



Review article

Analysis of health habits, vices and interpersonal relationships of Spanish adolescents, using SEM statistical model

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ABSTRACT

The objective of this article is to know the state of health of a sample of adolescents and how it relates to toxic habits and personal relationships. Likewise, it is presented how can influence eating habits, sports practice and interpersonal relationships in their general health status. The research has carried out through a survey of 56 questions to 470 adolescents, between 13 and 18 years old, of both sexes, of different schools in the province of Cordoba, Spain. These results have been subjected to a statistical model widely used in health and social sciences in general, called Structural Equations Model (SEM), through the SPSS program, v. 23 and AMOS. SEM is widely used in the social sciences to estimate regression models (usually multi-equational). The estimated model shows a significant global acceptability based on the usual statistical tests and goodness-of-fit measures. In this regard, these results are: CMIN = 17.554 with 33 degrees of freedom (DF) and a probability level, $p = 0.987$, which is higher than any reasonable level of significance ($\alpha = 0.05, 0.10, \text{even } 0.20$). Likewise, FMIN = 0.038, CFI = 1.000 and RMSEA = 0.000. The main recommendation of this research aimed at improving good eating and healthy habits, and to avoid toxic habits of adolescents, is to begin the education in the family, in coordination with their school and high school.

1. Introduction

Adolescence is a stage of transition between childhood and adulthood. It is a period of important physical, emotional, social and cognitive changes that cause contradictions, alternations, opposition to rules and ambivalence at any level, especially in the process of personal and social balance, therefore is a critical moment for the development of the individual (García et al., 2012). Hence, this period becomes a decisive stage in the acquisition and consolidation of healthy lifestyles, as well as is a time of experimentation and choice of behaviour that is related to health. There are important aspects that provide the individual with a well-being and implies the subsequent development at the biopsychosocial level of the person, influenced by fashions and trends.

The acquisition of toxic habits can represent a novelty for the adolescent who wants to integrate experiencing something different, or, be a way to attract attention, which often have serious consequences for the health and the behaviour of people. However, as regards tobacco, for

example, in recent years there have been advances in control policies in Spain. Thus, a decrease in prevalence in the general population has been observed, in large part associated with greater early abandonment among smokers.

The main contribution and originality of this research is that all adolescent problems in relation to eating, healthy and habits, interpersonal relationships, etc., are analyzed -not from a disaggregated point of view- but rather transversal and integral. And this can be achieved thanks to the structural equation model. However, the specific problem presented is the neglect of health in the classrooms of adolescents and young people in Córdoba, Spain, which can be extrapolated to the rest of the country. Obviously, this study is only the beginning of a series of investigations that try to raise this problem to find alternative solutions. Based on the above, the hypotheses (H) of our investigation were:

H1. The state of health is closely related to toxic habits and interpersonal relationships.

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- H2. Eating habits directly influence health status.
- H3. Sports practice is related to health status.
- H4. Interpersonal relationships have an impact on health status.

2. Literature review

The main determinants of health in adolescence are the lifestyle, such as food and physical activity, as well as others such as the consumption of toxics (García et al., 2012). The World Health Organization (2003), in the summary of the conclusions of the Macroeconomics and Health Commission, focuses on specific goals and timetables to reduce suffering and increase well-being in the health of adolescents. However, these subjects are not included in the academic programs of the schools, a regulated and specific training in this regard. Kim et al. (2016), indicates that the eating habits of adolescents are associated with low academic performance. In fact, it appears in several articles, the conception of health as a way of living in an autonomous, satisfactory, healthy and supportive way. The action is placed at the educational level in the creation of a health classroom.

Carrasco-Luna et al. (2018) present a fairly complete description of the eating, healthy and toxic habits of adolescents. In this regard, they analyze adolescent nutritional requirements from a scientific, nutritional, and psychosocial point of view, emphasizing the main risks of malnutrition at this age. For instance, too many teenagers are alone at home and prepare their own meals. The influence of friends replaces parental rules. The authors also mention that the habits of adolescents are characterized by a tendency to skip meals, especially breakfast, and, less frequently, the midday meal; to purchase carry-out meals away from home; to consume snacks, especially sweets; to eat at fast food restaurants, almost always with high-calorie content; and to eat fried foods, soft drinks, and sweets. Toxic habits, such as smoking, alcohol, and drugs, interfere with a healthy diet, as well. Regarding, physical activity, the authors say that usually decreases during adolescence, particularly in girls. The lack of physical activity is due to a precarious knowledge of the benefits associated with practicing physical activity, low motivation, time constraints, and, in many cases, the lack of adequate facilities. On this same matter, in 2018, Larsen et al. have studied that although parents often report positive intentions to promote and create a healthy food environment for their children (e.g., setting limits to snacks offered), they also experience difficulties in translating these intentions into actual behaviors. Likewise, Scarbrough et al. (2019) study that as young adults transition from secondary education to post-secondary education, they enter a time of life when they are able to independently and potentially for the first time make all of their own food decisions. This shift from childhood to young adulthood and the new-found freedom to make food decisions makes students vulnerable to weight gain. In addition, and of much concern, during this transition health behavioral patterns develop that often persist into later life. In 2018, Rathi et al. affirm that family-environmental determinants of adolescent dietary habits provides useful directions for nutrition promotion interventions. Health and educational professionals associated with adolescents could communicate about the development of healthy home food environments to provide positive health benefits for adolescents and their families.

