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# Use of structural equation models to evaluate the relationship between eating patterns and obesity for elderly people

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*Uso de modelos de ecuaciones estructurales para evaluar la relación entre los patrones de alimentación y la obesidad en personas mayores*

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**ABSTRACT**

**Introduction:** in theBrazilian population it is noted that obesity is increasing in all ages, particularly in the elderly, due to changes in habits and the consumption of foods with high energy density. The objective of this study was to reanalyze the data from a Food Frequency Questionnaire (FFQ) in order to obtain new food patterns from the elderly population.

**Methods:** sociodemographic data, morbidities, and Food Frequency Questionnaire (FFQ) results were collected from a representative sample of 355 elderly in the city of Botucatu, São Paulo, Brazil, and stratified by Basic Health Unit in the municipality. The data from the FFQ were transformed into daily consumption, and only foods with an intake of at least 40 % were included in the analysis. Eating patterns were obtained by means of an exploratory and confirmatory factor analysis using the principal component method, with associations with obesity and demographic variables obtained via structural equation models (SEMs).

**Results:** with the data from the FFQ, four eating patterns were obtained using the exploratory and confirmatory factor analysis: healthy, traditional, snacks and weekend meals, and mild diet. Using SEMs and considering general obesity as measured by the body mass index (BMI), being female, younger, hypertensive, or diabetic, and having lower adherence to the traditional pattern increases BMI. Additionally, using SEMs and considering central obesity as measured by waist circumference (WC), being hypertensive or diabetic, and having a lower adherence to the traditional pattern increases WC.

**Conclusion:** removing excess zeroes from FFQ data it was possible to obtain well-defined eating patterns using the exploratory and confirmatory analysis, and to associate them with obesity through SEMs.

**Keywords:** Body mass index. Confirmatory factor analysis. Exploratory factor analysis. Food frequency questionnaire. Structural equation models. Obesity.

**RESUMEN**

**Introducción:** en la población brasileña se observa que la obesidad ha aumentado en todas las edades, incluidas las personas mayores, debido a los cambios en los hábitos y el consumo de alimentos con alta densidad energética. El objetivo de este estudio fue volver a analizar los datos de un cuestionario de frecuencia alimentaria (FFQ) con el fin de obtener los nuevos patrones dietéticos de la población de edad avanzada.

**Métodos:** se recogieron datos sociodemográficos y de morbilidad, y los resultados de un cuestionario de frecuencia alimentaria (FFQ) de una muestra representativa de 355 personas mayores de la ciudad de Botucatu, São Paulo, Brasil, y se estratificaron por Unidad Básica de Salud del municipio. Los datos del FFQ se transformaron en consumo diario y solo se incluyeron en el análisis alimentos con al menos un 40 % de consumo. Los patrones dietéticos se obtuvieron mediante el análisis factorial exploratorio y confirmatório con el método del componente principal, asociándolos con la obesidad y las variables demográficas mediante modelos de ecuaciones estructurales (SEM).

**Resultados:** con los datos del FFQ se obtuvieron cuatro patrones dietéticos mediante el análisis exploratorio y confirmatorio: saludable, tradicional, tapas y comidas de fin de semana, y dieta ligera. Con los SEM y considerando la obesidad general medida por el índice de masa corporal (IMC), ser mujer, más joven, hipertensa, diabética y con menos adherencia al patrón tradicional aumenta el IMC. Además, con los SEM y considerando la obesidad central medida por la circunferencia de la cintura (WC), ser hipertenso, diabético y tener

una menor adherencia al patrón tradicional aumenta los valores de WC.

**Conclusiones:** el análisis factorial exploratorio y confirmatorio reveló los patrones dietéticos y los modelos de ecuaciones estructurales resultaron útiles para obtener las relaciones existentes entre los resultados de interés.

**Palabras clave:** Índice de masa corporal. Análisis factorial confirmatorio. Análisis factorial exploratorio. Cuestionario de frecuencia alimentaria. Modelos de ecuaciones estructurales. Circunferencia de la cintura.

