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Soft Drink Addiction Scale: Reliability and Validity Analysis in Young Mexican People

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Abstract: It has been proposed that the consumption of foods high in sugar or fat may cause addictive behavior. The aim of this study was to adapt and validate a soft drink addiction scale that can be used in future studies and to strengthen the proposal of food addiction with the hypothesis that people with high consumption of soft drinks have similar characteristics to people who consume abuse drugs. A non-probabilistic convenience sample of 394 Mexican participants answered a soft drinks' consumption frequency questionnaire, an addiction scale, and a self-efficacy scale for soft drinks' consumption. Additionally, anthropometric measurements were taken. The addiction scale showed three factors with an adequate reliability (Cronbach's alpha coefficient = 0.903), as well as construct validity and criterion validity with the self-efficacy scale and total body fat percentage on soft drinks, mainly those with substantial caloric content. Additionally, the results showed a predictive value for soft drink consumption, strengthening its validity. This scale is useful to identify and evaluate the characteristic patterns of a substance addiction. The total reliability indicates that the items as a whole are correlated with each other and that the scale is stable to be used over time. This is the first study that evaluates the addictive characteristics of soft drink consumption through a scale, and it represents an advance in the exploration of the behavioral sciences field and an important tool for the creation of public health policies, mainly in countries with a high consumption of these beverages.

Keywords: soft drink consumption; addiction; scale; validity; reliability

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1. Introduction

From 1980 to 2013, the prevalence of overweight or obesity worldwide has increased by at least 10%, in both men and women [1]. In Mexico, The National Health and Nutrition Survey 2016 [2] reported the combined prevalence for overweight and obesity at around 70% in adults over 20 years old. Hypercaloric diets and soft drinks' consumption are the main contributors for the development of these conditions in both young and adult populations, and this is due to the high sugar content in these products [3–5]. Mexico is the main soft drinks' consumer worldwide (mainly the young population), with an average of 115.4 L/year/person, followed by the United States and Chile with 103.3 and 79.1 L, respectively [6].

The so-called food addiction is not accepted as a pathology and is not included in the Diagnostic and Statistical Manual of Mental Disorders [7] of the American Psychiatric Association (DSM); however, there is evidence that sustains it [8–10]. This proposal has emerged to explain the increase in overweight and obesity, establishing that foods high in sugar or fat may be causing physiological conditions similar to those that occur with the

use of addictive substances such as alcohol, tobacco, or drugs like cocaine and opiates [11]. These phenomena include changes in connectivity and information exchange between the structures of the cerebral reward system. These changes predispose the development of addictive behaviors [12–14].

Unlike drugs, sugar has the ability to elicit hedonic and caloric value, which have important implications in its consumption. The higher the hedonic value of food and drugs, the greater the release of dopamine in the nucleus accumbens, increasing lesions in the dopaminergic system, and the blocking of dopamine receptors that reduce the hedonic value of sugar-rich beverages and drugs [15]. Obese people have behavioral traits similar to those presented in people with addiction to drugs, such as impulsivity and bingeing on highly palatable foods [16]. In the case of soft drinks, it is important to mention that addiction is attributable to the high content of sugar [16]. High-fructose corn syrup is often added to soft drinks, which are one of the most consumed beverages in Mexico [6,17,18]. Therefore, in recent years, research has been conducted to define whether there is an addiction to sugar or beverages and foods high in sugar because although the neurobiological basis for which addiction to these foods could develop is known, it has not been fully accepted since it does not fully meet the diagnostic criteria of other addictive substances, such as intoxication or overdose [9,16].

There is only one scale that evaluates the food addiction conducted through the "Yale Food Addiction Scale" (YFAS) psychometric instrument [19]. It is composed of questions based on the criteria for substance dependence of the DSM-IV [20] and focuses on the identification of addiction symptoms to foods high in sugar or fat. Currently, the literature based on scales and instruments for assessing food addiction is available only for the English-speaking population, which could create certain complications for understanding and using it in multicultural populations. The translation and validation of scales allow researchers and health professionals to access reliable and cross-culturally validated evaluations and diagnostic instruments that allow their use in different populations [21]. There is little evidence of previous studies on the Mexican population that evaluate food addiction-related factors in humans [22]. For example, food self-efficacy is one of the factors investigated based on the cognitive social theory [23]. It is one of the personal determining factors for motivation and execution [24,25] related to the expression of healthy behaviors. Low self-efficacy is a useful parameter to identify addictive behaviors [17,26,27].