A research carried out by the Committee on Nutrition Standards for Foods in Schools, of The National Academies of Sciences Engineering Medicine (2007), assured that good nutrition during childhood and adolescence is essential for growth and development, health and well-being, and the prevention of some chronic diseases. However, the diets of many American children are far below recommended dietary standards. Furthermore, poor diet and physical inactivity, resulting in an energy imbalance, are the most important factors contributing to the increase in childhood obesity. The study AVENA (Food and Nutritional

Assessment of Adolescents, 2003–2006) showed that the caloric distribution has been characterized by a high consumption of fat and low carbohydrates and that the consumption of dietary fibre among Spanish adolescents is deficient (Wärnberg et al., 2006). In the society in which we live, the main role of socializing agent is maintained by the family. Learning takes place, fundamentally, through the imitation of the behaviours of parents by their children, and through open communication between them in the process of growth and maturation (García et al., 2012). The research by Koehler et al. (2012) focused on iron depletion that would occur more frequently among athletes than in the general population. But they mentioned that there was little information available on the prevalence of iron status abnormalities in young athletes and whether the depletion of iron was associated with factors related to gender, sports, age, or nutrition. Braun et al. (2009) conducted research to evaluate information on dietary supplement use among 164 elite adolescent and youth athletes, ages 13–19. 80% reported having used at least 1 supplement, and the prevalence of use was significantly higher in athletes aged 16–19 years.

According to Rojas (2013), the family atmosphere, the relationship between parents and children, the styles of parenting, family climate, conflict, resilience of the periods of crisis, parental perception of the use of alcohol (Bräker and Soellnes, 2016) and other drugs among other factors, apparently determine the likelihood of certain adolescents' risk factors. Nevertheless, they can contribute to the psychological, emotional, behavioral empowerment and development of good quality of parental bonds, and the family system. The study of the National Commission of prevention and consumption in schoolchildren for the development and life without drugs (DEVIDA, 2012), confirm that alcohol continues to be the legal substance most consumed by schoolchildren, although the consumption of tobacco and marijuana is usually later, it is currently reaching very high levels (Rojas, 2013).

About articles on specific foods for young athletes, Lomiwes et al. (2019) ensure that affective responses experienced during exercise are a significant determinant on exercise adherence. These authors have previously demonstrated that consumption of New Zealand blackcurrants preserves cognition by attenuating the feeling of fatigue. Likewise, Patton-Lopez et al. (2018) examine the impact of a sport nutrition education and life-skills intervention on sport nutrition knowledge (SNK), attitudes/beliefs and dietary behaviors relevant to sport nutrition among high school (HS) soccer players. Similarly, the statement of Desbrow et al. (2014) is that dietary education and recommendations for adolescent athletes should reinforce eating for long term health. In 2018, Nascimento et al. examine the impact of a sport nutrition education and life-skills intervention on sport nutrition knowledge (SNK), attitudes/beliefs and dietary behaviors relevant to sport nutrition among high school (HS) soccer players. In a similar study, Philippou et al. (2017) evaluated the impact of nutrition education on nutrition knowledge and adherence to the Mediterranean Diet (MD) and explore the effect of parental education on the swimmers' MD adherence. On this same matter, Chacón-Cuberos et al. (2018), carried out a study with a sample of 1,059 adolescents from various regions of Spain and demonstrated that a healthy diet and regular practice of physical activity (PA), impacts multiple health benefits.

The study carried out by López-Sobaler et al. (2016), focuses on negative aspects of sedentary life. In this regard, the authors consider that these adolescent and youth behavior styles are fostered by addictive video games and, more recently, by sports betting. The abuse of this type of entertainment are causes of obesity, disorders of sleeping habits and increased cigarette addiction. Pretty much the same, Caine et al. (2001) analyzed the increasingly dominant performance of smaller female gymnasts and the greater magnitude of training from an early age have raised public and medical concerns, especially from an auxological perspective.

More specifically, they should be encouraged to moderate eating patterns to reflect daily exercise demands and provide a regular spread of high-quality carbohydrate and protein sources over the day, especially in the period immediately after training. In this sense, [Rimmer et al. \(2007\)](#), also mention that children and adolescents with physical and cognitive disabilities have a higher prevalence of overweight compared to their non-disabled peers. This health risk can lead to a greater number of obesity-related secondary conditions (e.g., fatigue, pain, deconditioning, social isolation, difficulty performing activities of daily living) and can impose significant personal and economic hardship on the child and family. In the same way, [Keresztes et al. \(2008\)](#), make an important statement: habits of leisure time sports activity, similar to other health behaviours, are established during late childhood and early adolescence. They say that while regular leisure time sports activity is a natural part of children's lifestyle, it starts to decrease during adolescence, particularly among girls. Among the factors influencing children's sports activity, the role of parents, peers, and other members of children's social networks seem to be crucial. On the other hand, [Bean et al. \(2014\)](#), in their research focuses on the negative effects caused by the requirements for organized sport in adolescents and young people, and therefore, in their family environment. In this regard, the results of this study show the dark side of the competitive stress of organized sport in adolescents and young people. The authors conclude by proposing a model that explains in what circumstances sport leads to positive, but also negative results.

In reference to the problem of adolescents and young adults (AYAs) with drug and sex problems that lead to cancer, [Morgan et al. \(2010\)](#) say that AYAs are a distinct group whose needs have been poorly addressed within health care systems. Besides, this article discusses some of the psychosocial issues of AYAs and, with reference to the phrase of sex, drugs, and rock and roll, highlights the various rites of passage that young people experience. Likewise, [Angus et al. \(2014\)](#) conducted research on the impact of alcohol consumption on age groups 16–17, 18–24, 25–34, 35–44, 45–54, 55–64 and over 75 years. They designed a 10-year screening program and brief interventions with a 30-year time horizon to estimate the total impact on health outcomes. The model showed an evident worsening of the mortality and morbidity rates in the analyzed population because of alcohol consumption, compared to the standard life tables of the general population. On this matter and although it is a fairly studied subject, [Irawan et al. \(2019\)](#), have confirmed once again that adolescent smoking behavior has a bad influence on health and fitness. The purpose of their study was to determine vital capacity and hemoglobin level in smoker and non-smoker adolescent towards physical fitness. The study was quantitative research with surveys and measurement tests. The value of hemoglobin levels in smoker adolescents were higher than non-smoker adolescents so that it affect the low levels of physical fitness. And when it comes to research on alcoholic beverages, it is important to mention to [Bardach et al. \(2019\)](#); they carried out an investigation based on mathematical models, and concluded that around 6% of all deaths are related to alcohol consumption worldwide.

