process of identity creation.

The social image of the adolescent in the search for his or her identity will be further reinforced if he or she holds a position of leadership. In a study by Corcuera et al. [16], it was observed that a large majority of adolescents have toxic lifestyles that lead to problems that affect their participation in activities that improve their social integration. A dysfunctional environment worsens the circumstances.

Social image and self-esteem are closely linked [17]. The self-esteem and self-concept of developing individuals are shaped by the environment in which they find themselves [16]. Thus, if given support and means by the environment, the adolescent will cope with the changes and conflicts he or she may go through in life and thus achieve a positive self-concept and a positive social image and identity.

With this article, we want to show the variety of factors that influence adolescent behavior and that, as recent research [18] has shown, there are possible multifactorial causes that influence the development of an ED. Therefore, body image is not the only cause of an adolescent developing an ED. However, the following are considered as contributing factors: (1) the subjective perception of physical appearance and sexual functional capacity; (2) object relations and their internal configurations; (3) the environment (body valuation will increase or decrease depending on whether or not they perceive that they meet the expectations of those around them); and (4) ideal body image (with whom they compare themselves and constitute the ideal of the self) [19,20].

The main EDs manifested in today's society are anorexia nervosa, bulimia nervosa and Binge Eating Disorder, in which, although the motor around which they revolve is food, the perception of food, as well as the behaviors and consequences of the patients, are not the same (DSM-V). And, following this behavior over an extended period of time, we can observe physical and physiological manifestations that are perceptible to the expert but are already signs that the disorder is advanced. When the disease is already manifested, there are tests that quickly determine attacks (SCOOF, BITE, BES, BULT, EAT-40, EAT-26, TFEQ/EI, etc.) [21] but are directly related to the relationship with food and/or bodily dissatisfaction and purgative measures. There are also studies establishing relationships between attack manifestation and the above defined concepts, such as identity [22], social image [23], self-esteem [24], self-concept [25] and body image [26], when the disease is already manifested. Adolescents need to control and regulate emotions that may be considered risk factors for the perpetuation of EDs [20]. These emotions can be anxiety, difficulty in expressing emotions, low self-esteem, negative attitude towards emotional expression, negative perception of emotions and the influence of food, weight and body shape on mood. Moreover, harmless behaviors normalized by young people (such as the use of social networks) [27] may contribute to increased anxiety, creating identity crises, changes in self-esteem, etc. [15]. Based on existing instruments, our aim was to develop a scale with the appropriate psychometric characteristics, which is brief, operational, easy to apply and which helps to assess the risk of adolescents developing EDs based on attitudes and behaviors with and towards the environment around them. With this, we aim to add to the list of scales and tools available to professionals, especially in the field of prevention, and thus form part of the instruments of interest to all those who work in environments with adolescents and in health promotion.

Different experts have tried to explain the appearance of these pathologies from different perspectives, but the most important ones are the new fashion trends and standards in physical appearance and eating patterns [21].

In summary, with this study, we aim, firstly, to find out what dimensions influence the development of this pathology in an educational center where the age cohort that suffers the most from this problem is to be found. Secondly, we aim to offer primary data to professionals working with adolescents in order to create effective intervention guidelines in the curriculum and competencies of educational centers and to prevent the appearance of this disorder. And thirdly, we aim to test the reliability of the instrument.

## 2. Methodology

This study is quantitative and correlative in nature but also cross-sectional because the age variable is fundamental in the explanation of the phenomenon. Given that the independent variable has not been manipulated, a posteriori study is needed.

### 2.1. Participants

The sample size for the test was 605 adolescents from five secondary schools in the province of Almeria participating in a project called “Food Culture, Health and Sustainability in the schools of Almeria”. A total of 125 participants were randomly selected from each school aged between 12 and 17 years considering the high risk for the development of abnormal eating behaviors according to most studies on the subject (1, 2 and 3). The mean age was 14.27 years (SD 1.44).

The sample was divided into 293 males (48.42%) and 312 females (51.52%). Of the total, 89.6% were born in Spain, 6.1% in South American countries, 2.6% were from North Africa and 1.7% were from European countries.