## INTRODUCTION

Obesity is currently one of the most serious public health problems and it can generally be classified as the degree of fat accumulation in the body associated with health risks due to its relation with several metabolic complications (1,2). The basis of this disease is the undesirable process of positive energy balance, that is, an imbalance between intake and energy expenditure, which results in weight gain. Considered as a multifactorial disease, its determinants may be biological, environmental, economical, social, cultural, or political (3).

Obesity growth in the elderly, as with other eating groups, may be associated with the events of this nutritional transition period in which changes in eating habits, increased consumption of foods with high energy density, and reduced intake of foods rich in fiber and nutrients become increasingly evident in society (4).

In addition to these changes in the eating pattern of the elderly population, there is also a decrease in physical activity in this phase of life. The World Health Organization (5) emphasizes physical activity, in association with food consumption, as fundamental factors

for the maintenance of the energy balance, that is, of the balance between intake and energy expenditure, thus preventing obesity.

Therefore, the aim of the present study was to obtain the eating patterns of an elderly population from a medium-sized city in São Paulo State, Brazil, and to associate adherence to these patterns with general and central obesity using structural equation techniques.

## METHODOLOGY

The data used in this study came from a cross-sectional epidemiological study with a representative sample of individuals aged 60 and above, living in the urban area and enrolled in the Basic Health Units (BHUs) of the city of Botucatu, São Paulo (SP), Brazil. Data collection took place in the households and in the Basic Health Units from March to June, 2011. A survey of socio-demographic, lifestyle, anthropometry, and morbidity data was administered to this population, and the results of a validated food frequency questionnaire (FFQ) for the elderly were collected (6).

Sample size was calculated considering five times the number of items present in the FFQ, according to the formula (7,8):

$$\text{if } k > 15 \text{ then } n = 5k,$$

where k = number of food frequency questionnaire items. As the applied FFQ contained 71 items, the total sample was 355 individuals, selected by stratified sampling among the 16 units of the basic health network in the municipality.

Interviews were conducted with the elderly who agreed to participate in the study, after providing an explanation of the research objectives and confirming who was able to respond to the survey. Individuals with auditory deficit or difficulty understanding the questions were included in the sample, provided they were accompanied by a caregiver who was responsible for answering the questions. In case of refusal, a new elderly person was drawn from the database. The

project was approved by the Ethics Committee of the Botucatu Medicine Faculty, SP, Brazil (Process no. 3560/2010, date of approval 07/06/2010), and all the participants signed a free and informed consent form.

The sociodemographic variables analyzed were: sex, age, education, family income per capita, and race. A TANITA® portable digital electronic scale was used to measure weight, an ALTUREXATA® portable stadiometer to measure height, and an inelastic tape to measure waist circumference (WC). The body mass index (BMI) was calculated by dividing weight (in kg) by height in square meters (weight / height²). The classification of BMI was in accordance with the cut-off points recommended by the Pan American Health Organization (PAHO) in the Health, Welfare and Aging project (WHO, 2001), which surveyed Latin American countries, including Brazil: low weight (BMI $< 23$ kg/m$^2$), normal weight ($23 \leq$ BMI $< 28$ kg/m$^2$), pre-obesity ($28 \leq$ BMI $< 30$ kg/m$^2$), and obesity (BMI $\geq 30$ kg/m$^2$). Waist circumference (WC) was classified as normal if less than 88 cm for women and less than 102 cm for men. The BMI variable was used to evaluate general obesity and the WC variable for central obesity.

Data obtained from the food frequency questionnaire (FFQ) were transformed into daily consumption, based on a 100 g of food scale. A routine in the SAS (Statistical Analysis System) software was developed to get daily food consumption data.