In 2010, Elosua proposed a model in the framework of SEM to assess preferences among quality of life dimensions for the elderly. [Caridad y Ocerín \(2016\)](#), have also written a book with clear examples about SEM with Amos. [Roberts and Thatcher \(2009\)](#) improved the practical elaboration of statistical models. Thus, they proposed some general principles to specify whether a statistical model should first be defined conceptually; then discuss the underlying statistical logic, and finally model and evaluate the results. We have also reviewed the classical literature on this topic, such as [Kline \(2016\)](#), who in the fourth edition of his book, presents the most updated criteria to adjust the SEM. Likewise, [Bagozzi & Heatherton \(1994\)](#), who proposed a framework for representing personality constructs at four levels of abstraction, using latent variables. [Browne and Cudeck \(1993\)](#), who had considered two types of error involved in fitting the model: the first was error of approximation and the second was overall error, which involved the fit of the model. [Bentler \(1990\)](#) cited that normed coefficient yield new norm (CFI), and

non-normed fit indexes (FI), are frequently used as adjuncts to chi-square statistics for evaluating the fit of a structural model. Similarly, [Bollen \(1989\)](#) has written about structural equations with latent variables including case studies in the field of social sciences.

3. Methods

3.1. Results

The survey was conducted during the 2016–2017 academic year and directed to a representative sample of 470 adolescents and young students from eight centers in Cordoba, capital, and province. For this, authorization was obtained from the management of the centers, this had consent for the performance of these activities by the parents of the students. They were studying high school and senior high school. Of this total, 461 have been validated. 52.1% were girls and 47.9% boys, whose ages were between 12 and 18 years; however, 75.5% of the answers came from 16, 17 and 18 year olds. The survey contained 56 questions about the sociodemographic profile, eating habits, sports hobbies and social relations of the respondents, which converged in the study on health. The structure of the survey was divided into six large blocks: (i) general information of the surveyed (educational center, course, age and sex); (ii) potential toxic habits; (iii) practiced sports; (iv) eating habits; and, (v) interpersonal relationships. The survey included yes/no, open and closed questions and responses, which were measured on a 5-point Likert scale (1 = *not very important*; 5 = *very important*). A non-probabilistic sampling technique was used, which is widely utilised in this type of research, where the sample is available to be surveyed in a certain place and time. The variables with several ordered categories have been considered as numerical data, as well as binary variables with two alternatives, whose associated and estimated coefficients with the structural equation model used, they represent a differential effect of the presence of this characteristic with respect to the base value of each variable. The research project obtained a favourable report from the Research Ethics Committee of Cordoba.

3.2. Interpretation

The statistical analysis was performed using the SPSS v. 23 and the structural equation modelling (SEM) designed with AMOS (Analysis of Moment Structures) software, which configures IBM software added to the cited version of SPSS. A model with latent variables has been used since some concepts such as toxic habits or personal relationships are not directly observable and are observed through a series of measurable variables.

To support the hypotheses mentioned in section 1, the SEM model has been used. This model allows the examination of a set of relationships between one or more independent variables, whether these are continuous or discrete, developing a way to break the correlations observed in a system of equations that describe their hypotheses regarding causal relationships. The SEM model studies these causal relationships between data that are directly observable, assuming that existing relationships are linear.

3.3. Other comments: graphic designed with the AMOS

[Figure 1](#) shows the representation of the model developed by combining the software. The AMOS allows specifying, estimating, evaluating and presenting graphical models to show the hypothetical relationships between the variables. The latent variables are represented by the three ovals: (i) Health, (ii) Toxic habits and, (iii) Personal relationships, which are related to each other through covariances, symbolized by double arrows. Likewise, each one of them is related to its observable variables (rectangles) that, in total, add up to twelve. In turn, each observable variable has its error variable. The detail of these