### 2.2. Instrument

The self-report protocol completed by the participants consists of several sections that collect the data of this study: socio-demographic data; data related to body image, social identity and self-esteem; and the Scoff scale. Although some authors [28,29] suggest using Likert-type graduated response scales, other researchers, such as López [30], prove that a dichotomous format provides almost as much information as a polynomial format. Moreover, as shown in Rasch’s studies [31], in work with children and/or adolescents, reduction to dichotomous categorical scales can optimize measurement because it better accounts for response variability [32].

The socio-demographic data refer to gender and age. Data on body image, social identity and self-esteem constituted our PETCA-PRE scale (see Table 1). Furthermore, the SCOFF questionnaire (Sick, Control, One, Fat, Food) [33] was used to identify signs of the presence of eating disorders (ED) (anorexia nervosa or bulimia nervosa). The index has five dichotomous elements (yes, no). For each “yes”, one point is added, and two or more points indicates a high likelihood of anorexia nervosa or bulimia nervosa. We also used this questionnaire to test the confirmatory factor analysis against our scale. In this way, we wanted to verify that our scale offers results consistent with the scale that measures TCA risk.

**Table 1.** PETCA-PRE scale items (27 items).

		True	False
1	I use social networking sites to report on my life.		
2	I use social networks mainly to upload photos or videos of myself or with my friends.		
3	I use social networking sites to see photos or videos of famous people.		
4	I use social networking sites to see photos of friends I know.		
5	I follow someone on social networks if he/she is nice and makes me feel good.		
6	I follow someone on social networks if he/she has the same interests as me.		
7	I follow someone on social media if they show content beyond the physical		
8	I would like to be mentioned or included by peers more often.		
9	I would like to be the centre of attention in class and/or at school.		
10	I don’t think I have much to be proud of.		
11	I think I am fat.		
12	I constantly think about food.		

**Table 1.** *Cont.*

		True	False
13	I think that others notice me.		
14	I don't value myself.		
15	I feel that others trust me.		
16	Others accept me just the way I am.		
17	Other people tell me that I am fat.		
18	I like what other people think about me.		
19	I feel I am a failure.		
20	I would like to be thinner.		
21	I would like to look like someone else in class or at school.		
22	I would like others to say that I am good-looking.		
23	I would like my physique to be different.		
24	I eat on the sly and hide food wrappers.		
25	I sometimes think that I am useless.		
26	I feel I am useless.		
27	I feel that I am capable of doing the same things as other people.		

Source: Own elaboration.

The initial prevention and evaluation of eating disorders (PETCA-PRE) scale can be seen in Table 1.

### 2.3. Procedure

This research is part of the UAL-Transfiere project called “Food Culture, Health and Sustainability in schools in Almeria”, with code UALBIO2022/03 8, whose main objective is the promotion of healthy and sustainable habits and the prevention of EDs in adolescents through educational interventions. Five Compulsory Secondary Education centers chosen through free enrolment in this program are participating in this project, with the mandatory permission of the management of each of them and the approval of the Parents' Associations (AMPA). The questionnaires were answered anonymously by randomly selecting 125 participants from each school.

The questionnaire was carried out in a computerized and anonymous way through the limesurvey platform.

### 2.4. Analysis

An Exploratory Factor Analysis (EFA) was carried out with SPSS-27 for Windows, using the principal axis extraction technique and the oblique rotation method (oblimin normalization with Kaiser). This method was selected because it was hypothesized that the scale factors would be correlated with each other. Furthermore, because the scale contains psychological constructs such as attitudes, there is sufficient theoretical and empirical evidence to apply oblique rotations [34–36]. In order to analyze the internal consistency of the scale, Cronbach's alpha coefficients [37] were obtained for each of the factors or subscales.

## 3. Results

Because the aim was to develop a scale that assesses the risk of adolescents developing an ED, but without the sole presence of questions related to physical appearance or negative attitudes towards food, the PETCA-PRE scale (Table 1) was designed, consisting of 27 items asking about the use of social networks, physical image, relationship with food, social image and self-esteem. The statements were drafted and selected based on information obtained from a panel of experts and a literature review [22–26].

Subsequently, the authors of this study with experience in EDs and adolescents, with backgrounds in Psychology, Sociology, Educational Sciences and Nutrition, corrected the defects detected in terms of item relevance, accuracy of the questions and terminology used. After this, content validity was analyzed between two external reviewers and a Cohen's Kappa value of 1 (sig < 0.001) was obtained (see Table 2). Both agreed that items 12 and 24 were poorly worded and were modified.