A descriptive analysis with demographic and anthropometric data was conducted, and the percentage of general obesity (as evaluated by BMI) and central obesity (as evaluated by the WC) were also obtained. A descriptive analysis of the daily consumption data was also run, and only foods with a consumption greater than 40 % were considered. This is due to an excess of null observations in several foods that characterize non-consumption, which causes overdispersion and may interfere in the factor analysis. Thus, from 71 foods only 45 foods were considered to obtain the study patterns. For these foods an exploratory factor analysis was applied using the principal component

method with varimax rotation to establish food patterns. Next a confirmatory factor analysis was performed, in which a chi-squared test was performed and adjustment quality indexes were measured (8). As follows, BMI and WC were associated with scores of consumption and with demographic and morbidity variables by means of structural equation models. Defining patterns as latent variables a correlation was calculated in order to verify the association between them.

All analyses were performed using the SAS for Windows v. 9.4 software, with PROC FACTOR and PROC CALIS, and the R software, v. 3.5.2, using the LAVAAN routine.

**RESULTS**

The sample was composed of 355 individuals who were sixty years of age or older, of which 163 (45.9 %) were male, and 192 (54.1 %) were female; age ranged from 60 to 92 years, and average age was 69.54 years (with a standard deviation of 7.73 years). This population lives with an average family income per capita of 1.76 minimum wages (US$ 330,00). Some demographic, socioeconomic, and lifestyle variables that describe this group are listed in table I.

Among the morbidities reported by the elderly, hypertension (58.6 %) followed by elevated cholesterol/triglycerides (37.5 %) and diabetes mellitus (22.0 %) were most common.

Using the cut-off points for BMI and WC according to the values established by PAHO for the elderly, it was found that 15.9 % of men and 30.2 % of women were classified with general obesity, and 42.9 % of men and 74.5 % of women were classified as having central obesity.

The data used in this study had been previously analyzed and six food patterns were obtained (9). In this work, a new analysis was run to determine patterns considering only foods with a consumption of at least 40 %. Thus, only 45 foods were included in the analysis. The patterns were obtained using a factor analysis with the principal

components method, varimax rotation, and a cutoff point of 0.20. Table II shows the results of the factor analysis with four factors, and table III presents the named patterns with their respective foods. In this new analysis, a 25 % of explained variance was found.

A confirmatory factor analysis was performed defining each pattern as a latent variable, testing the sample variance matrix as being the population variance, and calculating the respective indexes of goodness-of-fit. The result of the confirmatory factor analysis is presented in table IV.

According to table IV, the chi-squared test statistic rejected the sample variance in the proposed model (p-value < 0.0001) as a population variance. It may be noted that the adjustment quality indexes good-of-fit index (GFI = 0.8116) and root mean square error of approximation (RMSEA = 0.0562; 95 % CI = [0.0523-0.0601]) showed a good fit. Then it may be concluded that the proposed model was adequate and confirmed the obtained patterns.

In order to correlate eating patterns with general and central obesity a multiple regression model was used to verify these effects through a structural equations model for direct effects.

Although the structural equations model is more appropriate to adjust continuous variables, categorized variables were included: gender (0-Male/1-Female), hypertension (1-Yes/2-No), and diabetes (1-Yes/2-No). Also age and scores of consumption related to the eating patterns were included in the analysis.

According to table V and considering BMI as a response variable, significant associations were found for gender (female has a higher BMI), age (the eldest has a lower BMI), hypertension (hypertensive has a higher BMI), diabetes (diabetic has a higher BMI), and the traditional pattern score (lower adherence to this pattern implies a higher BMI). For WC significant associations were found with hypertension (hypertensive has a higher WC), diabetes (diabetics have a higher WC), and the traditional pattern score (lower adherence

to this pattern implies a higher WC). The adjustment quality index in this case was 88 %.

As differences between both sexes were found, a separate analysis was made of males and females, as shown in table VI.

According to table VI, considering again BMI as a response variable for males, significant associations were found for age (lower BMI with higher age), hypertension (hypertensive has a higher BMI), traditional pattern score (lower adherence to pattern has a higher BMI) and score for snacks and weekend meals (lower adherence to this pattern has a lower BMI). For WC, associations with hypertension (hypertensive has a higher BMI), traditional pattern score (lower adherence to pattern has a higher BMI), score for snacks and weekend meals (lower adherence to this pattern has a lower BMI), and score for mild diet (lower adherence to this pattern has a higher WC) were found.