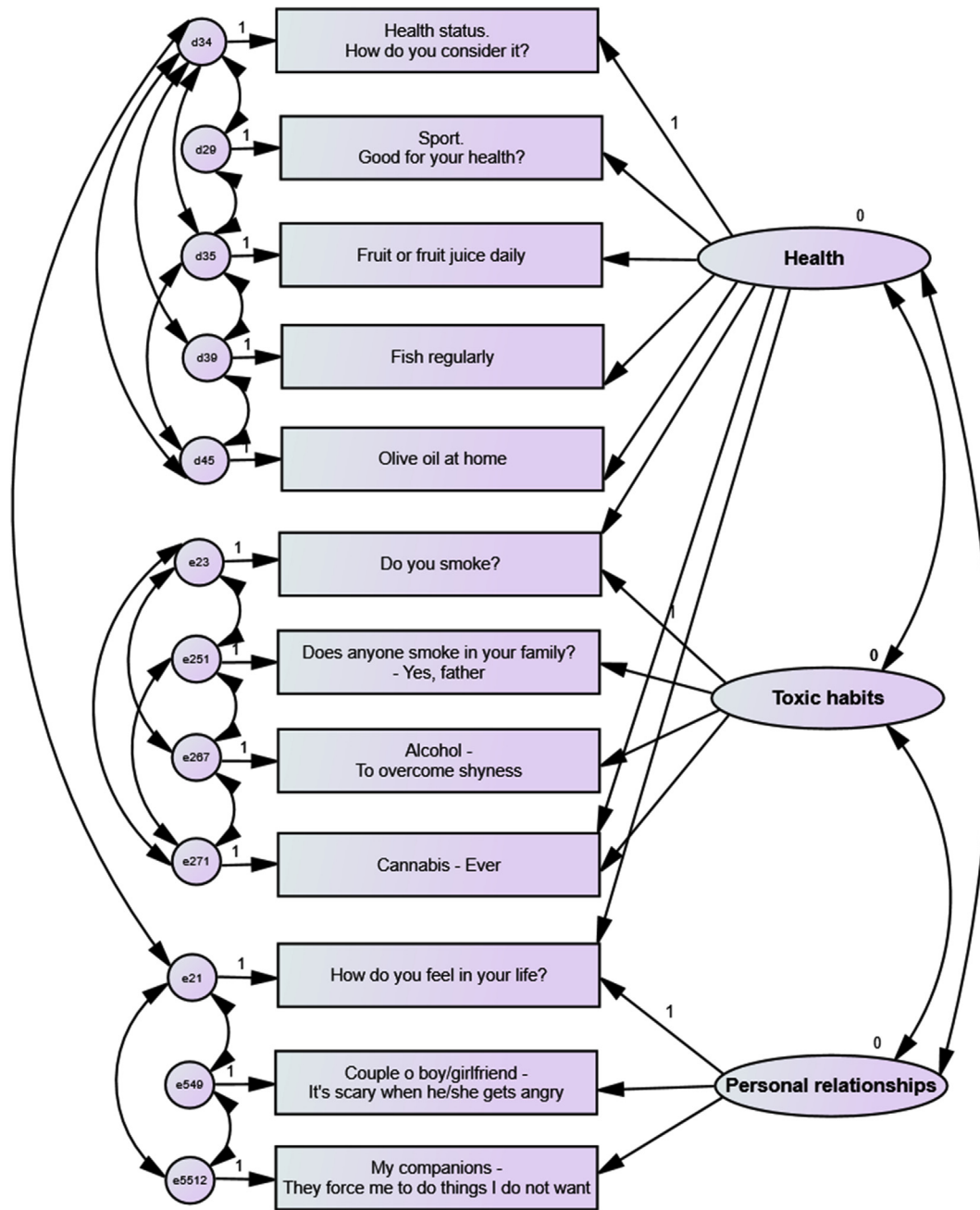


Figure 1. Statistical graph.

relationships—arrows that represent the connections that concern regressions and correlations is described below.

- a. The first latent variable, Health, is related to five types of observable variables: (i) State of health, how do you consider it? And (ii) Sport, good for health? It is also linked to the observable variables of (iii) eating habits, (iv) toxic habits, and (v) feelings about life. The variables of the alimentary habits with which it is related are: Fruit or juice of daily fruit, Fish with regularity and Olive oil in house. Those of the toxic habits are: Do you smoke? and Have you ever used cannabis. Finally, it is related to the observable variable How do you feel in your life?
- b. The second latent variable, Toxic Habits, is related to the observable variables: Do you smoke?, In your family, does anyone smoke? - Yes, father, Alcohol - To overcome shyness and Have you ever used

cannabis. In this sense, a person with acute toxic habits should present positive responses to the observable variables.

- c. The third latent variable, Personal relationships, is linked to the observable variables: How do you feel in your life?, Couple or boyfriend - It's scary when you get angry and My colleagues - They force me to do things I do not want.

Regarding the error variables of the observable variables, they have been ordered in three groups, basically around the observable variables of each latent variable. The covariance between the error variables d34 and e21 is striking because it is the only covariance between the error variables that do not belong to the same group. The relationships among the variables (arrows representing the connections pertaining to regressions and correlations) are described in more detail below, in section 4.1. The respective weights and coefficients are presented in Table 1 and Table 2.

Table 1. Regressions.

		Estimate		S.E.	
Q267	Alcohol -To overcome shyness	<-	Xi2	-2.719	12.298
Q21	How do you feel in your life?	<-	Xi3	1.000	
Q549	Couple o boy/girlfriend – It's scary when he/she gets angry	<-	Xi3	-1.180	0.739
Q39	Fish regularly	<-	Xi1	1.874	3.559
Q5512	My companions – They force me to do things I do not want	<-	Xi3	-0.028	0.148
Q35	Fruit or fruit juice daily	<-	Xi1	1.178	2.294
Q45	Olive oil at home	<-	Xi1	-0.566	1.096
Q29	Sport, good for your health?	<-	Xi1	0.312	0.575
Q34	Health status, how do you consider?	<-	Xi1	1.000	
Q271	Cannabis - Ever	<-	Xi1	-2.846	5.288
Q21	How do you feel in your life?	<-	Xi1	-48.135	174.046
Q23	Do you smoke?	<-	Xi1	-4.367	8.218
Q271	Cannabis - Ever	<-	Xi2	0.320	1.674
Q23	Do you smoke?	<-	Xi2	1.000	
Q251	Of your family. Does anyone smoke? Yes, father	<-	Xi2	-1.227	6.041

Source: The authors.

The numbers 1 and 0 represent the weights of the regressions and covariances, respectively.

4. Results

4.1. Weights and coefficients

The estimated coefficients of the SEM model are presented in the following table, with their standard deviations. The objective hypotheses are confirmed, accepting the influence of the exogenous latent variables upon the endogenous latent variables.

The first and second column of Table 1 shows the question numbers of the survey included in the SPSS database. Thus, for example, Q267 refers to question number 26, item 7, “Alcohol – To overcome shyness”; Q21 refers to question 21, “How do you feel in your life?”, and so on. In this regard, the corresponding SPSS page editor is presented in Table 2 below.

As regards Figure 1, it should be noted that:

- The first latent variable, *Health*, is related to eight observed variables: *Health statues, ¿how do you consider it?; Sport, ¿good for your health?; Fruit or fruit juice daily; Fish regularly; Olive oil at home; ¿Do you smoke?; Cannabis – ever; and ¿How do you feel in your life?*
- The second latent variable, *Toxic habits*, is related to four observed variables: *¿Do you smoke?; Of your family, ¿does anyone smoke? – Yes, father; Alcohol – To overcome shyness; and Cannabis – ever.*
- The third latent variable, *Personal relationships*, is related to three observed variables: *¿How do you feel in your life?; Couple or boy/girlfriend – It's scary when he/she gets angry; and My companions – They force me to do things I do not want.*

As regards the error variables (which capture the variance not considered in the model), are closely interrelated.

