

**PhD Thesis**

**Food addiction in childhood**

**Erzsébet Éva Magyar M.D.**



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## **Introduction**

The theory of food addiction was suggested as early as 1956 (Randolph et al., 1956), but this concept has become more of a focus of addiction research due to the global pandemic. A growing body of evidence supports the hypothesis that specific types of foods (especially processed foods with high sugar and fat levels) may carry an addictive potential, similar to classic addictive substances (Avena et al., 2011). Meule and Gearhardt pointed out that the diagnostic criteria for substance use disorders can be determined in patients under treatment with obesity (Meule & Gearhardt, 2004). Behavioral patterns, such as the tendency to lose control over consumption of highly palatable foods, suffering from repeated failed attempts to reduce or to completely stop the consumption of these products, despite the negative physical and/or social consequences has been described (Gearhardt, Corbin & Brownell, 2009). However, the empirical assessment of two crucial criteria for addiction, tolerance and withdrawal, on human sample is problematic, several animal experiments imply that tolerance and withdrawal symptoms can be induced by repeated sugar intake (Avena, Rada, & Hoebel, 2008). Schulte et al. pointed out that the danger of food addiction lies within these products' widespread availability (they are usually rather cheap and legal to be purchased) – similar to cigarettes regarding nicotine addiction (Schulte et al., 2015). As the overconsumption of the aforementioned products causes not only serious somatic problems but also predisposes to other forms of addiction, the development of a reliable, objective tool with adequate psychometric properties, has become necessary to assess the presence and severity of food addiction. In 2009 Gearhardt et al. (Gearhardt et al., 2009) developed the Yale Food Addiction Scale (YFAS), thus enabling the identification of people presenting with food addiction symptoms. The YFAS applies the same diagnostic criteria used to diagnose substance use disorders to the conception of highly palatable foods (e.g., chocolate, pizza). The German, French, Italian and Chinese versions of the scale have been already developed and used for food addiction assessment (Meule et al., 2012; Brunault et al., 2014; Innamorati et al., 2015; Chen et al., 2015). Yale Food Addiction Scale for Children (YFAS-C) has been validated for the child population in 2013, also showing good psychometric properties (Gearhardt et al., 2013).

Childhood obesity proves to be an especially important public health issue, since it serves as a potential risk factor for multiple diseases. Although numerous etiological factors have been already proven to cause childhood obesity (Kumar, 2017), the recent re-emergence of the food addiction concept could also serve as an important contributing factor. The data regarding the prevalence of food addiction in childhood are different, ranging from 4% up to 27.7% (Burrows et al., 2017). The issue of food addiction in childhood is particularly of great importance, because the central nervous system is not fully developed, thus the exposition of foods with addictive potential are more likely to result in unfavorable changes in the neural system, making the subject more prone to develop the behavioral patterns of addiction (Burrows et al., 2017). Children with long-term excessive consumption of highly palatable, high-calorie foods are more likely to become overweight and obese. The positive correlation between the BMI and food addiction has been already established in the adult as well as in the child and adolescent population. (Pursey et al., 2014; Burrows et al., 2017). Csábi et al. found that potential risk factors for cardiovascular diseases already tend to cluster in childhood and they are strongly associated with obesity, suggesting that the development of metabolic cardiovascular syndrome has its origin in childhood (Csábi et al., 2000). Besides its effect on the cardiovascular system, childhood obesity predisposes to multiple comorbidities (psychological, pulmonary, endocrine, gastrointestinal etc.) (Kumar, 2017).

Recently childhood obesity has become a serious issue also in Hungary. In a study, aiming to assess the prevalence of overweight and obesity in children between 3-18 years of age, Bodzsar and Zsakai found, that the number of overweight and obese children peaks at the 10-12 age group, with 23% in boys and girls, respectively (Bodzsar, Zsakai, 2012). Taking into consideration the growing number of research regarding food addiction's contributory role in obesity, a reliable assessment tool has become necessary for two reasons: 1) it may serve as a primary prevention to screen children and to identify those who tend to show addictive like symptoms to certain foods; 2) it may serve as a useful tool in secondary prevention in overweight/obese children by evaluating the child's tendency to addictive-like eating behavior. To our knowledge, currently no Hungarian questionnaire exists to assess food addiction in children. Our aim was to analyze the psychometric properties of the Hungarian translation of the YFAS-C (H-YFAS-C) on a non-clinical sample.