Now, considering BMI as a response variable for female, a significant association was found for age (lower BMI with higher age), hypertension (hypertensive has a higher BMI), diabetes (diabetic has a higher BMI) and traditional pattern score (lower adherence to pattern has a higher BMI). For WC, associations with hypertension (hypertensive has a higher BMI) and diabetes (diabetic has a higher WC) were found. The adjustment quality index for this case was 87 %.

Considering the patterns as latent variables, a correlation was found between the healthy and the mild diet patterns ($r = 0.4907$, $p < 0.0001$). This correlation is interesting because the foods that make up the two standards are light, like green groceries, and therefore healthier.

## DISCUSSION

The present study makes a reanalysis of the data obtained from a representative sample of the elderly population of the city of Botucatu, SP, Brazil, referring to the application of a questionnaire involving demographic data, morbidities, anthropometry, and FFQ results. In previous results (9)we obtained six eating patterns

(healthy, snacks and weekends, fruits, light and diet, soft, and traditional diet). In that case a significant association was found with the socioeconomic level of the population, in which families with higher incomes adhere more to snacks and weekend meals than to a soft and traditional diet, indicating a new scenario and a new challenge regarding food consumption in this group. In addition, associations with obesity were also revealed, obtaining that a high adherence to the healthy pattern is a protective factor for general obesity. Altogether, moderate adherence to the healthy pattern is a protective factor for central obesity whereas moderate adherence to the snacks and weekend pattern is a risk factor for central obesity (10).

In this new approach, only foods with a consumption greater than 40 % were considered, and four eating patterns were obtained. Here, income and some sociodemographic variables were not included. Aconfirmatory factor analysis demonstrated a good fit for the proposed patterns, as well as a correlation between them through the use of latent variables. It was possible to correlate values of BMI and WC with scores of consumption for each pattern, and for demographic and morbidity variables using structural equation models.

Considering aging as a natural process that involves several anatomical and functional changes, with consequences on the individual's health and quality of life that can lead to a reduction in functional capacity, nutritional status, and eating habits, and the presence of chronic diseases, not forgetting compromised socioeconomic conditions, all of it should be highlighted when it comes to elderly people (11).

In the overall analysis of the elderly sample we found a significant inverse association between BMI and age, adherence to the traditional pattern, and a direct association with hypertension and diabetes. For WC, a significant inverse association with the traditional pattern and a direct association with hypertension and diabetes were obtained.

The results obtained in the present study showed a significant association of anthropometric indicators (BMI and WC) with eating patterns and chronic diseases (hypertension and diabetes), consistent with the national and international literature (12,13). Several researchers have highlighted the association between consumption of foods with high energy content, poor in nutrients and fibers, with weight gain, increased abdominal fat, and development of hypertension, diabetes mellitus and obesity (11,14-16). These findings support the importance of maintaining an adequate and healthy food consumption pattern. Of course, this consumption must be associated with other actions promoting a better quality of life and also ways to prevent and control the development of chronic diseases such as obesity, hypertension, diabetes, and others.

In our study, we found that increased adherence to the traditional pattern of eating decreases BMI and WC. The traditional pattern described in this study is related to the consumption of foods rich in fat (sausage, whole milk, feijoada), low in fiber (white rice, cassava flour, coffee with sugar, sugar), but such is the traditional food in Brazil. However, similar results were found in a study in which the Healthy Eating Index (11) was applied. The authors verified that 32.9 % of the elderly had a "poor quality" diet, 60.3 % "needed improvement," and only 6.8 % had a "good quality" diet with lower intakes of fruits, vegetables, carbohydrates, and milk and dairy products (17). Another study carried out in the city of São Paulo (Health Survey of the City of São Paulo) also found an indirect and inverse association between the traditional pattern and BMI and WC, but in this case mediated with the effect of serum leptin (18).

It is well known that various changes that occur with aging are related to body composition and the distribution of body fat. As observed in this study, increased age showed a significant association with decreased BMI (19).