On the other hand, all the variables were estimated through the Maximum likelihood estimation. The other method of structural equation is called Generalized least squares. All the results obtained are considered adequate, and therefore, the model is adjusted to the hypotheses. Following the instructions of Browne and Mels (1992), we will focus on the presentation of the main results of the research: Chi-square, Minimum value of the discrepancy of function F (FMIN), Comparative fit index (CFI) and Root Mean Square Error of Approximation (RMSEA).

4.2. Global test for the model (CMIN)

The chi-square (χ^2) goodness-of-fit test is one of the most widely used nonparametric tests to determine the discrepancy between an observed dataset and an expected dataset. This test and its limiting probability (p) are the only goodness-of-fit test associated with significance testing; the other measures and indices are merely descriptive. In this regard, the result obtained with the (χ^2) is very good: 17,554 with 33 degrees of freedom (DF). Likewise, the probability level ($p = 0.987$) is excellent, which is higher than any reasonable level of significance ($\alpha = 0.05, 0.10, even 0.20$). Therefore, it can be affirmed that the χ^2 obtained allows contrast to the hypothesis because the model correctly fits the 461 validated data.

Table 2. Covariances.

			Estimate	S.E.
Xi2	<->	Xi1	0.000	0.001
Xi2	<->	Xi3	-0.003	0.014
Xi3	<->	Xi1	0.007	0.013
e23	<->	e267	0.012	0.009
e251	<->	e271	0.010	0.008
e21	<->	e5512	0.009	0.055
e23	<->	e271	0.146	0.015
d35	<->	d45	0.002	0.003
d34	<->	e21	0.061	0.020
d29	<->	d35	0.002	0.001
d35	<->	d39	0.027	0.009
d39	<->	d45	0.006	0.003
e23	<->	e251	0.020	0.017
e267	<->	e251	-0.004	0.005
d29	<->	d34	0.005	0.002
e267	<->	e271	0.003	0.005
e21	<->	e549	-0.378	1.166
e5512	<->	e549	-0.008	0.006
d45	<->	d34	0.003	0.004
d35	<->	d34	0.016	0.011
d39	<->	d34	0.010	0.013

Source: The authors.

4.3. Goodness of fit indexes

4.3.1. Minimum value of the discrepancy of function (FMIN)

The *FMIN* index is used to measure a model's fit. *FMIN* is the minimum value of the discrepancy function *F*, which is obtained by fitting the model to population moments rather than sample moments. The value of 0.038, minimum value of the discrepancy is also considered an outstanding result.

4.3.2. Comparative fit index (CFI)

The comparative fit index (*CFI*) analyses the model fit by examining the discrepancy between the data and the hypothesized model, while adjusting for the issues of sample size inherent in the chi-squared test of model fit and the normed fit index. The values of this index vary between 0 and 1. By convention, the *CFI* value must be greater than 0.90. This indicates that at least 90% of the covariance of the data can be reproduced by the model. Therefore, the result of 1,000 is the maximum.

4.3.3. Root Mean Square Error of Approximation (RMSEA)

A measure of goodness of fit for statistical models, where the goal is for the population to have an approximate or close fit with the model, rather than an exact fit, which is often not practical for large populations. Values below 0.05 indicate a good fit of the model. Therefore, the result of 0.000 also indicates a perfect fit of the model.

In summary, all the results obtained allow to affirm that the elaborated model is correct, since it adequately specifies the relationships among the variables, thus predicting reality, which is manifested in the four hypotheses of the study.

Next, [Table 3](#) presents a summary of all the results obtained and discussed above.

The usual goodness of fit measures confirms the acceptability of the model. The saturated model has no degrees of freedom and corresponds to a perfect fit, while the independence model is the opposite extreme, when there is no relation between the observed variables. The proposed model provides values of fit near to the optimum values of the saturated model. The likelihood ratio statistics *CMIN* and the *FMIN* coefficient are close to its optimum.

5. Discussion

We are not concerned too much about health until we lose it; however, learning to take care of yourself and to have healthy habits, both food and non-toxic intake, must be based on learning to be critically aware of what affects your health. It rests on dynamic and variable criteria in relation to living conditions, responding to factors of biological and socioeconomic levels ([Bermejo Fernández, 2011](#)). That is the reason why inappropriate styles and habits of life form a set of behavioural patterns that can imply health risks from an early age. The ability to influence them, from the school environment, can represent a quantitative and qualitative improvement of the present and future health of adolescents. We know, therefore, that the variables most related to health and which should be influenced after analyzing our results, are food, physical exercise, and avoid or drastically reduce the consumption of toxic substances, such as alcohol and tobacco.

The eating habits acquired in the adolescence stage are decisive in the behaviour on the same stage in the adult age; many of these influences

promote dietary patterns that predispose to obesity in the future generations; therefore learning from childhood and adolescence is essential. Although the students who have participated in our study seem to have very clear knowledge about which are the most favourable foods for health, they are not consistent when it is consumed. The lack of knowledge during adolescence and youth about the potential diseases that can develop -such as obesity, hypertension, cardiovascular diseases, among others- can be the reason for this erratic behaviour during this stage of life.

Regarding toxic habits, tobacco should be highlighted. There is a downward trend in the current consumption of it in Spain: thus, in 2002, 14.7% of the population was addicted to tobacco, while in 2010, it dropped to 8.6%. The same pattern of decline occurred in adolescents, although to a lesser extent in women ([Moreno et al., 2013](#)). We can emphasize that the prevalence has increased among women in this age group (7.0%), compared to the prevalence in males (6.5%) ([Villabí et al., 2012](#)). At this point, it is important to mention that it must be vigilant about new forms of smoking, such as hookahs and vapers, among others. In this sense, the school can offer this learning framework, in order to reduce the adolescent's start in these vices ([EDADES, 2017](#)).