**Table 2.** Content validity analysis (external reviewers' results).

	Value	Asymptotic Standard Error <sup>a</sup>	Approximate T <sup>b</sup>	Approximate Significance
Measure of agreement Kappa	1.000	0.000	5.745	0.000
Valid cases	27			

<sup>a</sup>. No assumption of the null hypothesis. <sup>b</sup>. Use of asymptotic standard error assuming the null hypothesis. Source: Own elaboration.

The confirmatory factor analysis (PFA) was conducted. An empirical selection was made of the items proposed through the corrected item-total correlation coefficient; in order to select the essential, relevant and most significant items, the cut-off point was 0.40, leaving 14 items. The rest did not achieve a score higher than 0.40 (Table 3).

**Table 3.** PETCA scale items.

		True	False
1	I use social networks to see photos or videos of famous people.		
2	I use social networks to look at photos or videos of friends and/or acquaintances.		
3	I follow someone on social networks if he/she is nice and makes me feel good.		
4	I would like to be thinner.		
5	I would like my clothes to fit better.		
6	I would like my physique to be different.		
7	I eat on the sly and hide food wrappers.		
8	I feel I am a failure.		
9	I would like to be mentioned or included by my peers more often.		
10	I would like to be the centre of attention in class and/or at school.		
11	I like what others think about me.		
12	I would like to look like someone else in class and/or at school.		
13	Other people say that I am fat.		
14	Sometimes I think that I am good for nothing.		

Source: Own elaboration.

The PFA was carried out again considering the questions described below.

Oblique rotation produces correlated factors, so it is considered appropriate when dependence and relatedness between factors is assumed (at least from a conceptual point of view) [32].

The values of the communalities are high considering what has been proposed for empirical research in Social Sciences [38], where the range of saturation is usually moderate/low (between 0.32 and 0.50); hence, saturations above 0.50 can generally be considered strong (see Table 4).

**Table 4.** Extraction method. Principal component analysis.

	Initial	Extraction
Item 1: I use social networks to see photos or videos of famous people.	1	0.565
Item 2: I use social networks to see photos or videos of friends and/or acquaintances.	1	0.602
Item 3: I follow someone on social networks if he/she is nice and makes me feel good.	1	0.578
Item 4: I would like to be thinner.	1	0.525
Item 5: I would like my clothes to fit me better.	1	0.592
Item 6: I would like my physique to be different.	1	0.649
Item 7: I eat on the sly and hide food wrappers.	1	0.685
Item 8: I feel that I am a failure.	1	0.662
Item 9: I would like to be mentioned or included by peers more often.	1	0.486
Item 10: I would like to be the centre of attention in class and/or school.	1	0.796
Item 11: I like what other people think about me.	1	0.475
Item 12: I would like to look like someone else in class and/or at school.	1	0.450
Item 13: Others say about me that I am fat.	1	0.633
Item 14: I sometimes think that I am good for nothing.	1	0.696

Source: Own elaboration.

With respect to the degree of determination of the factors, through the percentage of the total variance explained (TVE), we reached 60% (Table 5), which is considered acceptable given that, in the Social Sciences, a minimum of 60% is set as the threshold for extraction [39].

Simultaneously, following the Gutman–Kaiser rule and its application on the sedimentation graph, we looked for the inflection point by comparison with a randomly created variable, as advised in clinical epidemiology studies [40]. We determined four dimensions; however, the TVE decreased to 40%. For this reason, the first option was chosen.

We thus obtained five factors with their variables (see Tables 6 and 7):

- Factor 1. Satisfaction with Body Image (eigenvalue 3.24) explains 23.16% of the common variance. Composed of items 4, 5, 6 and 12.
- Factor 2. Self-esteem (eigenvalue 1.48) explains 10.58% of the common variance. Composed of items 8 and 14.
- Factor 3. Use of social networks (eigenvalue 1.36) explains 9.76% of the common variance. Composed of items 1,2,3 and 11.
- Factor 4. Negative relationship with food (eigenvalue 1.26) explains 8.98% of the common variance. Composed of items 7 and 13.
- Factor 5. Image and social recognition (eigenvalue 1.04) explains 7.4% of the common variance. Composed of items 9 and 10.