The recommendations regarding nutritional consumption for population groups, in general, are distinct for men and for women.

The study by gender details the one found in the analysis of the general group. For males, it was found that greater adherence to the snacks and weekend pattern tended to increase BMI and WC, while higher adherence to the traditional pattern decreased BMI and WC. Also, low adherence to the mild diet and the traditional patterns tended to cause lower WC values. These findings agree with Brazilian studies that reported that the traditional pattern is more frequent among men (20,21). For women, higher adherence to the traditional pattern decreased BMI as usual in the Brazilian population, although some studies noted that women have a higher consumption of fruits and vegetables (22,23).

One of the study limitations can be pointed out as the occurrence of some bias because individuals can overestimate or underestimate their intake. There is a memory bias and also a bias related to the use of a FFQ instrument, which takes a long period of time to fill out. Another limitation is the use of the factor analysis, as a gold-standard method to obtain eating patterns does not exist (9). Nevertheless, we found a good quality of indexes in the confirmatory analysis, and also a relationship among obesity and morbidities and eating patterns using structural equation models.

Although aging is a dynamic process that involves several modifications in the body, awareness is important of the eating patterns of this population and of their association with some demographic and morbidity factors in order to allow the elaboration and planning of actions aimed at improving this scenario and to maintain healthy habits and an appropriate weight.

## FINAL CONSIDERATIONS

The present study addresses a reanalysis of data on food consumption patterns in the elderly, based on an exploratory and confirmatory factor analysis, and their correlations with demographic and morbidity factors through the use of structural equation models.

Considering only the food most commonly consumed by older people, the established patterns presented an approximation of what would be observed in the practice and culture of the region involved. In addition, it was possible to establish associations of these patterns with general and central obesity, and also with morbidity including risk factors for metabolic syndrome.

Thus, through this study, it is possible to follow the trends and behaviors of the elderly regarding nutritional aspects by encouraging and establishing policies to promote healthy eating habits.

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Table I. Demographic, socioeconomic and lifestyle variables that characterize individuals aged 60 years or above, enrolled in the basic health network of the city of Botucatu-SP, Brazil. 2011

| Variables | Categories | n | % |
|---|---|---|---|
| *Demographics* | | | |
| Sex | Male | 163 | 45.9 |
| | Female | 192 | 54.1 |
| Age group | 60-69 years | 196 | 55.2 |
| | 70-79 years | 114 | 32.1 |
| | 80-89 years | 39 | 11.0 |
| | 90 years and above | 6 | 1.7 |
| Race | White | 300 | 85.2 |
| | Black | 19 | 5.4 |
| | Brunet | 32 | 9.1 |
| *Socioeconomics* | | | |
| Schooling | Never studied | 44 | 12.4 |
| | Elementary | 173 | 48.7 |
| | Fundamental | 61 | 17.2 |
| | High school | 40 | 11.3 |
| | University or more | 37 | 10.4 |
| Marital status | Without partner | 140 | 39.4 |
| | With partner | 215 | 60.6 |
| *Lifestyle* | | | |
| Physical activity | Inactive | 160 | 45.1 |
| | Active | 195 | 54.9 |
| Alcohol consumption | Yes | 120 | 33.8 |
| | No | 235 | 66.2 |
| Alcohol abuse | Yes | 24 | 6.8 |
| | No | 96 | 27.0 |

Table II. Description of the factor analysis for the consumption data obtained from the FFQ for the elderly. Botucatu-SP, Brazil, 2011