Alcohol consumption is variable, justified by the different social norms. The prevalence in Spain in the year 2002 was 30.8%, 49.7% in 2006, and 50.2%, in 2010 ([Moreno et al., 2013](#)). It is important to note that alcohol is the legal substance most consumed by adolescents and young schoolchildren. One of every four students who declares to have consumed alcohol at some time in their life had started alcohol consumption between 8 and 11 years ([Rojas, 2013](#)). In Spain today, and especially among adolescents, alcohol is the substance with the highest prevalence: among boys, 93.6%, and among girls, 88.8%. Likewise, according to [EDADES \(2017\)](#), alcohol has been consumed even once in life by most of the population of both sexes. Therefore, it is clear, the normalization and relativization of the mentioned consumption from an early age, since it is open and normalized among adults. Alcohol and tobacco are the substances that begin to be consumed earlier, at 16.6 years. The figures remain stable throughout the entire historical series of data analyzed in Spain (2002-2006-2010). Faced with this reality, it seems unquestionable that the school environment is the best place for health education ([EDADES, 2017](#)).

Regarding the consumption of marijuana and hashish, it should be noted that marijuana is the illegal drug with one of the highest consumption rates in the world. The serious added problem is that adolescents and young consumers do not know the harmful and irreversible effects that consumption implies for their health. The risk, from the perspective of public health, is alarming, since it is considered that the earlier the start of consumption, the more damaging its effects will be ([Rojas, 2013](#)). The prevalence in Spain was 38.4%, in 2002, 32.3% in 2006 and 29.0%, in 2010 ([Moreno et al., 2013](#)). Today, among illegal drugs, cannabis is the substance that begins to be consumed at an earlier age (18.4 years). The age of onset of consumption has been maintained between 18 and 19 years throughout the entire historical series mentioned above ([EDADES, 2017](#)).

On the other hand, intimate partner violence is a phenomenon of alarming magnitude, with a current prevalence in Spain of 24.1% in 2002, 12.5% in 2006 and 13.3% in 2010 ([Moreno et al., 2013](#)). First, romantic relationships during adolescence and courtship, configures to a large extent, the behaviour that the couple will have in the adult stage.

Table 3. *CMIN*, *FMIN*, *CFI* and *RMSEA*.

Model	Default model (Fixed model)	Saturated model (Perfect fit model)	Independence model (All coefficients are null)
<i>CMIN</i>	17.554	0.000	264.776
DF	33	0	66
<i>p</i>	0.987	-	0.000
<i>FMIN</i>	0.038	0.000	0.576
<i>CFI</i>	1.000	1.000	0.000

Sometimes, victims of adolescent violence could go unnoticed because they would be hidden within family and social roles. This will have a negative effect affecting adolescent health at different levels (García-Díaz et al., 2017).

There is an alarming increase of adolescents and young people with chronic pathologies, such as allergies, obesity, diabetes, as well as the growing increase and variety of addictions, in addition to a large number of other problems related to mental, physical, emotional, social or environmental, associated with family and social dysfunctions. This is creating a shortage of a clear strategy and care on society, regarding the promotion and health care, a problem difficult to justify.

Faced with the above, and as an alternative solution, there are countries where the need to implement a multidisciplinary educational program in schools is being evaluated, where subjects related to physical exercise, nutrition, toxic habits, first aid, etc., are mandatory for students. The concept of health as a form of living autonomously, in a satisfying, healthy and supportive way, based on the construction of the Health class within the school (Ignacio and Sousa, 2007), is one of the learning parameters and evaluation during the schooling. In this context, the World Health Organization recognizes that adequate investment in health education, from the earliest ages, is a positive and profitable impact for the economy and the sustainability of the welfare society (World Health Organization, 2003). Thus, the inclusion of a compulsory subject could be one of the best social investment projects, economically viable, for the future health of adolescents and young people. In this sense, the results obtained from this research, which are summarized in Table 3, and which indicate a highly satisfactory adjustment, support future evaluations of adolescent and youth health projects, which should be framed within the development strategies of the country.

Finally, based on the results of behaviours related to health, toxic habits and interpersonal relationships, it is well known that the family forms the pillar that helps the adolescent and the youngster's development. Educating in values such as physical activity, adequate nutrition and other healthy habits, as well as training in well-being and emotional health, are key factors that can improve health at all levels of the future population. It is evident that the health professional, who can collaborate in the implementation of this knowledge, will help the best development in health of the population, thus promoting prevention, promotion and education for health in the school setting that will affect the future in society.

6. Conclusions

The goodness of fit of the model of structural equations designed, is represented by the chi - square statistic (χ^2) that is equal to 17.554 with 33 degrees of freedom (DF). In addition, the probability level, p , 0.987, is optimum. Therefore, these results, as well as the others presented in section 4, allow us to contrast the four hypotheses defined in section 4.2, and, they are correctly adjusted to the 52 questions included in the 470 surveys conducted.

The endogenous variable, perception of health in adolescents and young people, correlates positively with sports, or physical activity, perform on a regular basis, which confirms the third hypothesis (H3). Likewise, the type of food is also positively correlated -stating the intake of juice and/or daily fruit, fish regularly and olive oil-fact that supports the second hypothesis (H2). The endogenous variable correlates negatively with toxic habits: cigarettes smoking and/or cannabis, which corroborates the first hypothesis (H1). The exogenous variables related to having or not health, are based on the sample and in the analysis of toxic consumption, emphasizing the relationship and influence of having family members that ingest alcohol and are addicted to tobacco, more than the conviction that they help them overcome behaviours such as shyness or socialization, facts that validate the first and fourth hypotheses (H1 and H4). Finally, it should be noted that the correlation between health and the exogenous variable, interpersonal relationships, affects negatively whenever the couple and/or friends contribute with toxic

feelings or fear, which also affirm the first and fourth hypotheses (H1 and H4).