**Table 5.** Total variance explained.

Component	Initial Eigenvalues			Sums of Squared Loadings from Extraction			Sums of Squared Loadings from <sup>a</sup> Rotation
	Total	% of Variance	% Cumulative	Total	% of Variance	% Cumulative	Total
1	3.244	23.169	23.169	3.244	23.169	23.169	2.633
2	1.482	10.587	33.756	1.482	10.587	33.756	1.425
3	1.366	9.760	43.516	1.366	9.760	43.516	2.374
4	1.258	8.983	52.499	1.258	8.983	52.499	1.325
5	1.044	7.456	59.955	1.044	7.456	59.955	1.381
6	0.801	5.724	65.679				
7	0.782	5.587	71.266				
8	0.742	5.302	76.568				
9	0.655	4.681	81.249				
10	0.590	4.214	85.463				
11	0.561	4.006	89.469				
12	0.536	3.832	93.301				
13	0.490	3.497	96.798				
14	0.448	3.202	100.000				

Extraction method: principal component analysis. <sup>a</sup>. When the components are correlated, the sums of the squared loadings cannot be added to obtain a total variance.

**Table 6.** Determination of the number of factors and composition.

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
Item 1	0.604	0.284	−0.312	0.114	−0.097
Item 2	0.625	0.337	−0.207	0.072	−0.224
Item 3	0.646	0.25	−0.277	0.005	−0.150
Item 4	0.627	−0.175	0.233	−0.189	−0.104
Item 5	0.686	−0.260	0.206	−0.089	−0.055
Item 6	0.701	−0.225	0.231	−0.201	−0.113
Item 7	0.136	−0.139	0.259	0.746	−0.152
Item 8	−0.065	0.628	0.496	−0.130	−0.013
Item 9	0.527	−0.026	−0.034	0.044	0.452
Item 10	0.272	0.032	0.065	0.194	0.824
Item 11	0.277	0.391	−0.464	0.141	0.096
Item 12	0.495	−0.342	0.212	−0.202	0.042
Item 13	0.135	0.141	0.447	0.619	−0.111
Item 14	0.016	0.610	0.470	−0.313	0.076

Source: Own elaboration.

As can be seen, items 8, 9, 11, 12, 13 and 14 showed shared saturations and, in addition, the items of scales 3, 4 and 5 were scarce. For some authors, this aspect can be considered negative because, as Velicer and Fava [41] indicate, due to the fact that there is a decrease or increase in the sample in certain circumstances, we need to compensate for low factor loadings or a limited number of items.



**Table 7.** Final PETCA scale items.

		True	False
1	I use social networks to see photos or videos of famous people		
2	I use social networks to see photos or videos of friends and/or acquaintances.		
3	I follow someone on social media if they are nice and make me feel good.		
4	I would like to be thinner.		
5	I would like my clothes to fit better.		
6	I wish my physique was different.		
7	I eat on the sly and hide food wrappers.		
8	I feel I am a failure.		
9	I would like to be mentioned or included by peers more often		
10	I would like to be the centre of attention in class and/or school.		
11	I like what others think about me.		
12	I would like to look like someone else in class and/or at school.		
13	I like what others say about me that I am fat.		
14	I sometimes think that I am good for nothing.		
15	I think I don't have much to be proud of.		
16	I feel I am useless.		
17	I think I am fat.		
18	Food dominates my life.		
19	I feel I am capable of doing the same things as others.		
20	I have a positive attitude towards myself.		
21	I think I have good qualities.		

Source: Own elaboration.

However, due to the high determinacy value of the variables of each factor, they might be sufficient. However, when calculating Cronbach's alpha values independently (each factor), it turned out that in these cases (3, 4 and 5) it was less than 0.70. Therefore, we decided to add two more items to each of them using part of those that had been discarded at the beginning (see Table 1). This decision was made because (1) criteria were supported by the literature for the definition of each factor [15,22]; (2) the variables that were already in each factor prior to the inclusion of the new ones provided loadings of more than 0.60, so they are considered sufficient to indicate the latent construct of interest; and (3) because of the positive results observed in Cronbach's alpha (by factor and total) as well as the fact that the VTE still maintained the same value.