The YFAS evaluates a wide range of hypercaloric foods; however, it lacks specificity towards individual foods, so its application needs an adaptation that specifically evaluates a single food or beverage, and its possible diagnosis may be addiction to a particular food and not to food in general. Therefore, the purpose of this study was to develop and obtain the psychometric properties (validity and reliability) of a soft drink addiction scale in young Mexican adults. It was decided that only soft drink consumption would be studied since, as mentioned above, Mexico is the main consumer followed by the United States, with young adults being the main consumers, probably due to a range of sociocultural factors such as the high availability of these products and the lack of dissemination of healthy eating practices [6,18]. Additionally, sugar from soft drinks represents the main contribution of sugar intake in the Mexicans diet [28], and research indicates that consumption in an addictive way occurs mainly with sugar in beverages [29–31].

2. Materials and Methods

2.1. Study Population

A total population of 1100 students from the Autonomous University of Querétaro, a public university, participating in a University Health System program (SUSALUD for its acronym in Spanish), which is a comprehensive health program that performs an integral nutritional and health assessment of first year students, were initially invited to participate in this research. The sample size, a 50% prevalence of risk behavior, a 95% confidence interval, and a 5% error were estimated, which resulted in a sample of 285 participants. From these, non-probability convenience sampling was used for the final sample, consisting

of 394 participants who finished all the evaluation procedures; the participants came from 7 states in the center of the country. The inclusion criteria were as follows: (a) to be a student in SUSALUD program, (b) to have signed the informed consent letter, (c) to attend the instructional session for the study's participants, (d) attend the anthropometric evaluation, and (e) completely answer the scales in full. The exclusion criteria were null or partial responses to the scale. Participation by the students was voluntary and without any type of remuneration, either monetary or of any kind for their inclusion in this study. After informed consent was signed, they were instructed to answer a printed form of the instrument at home and deliver it the next day to avoid bias in response time. The data collection and instruments were applied between July and October 2018. The participants' names were not published at any time and the data provided were used solely for the present investigation. The ethics committee of the Department of Natural Sciences from the Autonomous University of Queretaro approved this study with registration number 98FCN2017 (1 July 2017) and ethical standards in accordance with the declaration of Helsinki and its later amendments.

2.2. Data Collection

2.2.1. Soft Drink Consumption

Soft drink consumption was estimated by using a semi-quantitative frequency questionnaire that evaluated consumption during the past year according to a daily, weekly, monthly, or annual basis. Sixteen different soft drinks were included, considering the option to indicate whether the soft drink was caloric or non-caloric. Soft drink options were based on their market availability at the time of this study. Six different portions were presented for each type of soft drink (30, 250, 355, 600, 1000, and 1500 mL). Soft drink consumption in mL was estimated based on the portion and the frequency selected by the participant.

2.2.2. Soft Drink Addiction Scale

The soft drink addiction scale used was derived from the YFAS [19]. The final version used is composed of 25 statements, with 5 possible responses (1 = never, 2 = once a month, 3 = two to four times a month, 4 = two to three times per week, and 5 = four or more times per week or daily). The drafting of the new scale considered the evaluation of the characteristic dimensions of substance addiction: binge eating, withdrawal syndrome, and craving [9,32]. The scale translation into Spanish was carried out by the authors, and the final version was reviewed by an expert translator. It was applied in this language since the total population's main language is Spanish. The YFAS scale has statements and response instructions according to the high-calorie food consumption, such as hamburgers or milkshakes; this scale was instructed to be responded according to the participants' soft drinks' consumption. For example, an item on the YFAS scale is "I find that when I start eating certain foods, I end up eating much more than I had planned" and, in the adaptation used in this study, is "I find that when I start drinking soft drinks, I end up drinking much more than I had planned". In addition, the adaptation of the scale to the Mexican context included universal indicators (Etic) that are relevant, adequate, and sensitive to the specific idiosyncratic characteristics (Emic) for the Mexican culture to grant a good execution of the construct [33,34]. Moreover, the impaired control of soft drink consumption was evaluated by means of four statements with the same five response alternatives as the rest of the scale. This set of statements came out from the scale, but due to previously reported difficulties in the evaluation of this construct, they were analyzed separately and were only used for this study [35,36]. The complete scale is available upon request from the corresponding author.