## Objectives

1. To validate the Yale Food Addiction Scale for Hungarian children.
2. To observe the different aspects of food addiction in Hungarian school-aged children with the validated Yale Food Addiction Scale.

## Methods

### Participants and Procedures

A total of 191 Hungarian native children and adolescents were recruited from primary schools located in Baranya area, Hungary. Inclusion criteria were the following: 1) age was between 8-18 years, 2) the children and adolescents received no treatment related to obesity. The participants completed a self-administered questionnaire, including a general sociodemographic part (age, gender, weight and height) and 2 questionnaires (the H-YFAS-C and the Eating Disorder Inventory (EDI)), which were adapted to Hungarian population by Túry et al. (Túry, 1997).

The translation procedure was carried out according to the existing guidelines for scale validation (Guillemin, 1993), and the back-translated version of the questionnaire did not differ significantly from the original.

### Measures

**Nutritional status.** The measurement of weight was carried out with an electronic scale (TANITA BC 420 SMA) to the nearest 0.1 kg. The children wore only underwear and T-shirts. Height was measured barefoot with a telescopic height measuring instrument (SECA 225) to the nearest 0.1 cm. Body mass index (BMI) was calculated as weight (kg) divided by height (m) squared. BMI categories were defined according to IOTF to classify overweight, obese and underweight children (Cole, 2012).

**The Yale Food Addiction Scale for Children.** YFAS-C is a 25-item, self-report scale designed by Gearhardt et al. (Gearhardt et al., 2013), which was adapted and validated based on the original YFAS, a validated measure of addictive-like eating behavior in adults (Gearhardt et al., 2009). The scale explores the eating behavior regarding the last 12 months. Having been developed based on the diagnostic criteria of substance dependence listed in the Diagnostic and Statistical Manual of Mental Disorders IV-TR (American Psychiatric Association, 2000), it assesses the following 7 criteria for food addiction (Gearhardt et al., 2013): substance is taken in larger amount and for longer period than intended (questions 1, 2 and 3), persistent desire or repeated unsuccessful attempts to quit (questions 4, 17, 18 and 25), much time is spent to obtain and to use the substance or to recover from its effects (questions 5, 6 and 7), important social, occupational or recreational activities are given up or reduced because of substance use (questions 8, 9, 10 and 11), the substance is continued to be used despite knowledge of adverse consequences (e.g., failure to fulfill obligations or to continue using it even when it's physically hazardous) (question 21), tolerance (questions 22 and 23), characteristic withdrawal symptoms, substance taken to relieve withdrawal (questions 12, 13 and 14)

The scale also involves 2 additional questions assessing clinically significant impairment or distress (questions 15 and 16). The 25-item scale comprises two kinds of questions: 18 being Likert-type scale and 7 being dichotomous. 3 questions serve as primers and are not scored (questions 19, 20 and 24). Scoring provides assessment of food addiction in 2 various ways. The “symptom count” scoring version offers a continuous assessment, reflecting the number of dependence symptoms (from 0 to 7). The “diagnostic” scoring version, offering a dichotomous evaluation, assesses whether the diagnosis of food addiction can be established or not (food addiction can be diagnosed when 3 or more symptoms are present and a clinically significant distress/impairment is established). The original development of the scale found that the YFAS-C had adequate internal consistency, convergent and incremental validity (Gearhardt et al., 2013) and proved to be reliable and valid regarding assessment of food addiction in children.

**The Eating Disorder Inventory.** The EDI evaluates emotional, cognitive and behavioral factors in eating disorders (Garner et al., 1983). The 64-item long, self-report scale contains Likert-type questions and evaluates the following 8 scales: 1) bulimia, 2) dissatisfaction with body image, 3) drive for thinness, 4) feeling of dissatisfaction, 5) perfectionism, 6) interpersonal uncertainty, 7) interoceptive exposure, 8) anxiety over becoming adult. The first 3 scales

measure the behavior of overeating and the impairment and distress in connection with it. The other 5 scales evaluate personal traits in case of anorexia nervosa and are not related to eating behavior. The questionnaire was adapted and validated to the Hungarian population by Túry et al. (Túry et al, 1997).