Thus, the final scale is composed of 21 items and 5 dimensions, with a total alpha of  $\alpha = 0.73$  (see Tables 7 and 8). Although factor 4 has a low alpha, we decided not to eliminate this factor because it correlated well with SCOFF and provided theoretical stability to the table as a whole.

Regarding the magnitude of the factor loadings, considering factors related to the context of study and the discipline being worked on, saturations above 0.50 can be satisfactory [32,38]. However, this result is highly dependent on the total sample. In our case, with  $N = 605$ ,  $\alpha = 0.72$  and factor loadings above 0.6 (except one), we consider the results acceptable (see Table 8).



**Table 8.** Internal consistency (alpha), number of items, mean and standard deviation of each factor.

Factors	Alpha	No. Items	N	Mean	Typical Deviation (TD)
1. Satisfaction with Body Image	0.73	4	605	1.5	1.4
2. Self-esteem	0.89	4	605	2.4	1.7
3. Use of social networks	0.67	4	605	2.43	1.34
4. Negative relationship with food	0.34	4	605	1.2	1.04
5. Image and social recognition	0.74	5	605	1.38	1.53

Source: Own elaboration.

The correlations between factors (Table 9) support the choice of the factorial rotation used, as their values are all statistically significant (except F2). Furthermore, these correlations are also significant between each factor (except F2) and the results on the SCOFF scale (used as a diagnostic criterion for the risk of developing an ED), thus generating criterion validity.

**Table 9.** Correlations between factors.

	F1	F2	F3	F4	F5	SCOFF
F1	1					0.290 **
F2	−0.038	1				−0.025
F3	0.405 **	0.017	1			0.166 **
F4	0.099 *	0.007	0.069	1		0.228 **
F5	0.321 **	−0.018	0.293 **	0.078	1	0.157 **

\*\* Correlation is significant at the 0.01 level; N = 605. \* Correlation is significant at the 0.05 level; N = 605. Source: Own elaboration.

#### 4. Discussion and Conclusions

The PETCA scale has a structure formed by five factors reflecting various dimensions that affect adolescents in terms of their risk of developing EDs proposed by various authors [42–44]. Significant correlations were found between each factor and the SCOFF scale (except for self-esteem). When analyzing the correlations between factors, it has been observed that self-esteem does not have a significant relationship with any of the other factors, nor between factors 3 and 4 (use of social networks and negative relationship with food respectively) and between 4 and 5 (negative relationship with food and image and social recognition). Nevertheless, the fact that internal consistency is observed to be good confirms our predictions: (1) there are risk attitudes related to the risk of developing EDs; (2) positive correlations between factors of the scale are found.

Academic studies show a trend towards a “multifactorial network perspective” of the risk of developing TCA [45–48], which addresses dietary restrictions, body shape and weight [49–51]. However, PETCA is seeking a broader multifactor analysis, taking into account models linked to social factors. The idea is to establish a possible relationship between these and TCA, so that they can be used as predictors of these disorders. For all these reasons, we believe that our instrument could be very useful. It could be administered to the target population and provide relevant physical and social data as part of the diagnostic and intervention process by professionals. We are aware that our study has certain limitations, such as the exclusion of factors such as the relationship with the family. Furthermore, the SCOFF scale with which it has been compared only measures the risk of developing anorexia and/or bulimia nervosa, leaving out the possible risk of Binge Eating Disorder, which is also on the rise in the adolescent population [52,53]. Therefore,

we are already working on collecting more samples and comparing them with a scale that measures the risk of Binge Eating Disorder.

On the other hand, it would be useful to improve the internal consistency of the factors “negative relationship with food” and “use of social networks” and to observe the correlations between the different factors in future studies. While establishing a more reliable factor structure should be a prerequisite for a proper assessment [54], the PETCA scale brings novel research factors to the table that bring together social and pathology factors.

In short, we believe that this scale is a useful and necessary tool for the relationship of attitudes and risk behaviors that may influence the development of an ED, especially in the educational context. Therefore, it should be subjected to future analysis and confirmatory validation of the results obtained and the sensitivity of the scale to changes in these risk behaviors should be determined, aspects on which we are already working.

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**Informed Consent Statement:** Informed consent was obtained from all subjects involved in the study.

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