Declarations

Author contribution statement

J. Vicente Fruet-Cardozo: Analyzed and interpreted the data; Wrote the paper.

Rafael A. Castro-Jimenez: Conceived and designed the experiments; Wrote the paper.

Francisco J. Fonseca del Pozo: Conceived and designed the experiments; Performed the experiments.

Gabriel Jimenez-Moral: Performed the experiments.

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The authors declare no conflict of interest.

Additional information

No additional information is available for this paper.

References

- Angus, C., Scafato, E., Ghirini, S., Torbica, A., Ferre, F., Struzzo, P., Purshouse, R., Brennan, A., 2014. Cost-effectiveness of a programme of screening and brief interventions for alcohol in primary care in Italy. *BMC Fam. Pract.* 15 (26), 5–8.
- Bagozzi, R., Heatherton, T., 1994. A general approach to representing multifaceted personality constructs: application to state self-esteem? *Struct. Equ. Model.* 1 (1), 35–67.
- Bardach, A., Alcaraz, A., Ciapponi, A., Garay, O., Riviere, A., Palacios, A., Cremonte, M., Augustovski, F., 2019. Alcohol consumption's attributable disease burden and cost-effectiveness of targeted public health interventions: a systematic review of mathematical models. *BMC Publ. Health* 19 (1378), 3–11.
- Bean, C., Fortier, M., Post, C., Chima, K., 2014. Understanding how organized youth sport may be harming individual players within the family unit: a literature review. *Int. J. Environ. Res. Publ. Health* 11, 10226–10268.
- Bentler, P., 1990. Comparative fit indexes in structural models. *Psychol. Bull.* 107, 238–246.
- Bermejo Fernández, M., 2011. Hábitos de vida y adolescencia. Diseño y pilotaje de un cuestionario sobre hábitos de vida en un grupo de adolescentes guipuzcoanos (13-17 años). *Zainak. Cuadernos de Antropología-Etnografía* 34, 75–105.
- Bräker, A., Soellner, R., 2016. Alcohol drinking cultures of European adolescents. *Eur. J. Publ. Health* 26 (4), 581–586.
- Bollen, K.A., 1989. *Structural Equations with Latent Variables*. John Wiley & Sons, New York, USA.
- Braun, H., Koehler, K., Geyer, H., Kleinert, J., Mester, J., Schänzer, W., 2009. Dietary supplement use among elite young German athletes. *Int. J. Sport Nutr. Exerc. Metabol.* 19 (1), 97–109.
- Browne, M., Cudeck, R., 1993. Alternative Ways of Assessing Model Fit. In: Bollen, K.A., Long, J.S. (Eds.), *Testing Structural Equation Models*. Sage, Newbury Park, CA, pp. 136–162.
- Browne, M., Mels, G., 1992. *RAMONA User's Guide*.
- Caine, D., Lewis, R., O'Connor, P., Howe, W., Bass, S., 2001. Does gymnastics training inhibit growth of females? *Clin. J. Sport Med.* 11 (4), 260–270. PubMedDOI:
- Caridad y Ocerín, J., 2016. In: *Modelos estructurales con AMOS*. Don Folio, Córdoba, Spain.
- Carrasco-Luna, J., Gombert, M., Carrasco-García, Á., Codoñer-Franch, P., 2018. Adolescent feeding: nutritional risk factors. *J. Child Sci.* 8 (1).
- Chacón-Cuberos, R., Zurita-Ortega, F., Martínez-Martínez, A., Olmedo-Moreno, E., Castro-Sánchez, M., 2018. Adherence to the Mediterranean diet is related to healthy habits, learning processes, and academic achievement in adolescents: a cross-sectional study. *Nutrients* 10, 1–13.
- Desbrow, B., McCormack, J., Burke, L., Cox, G., Fallon, K., Hislop, M., Logan, R., Marino, N., Sawyer, S., Shaw, G., Star, A., Vidgen, H., Leveritt, M., 2014. Sports dietitians Australia position statement: sport nutrition for the adolescent athlete. *Int. J. Sport Nutr. Exerc. Metabol.* 24 (5), 570–584.
- DEVIDA, 2012. IV Estudio nacional. Prevención y consumo de drogas en estudiantes de secundaria. Observatorio Peruano de Drogas – OPD. Mercedes Group S.A.C. Lima, Perú.