**Statistical analyses.** Statistical analyses were conducted using the IBM SPSS Statistics 23 and R statistical software with the Lavaan package (Rosseel, 2012). Descriptive statistics were used to analyze sample characteristics. The scale's psychometric properties were examined in terms of internal consistency, construct validity, convergent and discriminant validity.

Internal consistency was examined by assessment of the Kuder-Richardson Formula 20 (KR20) for the items' dichotomized versions (Kuder, Richardson, 1937). Confirmatory factor analysis with the seven-factor solution was conducted to test the scale's construct validity, using the mean- and variance-adjusted weighted least square (WLSMV) estimator with a polychoric correlation matrix. To examine the model's global fit, the following items were calculated: 1) root mean square error of approximation (RMSEA), 2) Chi-squared test, 3) comparative fit index (CFI), 4) Tucker-Lewis index (TLI). The Hungarian version of the EDI was used to examine convergent and discriminant validity. These psychometric properties were examined with both H-YFAS-C scoring options: 1) When scoring according to "symptom count", PLUM-Ordinal regression model was performed, where the dependent variable was the "symptom count" and the independent were the subscales of EDI. Due to the relatively small sample, the cases with symptom counts of 6 and 7 were grouped together. 2) Multiple binary logistic regression test was performed to determine these psychometric properties if the "diagnostic" scoring system was used. The independent variables in this case were also the EDI subscale values.

All results were considered to be statistically significant if the p-values of two-tailed analyses were  $<0.05$ .

The study procedures were carried out in accordance with the Declaration of Helsinki. The Institutional Review Board of the University of Pecs - Clinical Center, Regional and Institutional Research Ethical Committee approved the study (reference number: 6909). All participants and their parents were informed about the study and all provided informed consent.

## **Results**

### **Sample characteristics**

191 children participated in our study, 109 (57%) were male. Participants had a mean age of  $15.1 \pm 1.7$  years. Mean BMI was  $21.2 \pm 3.0$  in males and  $21.8 \pm 4.8$  in females. According to the IOTF classification of BMI percentiles, females and males were analyzed separately. 5.3% of male participants were underweight (<15.5% percentile), 82.9% were normal weight (15.5-90.5% percentile), 7.9% were overweight (90.5-98.9% percentile), 3.9% were obese (98.9-99.83% percentile) and 0% were morbid obese (>99.83% percentile). Among females 13.6% were underweight (<16.5% percentile), 70.5% were normal weight (16.5-89.3% percentile), 9.1% were overweight (89.3-98.6% percentile), 4.5% were obese (98.6-99.76%) and 2.7% were morbid obese (>99.76% percentile).

### **Item statistics and internal consistency**

The distribution of the answer-based item-points for the continuous questions was not normal; the “very often” (answer 3) and “always” (answer 4) answers were given very rarely (in only 1-2 cases) or were given not at all (items 8 and 9). Therefore, the item analysis was performed with the dichotomous transformed items. The 0-4 ranged items were dichotomized, according to the following system: 0 corresponded to absent or rare, while 1 for a rather often occurrence of the symptom. In this present study the following cut-offs were developed: Questions #1, #2, #4, #6, #17, #18 were scored 0 if the answer was 0-2, and 1 if 3-4; Questions #3, #5, #7, #8, #9, #10, #11, #12, #13, #14, #15, #16, #21, #22, #23 and #25 were scored 0 if the answer was 0-1, and 1 if 2-4. The K20 internal consistency coefficient for these items was 0.81.

### **Construct validity**

Assessing the model’s global fit, confirmatory factor analysis was performed with the following results: RMSEA=0.0528 (CI95% 0.04-0.065) (RMSEA associated p value was 0.342). Chi-square statistics=279.06 which proved to be not significant on a 5% significance level. CFI=0.896. TLI=0.868. Partial tests were also performed for examining the items



regarding the 7 diagnostic criteria and question #25 proved to have no significant effect for its own group (Persistent desire or repeated unsuccessful attempts to quit). We removed this item from our further analyses and used the 21 item scale. After removing item #25 the K20 internal consistency coefficient was 0.82.