2.2.3. Self-Efficacy

The evaluation for self-efficacy was performed using the modified and adapted version for soft drinks' consumption [23]. The measurement was made up of 12 numerical estimation items, with answer options ranging from 1 to 10, allowing to estimate the ca-

pacity to avoid consuming sweetened beverages (e.g., I can stop drinking soft drinks and drink natural water). This scale was used since it has construct validity, criteria validity with the body mass index (BMI) of participants, and predictive validity of food risk problems, as well as Cronbach's alpha reliability levels of 0.80 (95% CI = 0.76–0.83) for the total instrument.

2.3. Anthropometric Analysis

All participants were instructed to attend analyses in fasting conditions at the Nutrition Clinic on the day. They were also advised to wear light clothes and to remove all metallic accessories for body composition assessments. The measures were performed by a trained and standardized nutritionist. Weight and height were taken in duplicate following the standard procedures of the World Health Organization (WHO) [37]. Height measurements were performed with a stadimeter (Holtain Limited, Crosswell, Crymych, Pembs, UK). Weight determination and body composition data were measured using a multifrequency bioelectric impedance device (Seca mBCA 515, model 0123; Hamburg Germany). We only used the body fat percentage (TBF%) measure for this study.

2.4. Statistical Analyses

Psychometric characteristics of the instrument were evaluated according to the frequency of individual items in the questionnaire and its distribution. To select the items with the best discrimination, the item-total correlation criterion was used, eliminating the items that obtained a correlation of less than 0.20. An exploratory factor analysis was performed to obtain the validity of the construct. To assess the reliability of the instrument, two procedures were used (Guttman's split-half methodology and internal consistency: Cronbach's alpha). A descriptive analysis (measurements of central tendency and dispersion) was carried out for each of the factors found. In addition, Pearson's correlations were used between the factors of the scale, as well as with the self-efficacy, soft drink consumption control impairment, and body fat percentage (TBF%) to obtain the validity of criterion. Finally, a stepwise multiple regression analysis was performed to estimate the predictive validity of the scale obtained on the consumption of soft drinks. Data analysis was performed using the program SPSS 22.

3. Results

The sample studied consisted of 158 men (40%) and 238 women (60%). The age range of participants was 18 to 32 years old, with an average age of 19.05 ± 1.97 years (Table 1).

Table 1. Age and school characteristics of students.

Variable	n	Weighted%
Age, years		
18	156	39.6
19	105	26.7
20	39	9.8
21	22	5.6
22	22	5.6
23–32		12.7
School		
Languages	105	26.6
Engineering	70	17.8
Chemistry	65	16.5
Natural Sciences	61	15.5
Political Sciences	61	15.5
Medicine	32	8.1

3.1. Factor Validity of the Scale

The correlation matrix was evaluated using the Kaiser–Meyer–Olkin (KMO) sampling adequacy index, and the obtained value of 0.916 was considered excellent. Bartlett's sphericity test index was significant (X2 = 5335; DF = 210; $p < 0.001$), indicating the significant correlations between the items and the adequacy of the multidimensionality. Therefore, it was possible to carry out a factor analysis. Subsequently, an exploratory factor analysis of the main axes and with orthogonal rotation was performed, which resulted in three factors: (1) withdrawal syndrome symptoms, (2) persistent desire, and (3) decrease in social or recreational activities (see Table 2). The criterion for selecting a factor was the break point of the Catell's sedimentation graph. In addition, it was chosen that the eigen value should be greater than 1. To interpret the factors, the inclusion criterion for an item within each factor had to have a factor weight greater than 0.35 and not have a similar factor weight in another factor [38]. Additionally, the conceptual clarity of each dimension was considered, so that each factor had at least three items. The factorial solution obtained explains 54.8% of the total variance, which was considered as sufficient and indicative of the amount necessary to represent that the measured construct was obtained.