- EDADES, 2017. Ministerio de Sanidad, consumo y bienestar social. In: Encuesta sobre alcohol y otras drogas en España (EDADES), 1995-2017. España.
- García-Díaz, V., Lana-Pérez, A., Fernández-Feito, A., Bringas-Molleda, C., Rodríguez-Franco, L., Rodríguez-Díaz, F., 2017. Actitudes sexistas y reconocimiento del maltrato en parejas jóvenes. *Atención Primaria* (xx).
- García, M., Muñoz, R., Conejo, G., Rueda, A., Sánchez, J., Garrucho, G., 2012. Influencia de los hábitos de alimentación y actividad física de los padres y madres en sus hijos/as adolescentes. *NODO, Ayuntamiento de Sevilla, España*.
- Ignacio, D., Sousa, C., 2007. *Revista Fuentes*, 7, pp. 107–116.
- Irawan, F.A., Putra, A., Chuang, L.-R., 2019. Physical fitness of adolescent smoker. *Jurnal Kesehatan Masyarakat (KEMAS)* 14 (3), 398–403. <https://journal.unnes.ac.id/nju/index.php/kemas/article/view/17222>.
- Keresztes, N., Piko, B., Pluhar, Z., Page, R., 2008. Social Influences in Sports Activity Among Adolescents. *Perspectives in Public Health*.
- Kim, S., Sim, S., Park, B., Kong, I., Kim, J., Choi, H., 2016. Dietary habits are associated with school performance in adolescents. *Medicine* 95 (12).
- Kline, R., 2016. *Principles and Practice of Structural Equation Modelling*, fourth ed. The Guilford Press, New York, USA, pp. 262–299.
- Koehler, K., Braun, H., Achtzehn, S., Hildebrand, U., Predel, H.G., Mester, J., Schanzer, W., 2012. Iron status in elite young athletes: gender-dependent influences of diet and exercise. *Eur. J. Appl. Physiol.* 112 (2), 513–523. *PubMedDOI*:
- Larsen, J., Hermans, R., Sleddens, E., Vink, J., Kremers, S., Rutter, E., Fisher, J., 2018. How to bridge the intention-behavior gap in food parenting: automatic constructs and underlying techniques. *Appetite* 123, 191–200.
- Lomiwes, D., Ha, B., Ngametua, N., Burr, N., Cooney, J., Trower, T., Sawyer, G., Hedderley, D., Hurst, R., Hurst, S., 2019. Timed consumption of a New Zealand blackcurrant juice support positive affective responses during a self-motivated moderate walking exercise in healthy sedentary adults. *Sports Nutr. Rev. J.* 16 (33), 1–14.
- López-Sobaler, A., Rodríguez-Rodríguez, E., Aranceta-Bartrina, J., Gil, Á., González-Gross, M., Serra-Majem, L., Ortega, R., 2016. General and abdominal obesity is related to physical activity, smoking and sleeping behaviours and mediated by the educational level: findings from the ANIBES study in Spain. *PloS One* 11 (12), 1–13.
- Moreno, C., Ramos, P., Rivera, F., Sánchez-Queja, I., Jiménez-Iglesias, A., García-Moya, I., Fuchs, N., 2013. Estilos de vida y salud de los adolescentes españoles a lo largo de la primera década del milenio. *Health Behaviour in School-aged Children (HBSC) 2002-2006-2010*. Retrieved from. <http://publicacionesoficiales.boe.es/>.
- Morgan, S., Davies, S., Palmer, S., Plaster, M., 2010. Sex, drugs, and rock'n'roll: caring for adolescents and young adults with cancer. *J. Clin. Oncol.* 28 (32), 4825–4830. <http://ascopubs.org/doi/pdf/10.1200/JCO.2009.22.5474>.
- Nascimento, M., Silva, D., Ribeiro, S., Nunes, M., Almeida, M., Mendes-Netto, R., 2018. Effect of a nutritional intervention in athlete's body composition, eating behaviour and nutritional knowledge: a comparison between adults and adolescents. *Nutrients* 10 (11).
- Patton-Lopez, M., Manore, M., Branscum, A., Meng, Y., 2018. Changes in sport nutrition knowledge, attitude/beliefs and behaviors following two-year sport nutrition education and life-skills intervention among high school soccer players. *Nutrients* 10 (1637), 1–22.
- Philippou, E., Middleton, N., Pistos, C., Andreou, E., Petrou, M., 2017. The impact of nutrition education on nutrition knowledge and adherence to the Mediterranean Diet in adolescent competitive swimmers. *J. Sci. Med. Sport* 20, 328–332. *PubMedDOI*:
- Rathi, N., Riddell, L., Worsley, A., 2018. Indian adolescent's perceptions of the home food environment. *BMC Publ. Health* 18 (169). <https://bmcpublichealth.biomedcentral.com/track/pdf/10.1186/s12889-018-5083-8>.
- Rimmer, J., Rowland, J., Yamaki, K., 2007. Obesity and secondary conditions in adolescents with disabilities: addressing the needs of an underserved population. *J. Adolesc. Health* 41 (3), 224–229.
- Roberts, N., Thatcher, J., 2009. Conceptualizing and testing formative constructs: tutorial and annotated example. *ACM SIGMIS - Data Base* 40, 3–39.
- Rojas, M., 2013. Abuso de drogas en adolescentes y jóvenes y vulnerabilidad familiar, 106. Centro de información para la prevención del abuso de drogas.
- Scarborough, A., Xie, Y., Ratnapradipa, D., 2019. Experiential learning using graphic information system to promote healthy College eating habits. *Health Educ.* 51 (1), 19–25. Retrieved from. <https://files.eric.ed.gov/fulltext/EJ1248323.pdf>.
- The National Academies of Sciences Engineering Medicine, 2007. *Nutrition Standards for Foods in Schools: Leading the Way toward Healthier Youth*. The National Academies Press, Washington D.C., USA. Retrieve from. <http://nap.edu/11899>.
- Villalbí, J., Suelves, J., García-Contente, X., Saltó, E., Ariza, C., Cabezas, C., 2012. Cambios en la prevalencia del tabaquismo en los adolescentes en España. *Atención Primaria* 44 (1), 36–42.
- Wärnberg, J., Ruiz, J., Ortega, F., Romeo, J., González-Gross, M., Moreno, L., García-Fuentes, M., Gómez, S., Nova, E., Díaz, L., 2006. Estudio AVENA (Alimentación y valoración del estado nutricional en adolescentes). *Results* 2003-2006.
- World Health Organization, WHO, 2003. Report of a Joint WHO/FAO Expert Consultation. Geneva, Italy. Retrieved from [https://books.google.es/books?hl=en&lr=&id=S6YsDwAAQBAJ&oi=fnd&pg=PA4&dq=World+Health+Organization+\(2003\),+conclusions+of+the+Macroeconomics+and+Health+Commission&ots=t8ZPpIPJdf&sig=4rf9cNMJWs82Qkqs8hnWiojKrOQ#v=onepage&q&f=false](https://books.google.es/books?hl=en&lr=&id=S6YsDwAAQBAJ&oi=fnd&pg=PA4&dq=World+Health+Organization+(2003),+conclusions+of+the+Macroeconomics+and+Health+Commission&ots=t8ZPpIPJdf&sig=4rf9cNMJWs82Qkqs8hnWiojKrOQ#v=onepage&q&f=false).