### **Convergent and discriminant validity**

Analyses according to the “symptom count” scoring version. According to the PLUM-Ordinal linear regression model, two subscales of the EDI corresponded with the H-YFAS-C symptom count: “bulimia” subscale ( $B=0.469$ ;  $p<0.001$ ) and the “dissatisfaction with body image” subscale ( $B=0.373$ ;  $p<0.001$ ). There was no statistically significant connection between the H-YFAS-C symptom count and the other 6 EDI subscales.

Analyses according to the “diagnostic” scoring version. The multiple binary logistic regression model showed a connection between the two subscales of the EDI and the dichotomous scoring (food addiction present or not) of the H-YFAS-C: “bulimia” subscale ( $\text{Exp}(B)=1.9$ ;  $\text{CI}_{95\%}$  1.3-2.7) and the “dissatisfaction with body image” subscale ( $\text{Exp}(B)=1.2$ ;  $\text{CI}_{95\%}$  1.1-1.2). There was no statistically significant connection between the H-YFAS-C’s dichotomous scoring and the other 6 EDI subscales.

### **Sample characteristics with evaluation of the Hungarian version of the YFAS-C**

Food addiction was diagnosed in 8.9% of our sample. The mean symptom count was  $1.7\pm 1.2$  (range: 0-7). The mean dissatisfaction of body image score was  $8.9\pm 8.7$  and 16% of the participants’ score reached the pathological threshold. The mean bulimia score on EDI was  $0.9\pm 2.1$ ; none of the participants reached the score threshold for bulimia pathology. Females were more often diagnosed with food addiction than males ( $p=0.016$ ;  $\text{OR}=3.6$ ,  $\text{CI}_{95\%}$  1.2-10.6). BMI percentiles were significantly higher in children with diagnosed food addiction ( $p=0.003$ ). There proved to be no correlation between age and the occurrence of food addiction.

## Discussion

Our aim was to assess the psychometric properties of the H-YFAS-C on a non-clinical sample. The confirmatory factor analysis showed that - in accordance with the original English version of the scale - all 22 original scored items, except for item 25, were significantly correlated with their total score. Therefore, exclusion of question 25 has been performed as it had no significant effect for its own group (“Persistent desire or repeated unsuccessful attempts to quit”).

The modified, 21-item scale’s internal consistency proved to be good, as the K20 internal consistency coefficient was 82%. The model’s total fit was adequate as the measurements of RMSEA was  $<0.06$  and CFI was close to 1. The Hungarian version of the scale showed adequate convergent validity for both the “symptom count” and the “diagnostic” scoring versions. The H-YFAS-C symptom count, as well as the dichotomous scoring (food addiction is present vs. food addiction is not present) were strongly correlated with the “bulimia” EDI subscale, showing that H-YFAS-C adequately measures the presence of overeating symptoms. This is also consistent with prior research exhibiting a strong association between food addiction and bulimia (Meule et al., 2014; de Vires, Muele, 2016) Symptom count also showed a strong correlation and “dissatisfaction of body image” EDI subscale, indicating that the scale is capable to reliably measure eating-related impairment and distress. This is also consistent with prior research that has identified an association between food addiction and concerns about shape and weight (Gearhardt et al., 2012; Gearhardt, Boswell, & White, 2014). Discriminant validity was also evaluated using the EDI. Our results showed that there was no significant correlation between the 4th, 5th, 6th, 7th, 8th EDI subscales and neither the “symptom count” nor the “diagnostic” scoring result of the H-YFAS-C. The aforementioned subscales do not relate to eating behavior rather measure personality traits regarding anorexia nervosa, so according to our results the H-YFAS-C owns good discriminant validity for these subscales. According to our results the 24-item H-YFAS-C possesses adequate psychometric properties (internal consistency, construct validity, convergent and discriminant validity) and can be used on the Hungarian child population 1) to screen the addictive like eating behavior in normal-weight child and adolescent population before the development of overweight/obesity and 2) to diagnose addictive like eating behavior in already obese patients who are undergoing obesity-related treatment (Gearhardt et al., 2009).