Table 2. Factor analysis of the soft drink addiction scale.

Item	Rotaded Factor Loadings		
	Withdrawal Syndrome Symptoms	**Persistent Desire**	**Decrease in Social and Recreational Activities**
My behavior towards my soft drink consumption causes me stress or distress.	0.816		
I have experienced anxiety when I decrease or avoid drinking soft drinks.	0.754		
I experience agitation or any other physical symptoms when I decrease or avoid drinking soft drinks.	0.702		
I drink the same types and amounts of soft drinks even when they cause me emotional trouble.	0.685		
I drink soft drinks to the point where I feel bad physically.	0.673		
I need to increase the regular amount of soft drinks I have to feel satisfied.	0.646		
I feel exhausted after drinking soft drinks in excess.	0.603		
My consumption of soft drinks has caused me depression, anxiety, anger, or guilt.	0.600		
My consumption of soft drink has caused a health problem or made one worse.	0.548		
I have drunk soft drinks to avoid sensations of agitation or any other physical symptom I live with.	0.368		
I drink soft drinks with most of the meals I have during the day.		0.746	
My consumption of soft drinks is high, but I do not consider it a problem.		0.666	
I drink soft drinks even when I am not thirsty anymore.		0.580	
When soft drinks are not available, I try to get them even if I have other options such as regular or flavored water.		0.554	
When I am drinking soft drinks, I end up having more than I had planned.		0.535	
I have a great craving or urgency to consume soft drinks when I have decreased or avoided its consumption.		0.496	
I avoid certain social/professional situations because there will not be soft drinks available.			0.831
My consumption of soft drinks is such that I stop doing activities like working, spending time with my family/friends, and other activities I like.			0.586

Table 2. *Cont.*

Item	Rotaded Factor Loadings		
	Withdrawal Syndrome Symptoms	**Persistent Desire**	**Decrease in Social and Recreational Activities**
I have avoided certain family, social, or professional situations where there will be soft drinks available because I am afraid of drinking in excess.			0.474
My soft drink consumption is such that I have depression, anxiety, anger, or guilt in such a way that I stop doing activities like working, spending time with my family/friends, or other activities I like.			0.482
I experience problems with my work and school skills, family, or social activities due to my soft drink consumption.			0.352
Explained variance	28.9%	14.4%	11.5%

3.2. Reliability of the Soft Drink Addiction Scale

The total reliability of the instrument was obtained by two different procedures that are typically used in reliability studies. The first was split-half methodology. The obtained result for section 1, with 13 statements, had a value of 0.912; section 2, with 12 statements, showed a value of 0.786. The correlation between procedures was 0.723, with a Spearman–Brown unequal length coefficient of 0.839 and a Guttman model reliability of 0.833.

The second methodology used was the internal consistency analysis (Cronbach's alpha coefficient), which showed an index of 0.903 (95% CI = 0.88–0.91) for the instrument as a whole, indicating the stability of the scale. The reliability levels obtained indicate that the instrument items are homogeneous in the construct measurement, and the relevance points out that the scale can be evaluated through the relationship between all the items that comprise it. The detailed values of the descriptive analysis obtained for each factor are shown in Table 3. The reliability confidence interval does not decrease below 0.78 and does not exceed 0.93, indicating the stability of the scale.

Table 3. Descriptive statistics of soft drink addiction scale.