| **Food** | **Factor** | **Factor** | **Factor** | **Facto** | **Communalit** |
|---|---|---|---|---|---|
| Soup | -0.073 | -0.059 | -0.026 | *0.661* | 0.447 |
| Fried snacks | -0.095 | -0.003 | *0.426* | -0.008 | 0.190 |
| Baked snacks | 0.036 | -0.042 | *0.463* | 0.049 | 0.220 |
| Pasta with meat | 0.105 | 0.104 | *0.438* | -0.062 | 0.217 |
| Pizza | 0.054 | -0.181 | *0.436* | -0.073 | 0.231 |
| Polenta | -0.054 | 0.208 | 0.027 | *0.357* | 0.174 |
| Beef | 0.074 | 0.191 | 0.060 | -0.043 | 0.047 |
| Pork | 0.072 | 0.166 | 0.060 | -0.011 | 0.037 |
| Sausages | 0.040 | *0.396* | 0.307 | -0.066 | 0.257 |
| Other sausages | -0.041 | -0.239 | *0.541* | -0.086 | 0.359 |
| Chicken | *0.239* | 0.112 | -0.195 | 0.017 | 0.108 |
| Fish | *0.257* | -0.155 | -0.084 | 0.137 | 0.116 |
| Whole milk | -0.090 | *0.247* | -0.012 | 0.201 | 0.109 |
| Mozzarella cheese | 0.049 | -0.277 | *0.365* | -0.100 | 0.223 |
| Cottage cheese | 0.198 | -0.414 | 0.111 | 0.101 | 0.233 |
| Egg | 0.116 | 0.067 | *0.200* | 0.029 | 0.059 |
| Beans | 0.128 | *0.517* | -0.159 | -0.155 | 0.333 |
| Feijoada | 0.006 | *0.239* | -0.007 | 0.019 | 0.058 |
| White rice | 0.159 | *0.545* | -0.048 | -0.157 | 0.349 |
| French fries | -0.099 | 0.170 | *0.343* | -0.006 | 0.156 |
| Cooked potatoes | -0.050 | -0.010 | 0.018 | *0.694* | 0.485 |
| Cassava flour | 0.099 | *0.347* | 0.018 | 0.106 | 0.142 |
| Lettuce | *0.656* | -0.027 | -0.033 | -0.111 | 0.445 |
| Tomatoes | *0.643* | -0.039 | 0.024 | -0.009 | 0.415 |
| Carrots | 0.330 | -0.135 | -0.017 | *0.530* | 0.409 |
| Other vegetables | 0.439 | -0.032 | -0.031 | *0.528* | 0.474 |
| Raw vegetables | *0.563* | -0.109 | -0.040 | 0.289 | 0.414 |
| Cooked vegetables | *0.492* | -0.042 | -0.034 | 0.292 | 0.331 |
| Broccoli | *0.501* | -0.118 | -0.158 | 0.352 | 0.414 |
| Oil | -0.101 | -0.014 | *0.223* | -0.046 | 0.062 |
| Salt | *0.617* | 0.083 | 0.109 | -0.201 | 0.440 |
| Orange | 0.192 | -0.231 | 0.123 | 0.102 | 0.116 |
| Banana | 0.065 | -0.130 | 0.142 | *0.279* | 0.119 |
| Apple | *0.249* | -0.460 | 0.053 | -0.008 | 0.276 |
| Papaya | *0.258* | -0.505 | 0.010 | 0.130 | 0.338 |
| Coffee with sugar | -0.195 | *0.526* | 0.139 | 0.109 | 0.346 |
| Regular soft drink | -0.150 | 0.105 | *0.398* | -0.082 | 0.198 |
| Rolls | -0.046 | 0.253 | *0.515* | 0.146 | 0.353 |
| Plain cookies | 0.063 | 0.136 | 0.022 | *0.202* | 0.064 |
| Plain cake | 0.024 | -0.099 | *0.261* | 0.165 | 0.105 |
| Butter | 0.082 | 0.002 | *0.490* | 0.179 | 0.278 |
| Chocolate | 0.057 | -0.198 | 0.107 | -0.030 | 0.055 |
| Desserts | 0.037 | 0.024 | *0.320* | 0.136 | 0.123 |
| Sugar | -0.051 | *0.524* | 0.079 | 0.113 | 0.296 |
| Salad dressing | *0.651* | 0.103 | 0.113 | -0.072 | 0.452 |
| % | 0.087 | 0.057 | 0.056 | 0.046 | 0.246 |
| Explained variance per | 3.318 | 2.790 | 2.564 | 2.403 | |