In our sample food addiction was diagnosed in 8.9% which showed only a slight difference to the sample of Gearhardt et al., where 7% of the children could be diagnosed (Gearhardt et al., 2013). The mean age of participants was also higher, than in the sample of Gearhardt et al. (Gearhardt et al., 2013). According to the results of the 2<sup>nd</sup> Hungarian National Growth Study, the number of overweight and obese children peaks at the 10-12 age group (with 23%), thus we hypothesize that this difference in food addiction prevalence could be attributed to the higher mean age in our sample. In our sample a female predominance of food addiction could be assessed, however in a recent study Burrows et al. (Burrows et al., 2017) found no correlation between childhood food addiction and gender. Assessing the adult population however, a meta-analysis by Pursey et al. showed a female predominance in food addiction (Pursey et al., 2014). Since the mean age of the participants in the sample of Burrows et al. (Burrows et al., 2017) was also lower than in our sample ( $15.1 \pm 1.7$  years vs.  $8.2 \pm 2.3$  years), we hypothesize that this age difference could have caused the discordance between our sample and the sample of Burrows et al., regarding the gender differences (Burrows et al., 2017). There proved to be no correlation between age and the occurrence of food addiction, similar to the results of Burrows et al. (Burrows et al., 2017). BMI percentiles were significantly higher in children who were diagnosed with food addiction, which also corresponds to the results of Burrows et al. (Burrows et al., 2017).

As the prevalence of childhood obesity shows a growing tendency in Hungary, it has become highly important to be able to assess the contributing factors for this condition. Growing number of evidence points toward the fact that food addiction could serve as one of the key factors. In the light of these results, we regard the use of the Hungarian version of the Yale Food Addiction Scale to be of special importance not only in the clinical practice but in the general practitioner care also. In the latter case, we propose the use of the scale not only in patients with already developed overweight and obesity, but also in children in the normal weight-range, who come from a family with problems of obesity. Since a positive correlation between the parents' and the child's food addiction symptoms has been proven, these children could benefit from an early intervention (Burrows et al., 2017). Identification of children, in either the normal or already in the overweight/obese weight range, who show a tendency of addictive-like eating behavior, could also be beneficial because an increased surveillance regarding other forms of addiction and eating disorders can be carried out (Meule, von Rezori & Blechert, 2014). Moreover, since the connection between parental feeding patterns and food

addiction has been proven, parental feeding advices could also be of great help in avoiding or treating obesity (Burrows et al., 2017).

In conclusion, our aim was to assess the psychometric properties of the H-YFAS-C (internal consistency, construct validity, convergent and discriminant validity). We propose the use of the H-YFAS-C to be an adequate tool for both primary and secondary prevention of food addiction in the Hungarian child and adolescent population.

## LIST OF PUBLICATIONS

### Publications related to the thesis

**Magyar ÉE**, Csábi Gy, Tényi T, Tényi D. A Yale Ételaddikciós Skála – irodalmi áttekintés. **Psychiatria Hungarica**, 2016, 31, 256-260.

**Magyar ÉE**, Tényi D, Gearhardt A, Jeges S, Abaligeti G, Tóth ÁL, Janszky J, Molnár D, Tényi T, Csábi Gy. Adaptation and validation of the Hungarian version of the Yale Food Addiction Scale for Children. **Journal of Behavioral Addictions**, 2018, 7, 181-188.

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### Abstracts related to the thesis published in journal

**Magyar É.E.**, Tényi D., Gearhardt A., Jeges S., Molnár D., Tényi T., Csábi Gy. Az ételaddikció vizsgálata magyar gyermekben a Yale Ételaddikció Skála gyermek változatának (Yale Food Addiction Scale for Children) használatával. **Gyermekgyógyászat**, 2018, 69,340.

### Lectures related to the thesis

**Magyar É.E.**, Tényi D., Gearhardt A., Jeges S., Molnár D., Tényi T., Csábi Gy. Az ételaddikció vizsgálata magyar gyermekben a Yale Ételaddikció Skála gyermek változatának (Yale Food Addiction Scale for Children) használatával. *2018. MAGYIPETT 42. Kongresszusa, Galyatető*, May 10-12.

**Magyar É.E.**, Tényi D., Gearhardt A., Jeges S., Molnár D., Tényi T., Csábi Gy. Adaptation and validation of the Hungarian version of the Yale Food Addiction Scale for Children. *2019.18th International ESCAP Congress, Vienna*, June 30-July 2.

### Publications not related to the thesis

Csábi Gy., **Magyar É.,E.**, Tényi T. Katatónia gyermek és serdülőkorban - rövid áttekintés betegbemutatás. **Psychiatria Hungarica**, (accepted).

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