	M	**SD**	**Items**	**Range**	**α**	**CI 95%**
Withdrawal syndrome symptoms	11.54	4.09	10	10–50	0.92	0.90–0.93
Persistent desire	8.66	3.69	6	6–30	0.82	0.79–0.84
Decrease in social activities	5.27	1.34	5	5–24	0.81	0.78–0.84

3.3. Soft Drink Consumption and Criterion Validity

The total consumption of soft drinks in the studied sample comprised an average of 1709 mL/week. Participants' mainly consumed caloric soft drinks with an average of 1572 mL/week, while non-caloric soft drinks had a lower average consumption of 137 mL/week. Regarding the preference of taste-based consumption, it was observed that cola-flavored soft drinks were the most consumed (49.6% of the individuals), followed by the apple, lemon-lime, and orange flavors (12.9%, 8.4%, and 4.3%, respectively). The remaining 24.8% was distributed among 13 different flavors. It is important to note that only four of the participants, which represents 0.1% of the sample, reported no consumption of soft drinks during the last year. The correlation between scale factors and soft drink indicators is shown in Table 4.

Table 4. Intra-scale correlation coefficients with the indicators of soft drink consumption.

	Persistent Desire	Decrease in Social and Recreational Activities	Caloric Soft Drink	Non-Caloric Soft Drink	Total Soft Drink
Withdrawal syndrome symptoms	0.579 **	0.779 **	0.162 **	0.041	0.167 **
Persistent desire		0.416 *	0.305 **	0.172 **	0.335 **
Decrease in social activities			0.086	−0.001	0.084

* $p < 0.05$, ** $p < 0.01$.

Table 5 shows the criteria validity, which was evaluated with Pearson's correlations between the three obtained factors in the scale and the measurements of independent constructs (impaired control and self-efficacy). Additionally, a correlation of 0.193 ($p < 0.05$) was found between the sum of the scale factors and the TBF%, as well as a positive correlation between persistent desire and TBF%.

Table 5. Criterion validity between the soft drink addiction scale factors, independent constructs, and TBF %.

	Impaired Control	Self-Efficacy	TBF %
Withdrawal syndrome symptoms	0.313 **	−0.386 *	0.105
Persistent desire	0.241 **	−0.605 **	0.180 *
Decrease in social activities	0.214 **	−0.197 **	0.0004

Pearson's correlation coefficients. TBF %, total body fat percentage. * $p < 0.05$, ** $p < 0.01$.

In order to obtain the predictive validity of the soft drink addiction scale, the prediction of each factor regarding soft drink consumption was made. Stepwise multiple regression analyses were performed considering the soft drink consumption as a dependent criterion. In the first analysis, non-caloric soft drink consumption was integrated as an independent criterion, and the factor of persistent desire was found to be statistically significant as an independent predictor ($F = 13.23$, $\beta = 0.182$, $p < 0.001$), with a value of $R2 = 0.033$. The second regression analysis integrated the caloric soft drink consumption as a dependent criterion. For this model, the three factors of the soft drink addiction scale were considered as predictors. The results showed that persistent desire is the best independent and statistically significant predictor that was entered in the regression model ($F = 35.81$, $\beta = 0.029$, $p < 0.001$), with a value of $R2 = 0.084$. Therefore, this factor explains 8.4% of the variance of caloric soft drink consumption. This was performed in this manner to strengthen the theory that sugar is the component that constitutes the addictive characteristics of these drinks.

4. Discussion

The instrument reliability obtained using Cronbach's alpha is considered very good [39], which indicates that the instrument items as a whole are correlated with each other and that the scale is stable and can be used over time. Through the exploratory factor analysis, we identified three factors that evaluate the soft drink addiction scale, namely (a) withdrawal syndrome symptoms—a condition of clinical importance since it manifests with dysfunctions at the psychiatric, motor, and autonomic level such as elevation in blood pressure, irritability, insomnia, and anxiety [19]; (b) persistent desire—a reflection of the knowledge of the high soft drink consumption by the person, in which it remains constant even when attempts have been made to stop or reduce it, indicating that the person has incomplete control of this behavior [19]; and (c) decrease in social and recreational activities—a clear example of the individual's social activity detriment, which can cause greater problems at work and family, promoting an even greater consumption of soft drinks [20]. It is important