Table III. Description of eating patterns for the elderly from the exploratory factor analysis. Botucatu-SP, Brazil, 2011

| Patterns | Foods |
|---|---|
| Healthy | Chicken, fish, lettuce, tomatoes, raw vegetables, cooked vegetables, broccoli, salt, apple, papaya, salad dressing |
| Traditional | Sausage, whole milk, beans, feijoada, white rice, cassava flour, coffee with sugar, sugar |
| Snacks and weekend meals | Fried snacks, baked snacks, pasta with meat, pizza, other sausages, mozzarella cheese, egg, French fries, oil, regular soft drinks, plain cake, butter, desserts |
| Mild diet | soup, polenta, cooked potatoes, carrots other vegetables, banana, plain cake |

Table IV. Adjustment indices obtained by confirmatory factor analysis for the eating patterns obtained with the FFQ data for elderly people. Botucatu-SP, 2011

| Fit summary | Indices | Values |
|---|---|---|
| Modeling info | Number o fObservations | 355 |
| | Number of Variables | 40 |
| | Number of Moments | 820 |
| | Number of Parameters | 86 |
| | Number of Active Constraints | 0 |
| | Baseline Model Function Value | 7.3993 |
| | Baseline Model Chi-Squared | 2619.361 |
| | Baseline Model Chi-Squared DF | 780 |
| | Pr > Baseline Model Chi-Squared | < 0.0001 |
| Absolute index | Fit function | 4.3928 |
| | Chi-Squared | 1555.0535 |
| | Chi-squared DF | 734 |
| | Pr > Chi-squared | < 0.0001 |
| | Z-Test of Wilson & Hilferty | 16.3594 |
| | Hoelter Critical N | 182 |
| | Root Mean Square Residual (RMR) | 0.0342 |
| | Standardized RMR (SRMR) | 0.0717 |
| | Goodness of Fit Index (GFI) | 0.8116 |
| Parsimony index | Adjusted GFI (AGFI) | 0.7895 |
| | Parsimonious GFI | 0.7638 |
| | RMSEA Estimate | 0.0562 |
| | RMSEA Lower 90 % Confidence Limit | 0.0523 |
| | RMSEA Upper 90 % Confidence Limit | 0.0601 |

Table V. Adjustment of the structural equations model for BMI and WC for the data of elderly people food patterns. Botucatu-SP, Brazil, 2011

| Path | | Variables | Estimate | Standard | t-value | Pr > \|t\| |
|---|---|---|---|---|---|---|
| BMI | <=== | Sex | 1.9412 | 0.5538 | 3.5051 | *0.0005* |
| BMI | <=== | Age | -0.1176 | 0.0364 | -3.2317 | *0.0012* |
| BMI | <=== | Hypertension | -2.7557 | 0.5501 | -5.0093 | *< 0.0001* |
| BMI | <=== | Diabetes mellitus | -1.5103 | 0.6574 | -2.2973 | *0.0216* |
| BMI | <=== | Score1 | -0.3415 | 0.2703 | -1.2634 | 0.2064 |
| BMI | <=== | Score 2 | -1.0267 | 0.2665 | -3.8528 | *0.0001* |
| BMI | <=== | Score 3 | 0.4163 | 0.2632 | 1.5816 | 0.1137 |
| BMI | <=== | Score 4 | -0.4104 | 0.2746 | -1.4945 | 0.1350 |
| WC | <=== | Sex | -2.5200 | 1.3195 | -1.9097 | 0.0562 |
| WC | <=== | Age | -0.1291 | 0.0867 | -1.4888 | 0.1366 |
| WC | <=== | Hypertension | -6.5881 | 1.3107 | -5.0263 | *< 0.0001* |
| WC | <=== | Diabetes mellitus | -6.5863 | 1.5664 | -4.2048 | *< 0.0001* |
| WC | <=== | Score1 | -0.3267 | 0.6441 | -0.5073 | 0.6119 |
| WC | <=== | Score 2 | -2.4496 | 0.6349 | -3.8583 | *0.0001* |
| WC | <=== | Score 3 | 0.7210 | 0.6272 | 1.1496 | 0.2503 |
| WC | <=== | Score 4 | -1.2283 | 0.6543 | -1.8774 | 0.0605 |

Table VI. Adjustment of the structural equations model for BMI and WC for the data of food patterns of the elderly stratified by sex. Botucatu-SP, Brazil, 2011

| Sex | Path | | Variables | Estimate | Standard | t-value | Pr > \|t\| |
|---|---|---|---|---|---|---|---|
| Male | BMI | <== | Age | -0.1528 | 0.0521 | -2.9353 | *0.0033* |
| | BMI | <== | Hypertension | -2.2854 | 0.6559 | -3.4844 | *0.0005* |
| | BMI | <== | Diabetes mellitus | 0.1825 | 0.8927 | 0.2045 | 0.8380 |
| | BMI | <== | Score1 | -0.1708 | 0.3599 | -0.4745 | 0.6351 |
| | BMI | <== | Score 2 | -1.1743 | 0.2979 | -3.9424 | *<0.0001* |
| | BMI | <== | Score 3 | 0.8341 | 0.3334 | 2.5018 | *0.0124* |
| | BMI | <== | Score 4 | -0.2015 | 0.3635 | -0.5544 | 0.5793 |
| | WC | <== | Age | -0.1381 | 0.1389 | -0.9941 | 0.3202 |
| | WC | <== | Hypertension | -5.6262 | 1.7503 | -3.2144 | *0.0013* |
| | WC | <== | Diabetes mellitus | -1.1200 | 2.3823 | -0.4701 | 0.6383 |
| | WC | <== | Score1 | -0.9376 | 0.9603 | -0.9764 | 0.3289 |
| | WC | <== | Score 2 | -3.3409 | 0.7949 | -4.2029 | *<0.0001* |
| | WC | <== | Score 3 | 2.6094 | 0.8897 | 2.9329 | *0.0034* |
| | WC | <== | Score 4 | -2.0326 | 0.9700 | -2.0955 | *0.0361* |
| Female | | | | | | | |
| | BMI | <== | Age | -0.1116 | 0.0519 | -2.1481 | *0.0317* |
| | BMI | <== | Hypertension | -3.1122 | 0.8607 | -3.6157 | *0.0003* |
| | BMI | <== | Diabetes mellitus | -2.3366 | 0.9507 | -2.4578 | *0.0140* |
| | BMI | <== | Score1 | -0.4201 | 0.4092 | -1.0267 | 0.3046 |
| | BMI | <== | Score 2 | -0.9934 | 0.4581 | -2.1686 | *0.0301* |
| | BMI | <== | Score 3 | 0.1149 | 0.3965 | 0.2898 | 0.7719 |
| | BMI | <== | Score 4 | -0.3519 | 0.4259 | -0.8264 | 0.4086 |

| | | | | | | |
|---|---|---|---|---|---|---|
| WC | <== | Age | - | 0.1124 | - | 0.3173 |
| | = | | 0.1124 | | 1.0000 | |
| WC | <== | Hypertension | - | 1.8629 | - | *0.000* |
| | = | | 7.0207 | | 3.7687 | *2* |
| WC | <== | Diabetes mellitus | - | 2.0576 | - | *<* |
| | = | | 9.5580 | | 4.6453 | *0.000* |
| | | | | | | *1* |
| WC | <== | Score1 | - | 0.8856 | - | 0.8298 |
| | = | | 0.1904 | | 0.2150 | |
| WC | <== | Score 2 | - | 0.9914 | - | 0.1116 |
| | = | | 1.5773 | | 1.5909 | |
| WC | <== | Score 3 | - | 0.8581 | - | 0.3692 |
| | = | | 0.7706 | | 0.8980 | |
| WC | <== | Score 4 | - | 0.9217 | - | 0.8658 |
| | = | | 0.1558 | | 0.1690 | |