to indicate these factors because they are widely recognized as diagnostic criteria for substance addiction. In addition, all these manifestations can worsen if soft drink consumption is maintained. In this way, the full scale presented here meets the established criteria for the diagnosis of substance addictions, which supports its use [7–9,32]. This is similar to what was found in a study where a factorial analysis of a Spanish translation of the YFAS was performed in a Mexican sample [40]. Five factors were found, which include those encountered in this study and with the YFAS itself [19], where four factors were found. The differences in the number of factors found may be due to an adaptation of the scale being carried out for the evaluation of soft drinks only and not food in general. Therefore, the factors obtained may vary in regard to the consumption characteristics of general food versus soft drinks.

A positive correlation was found between soft drinks' consumption and the factors of the soft drink addiction scale, mainly with caloric soft drinks, which agrees with the other results found in this study and indicates that the addictive component is the sugar content that is only found in caloric drinks. The above can be explained by the capacity of sugar to activate the opioid and dopaminergic systems, having important implications in generating changes in neuronal communication, mainly in the metabolism of neurotransmitters involved in these systems. This, in turn, causes a detriment in the normal functioning of the brain structures involved and leads to the development of addictive behaviors, and, in this case, with its manifestation being the high consumption of soft drinks [9,15,32]. The scale also has criterion validity with the measurement of self-efficacy on sweetened beverages, which corroborates with what was previously reported [17], in which it was observed that the self-efficacy construct is an important predictor in soft drinks' consumption, and even greater than the behavioral intention of consuming either caloric or non-caloric soft drinks. This trend has been found in other types of health risk behaviors such as lack of physical activity or high consumption of high-fat foods [23]. Among the findings, criterion validity was also found with impaired control measurement. While the YFAS did not perform any anthropometric or body composition measurements, a correlation was found in this study between the soft drink addiction scale and TBF%, which increases the scale's validity since it is a sensitive body composition indicator of high soft drinks' consumption [3].

One of the main advantages of carrying out this work is the specificity that is achieved by adapting the scale to a single food group, which provides us with a specific evaluation point of a risk eating behavior, since the original scale evaluates a wide range of foods high in sugar or fat and therefore the diagnosis can be ambiguous when pointing out the specific foods on which an intervention should be performed. The instrument has the ability to help (mainly) in Latin American and Spanish-speaking countries, which are particularly vulnerable since they have populations with the highest levels of soft drink consumption worldwide. According to the study by Martinez et al. [41], there is a high consumption of sugar sweetened beverages (SSB) in Latin American countries (Mexico, Brazil, Argentina, and Uruguay), representing between 18 and 37% of total fluids' intake. This study particularly shows that Mexico, followed by Brazil, shows the highest levels of carbonated sweetened drinks' consumption with averages of 171 mL/day and 168 mL/day, respectively, which increases the need for the development of instruments to understand the problem of high SSB consumption. These populations also lack evaluations that are quick, simple, and low-cost, with a special focus on the evaluation of symptoms and behaviors related to a high consumption of soft drinks. Therefore, the instrument presented here can provide vital support in these countries; this increases the need for the dissemination of the results and information presented in this study.

This study may not have reproduced the original factors of the YFAS, probably due to the demographic and cultural differences between the sample used in the original scale's construction and the sample in this study. In order to complement and strengthen the scale, it is necessary to include items focusing on the evaluation of other related behaviors, such as compulsivity and craving, in addition to diagnostic criteria for substance addiction.

This is the first study on the Mexican population that evaluates the addictive characteristics of soft drinks' consumption, and it represents an important advancement in the exploration of the field of food addiction. The scale presented in this study could be applied in universities and health centers to generate a broader reach to their populations. Additionally, this scale provides a tool with high potential for the development of prevention and treatment strategies against excessive soft drink consumption and can be used in various research topics, such as physiology, psychology, and behavioral sciences, as well as to complement the current human health guidelines or the prevention and treatment manuals of obesity, diabetes, and hypertension. It even applies to research in neurophysiology and neuroimaging as a simple and quick assessment prior to diagnostic studies.

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