DOI: 10.1590/1413-81232018245.12362017

Studies assessing food consumption by the scores method: a systematic review

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Abstract *This article describes a systematic review of the literature on studies that have used the scores method proposed by Fornés et al. (2002) to evaluate food consumption and discuss the method from the perspective of food pattern assessment. The search of the Medline, Lilacs and Scielo databases was limited to the English, Portuguese and Spanish languages and to articles published from 2002 to 2016. The inclusion criterion was studies that used the scores method proposed by Fornés et al. to evaluate food consumption. The original search found 8300 items. After reading titles and abstracts and applying the exclusion criteria, 14 articles were selected. The articles evaluating food pattern used different groupings and examined associations with anthropometric, socioeconomic and biochemical variables. It was concluded that the scores method is able to evaluate food patterns and enables associations to be established between anthropometric, biochemical, socioeconomic and clinical variables and the components of the study diet/food grouping to which the individual was exposed.*

Key words *Food consumption, Human eating behaviour*

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Introduction

The food pattern of Brazil's population has undergone changes characterised by increasing intake of foods that are high energy density, poor in fibres and rich in saturated fats, trans fats and sugars. These, in association with physical inactivity, smoking and alcohol abuse, have been identified as independent predictors of several diseases[1-4].

The World Health Organisation[5] has suggested that population food consumption is better assessed by way of food patterns, considering that individuals do not consume isolated nutrients or foods. Northstone et al.[6] argue that assessment by isolated nutrients does not reflect the multifactorial nature of human diet. In that light, there is growing interest in this line of investigation into consumption of food groups considered to define healthy and unhealthy food patterns[7,8].

Food patterns characterised by a set or group of foods consumed by a given population can be specified theoretically, by grouping nutritional variables, such as foods and nutrients, according to previously chosen nutritional criteria, or empirically, by reducing the variables to the smallest number by means of statistical analysis and then evaluating them[9].

As an alternative for analysing overall diet, Fornés et al.[10] proposed the scores method, which is conducted by awarding points to foods in the diet, by categories grouped according to the study objectives. Note that in dictionaries, "score" is synonymous with "points", "a value that needs no unit of measurement".

When applied to a population group, this makes it possible to determine consumption patterns by food groups of interest to that study and, once the score is established, as it is a numerical value, it becomes possible to draw comparisons with outcomes of interest to that study[11].

The scores method for evaluating food consumption is a relatively simple measure that reflects qualitative and/or quantitative aspects of diet. Higher scores mean greater consumption of a given food group, which permits statistical analyses of the association between patterns of consumption and explanatory variables[12].

In view of the foregoing, this study reviewed the literature on studies that have examined food consumption using the scores method proposed by Fornés et al.[10], and discussed by the method from the perspective of food pattern assessment.

Methods

A systematic literature review was conducted, drawing on an article search based on the pre-defined question: "Is the scores method a tool used to evaluate food consumption with a view to identifying food patterns and does it enable their association with other variables to be determined?" In order to organise the study question, research strategy and selection criteria, an expanded version of the Population, Intervention, Comparison, Outcome (PICO) model[13] was used: the PICOCS model, which also contemplates Context and Study design.

Search strategy

Articles of interest were identified in April 2016 in the following electronic databases: the Medical Literature Library of Medicine (Medline), via PubMed; the Scientific Electronic Library Online (SciELO); and Latin American and Caribbean Health Sciences Literature (Lilacs), via the Virtual Health Library (BVS). From these, studies published from 2002 until 01 December 2016 were selected. It was decided to search from the start of 2002, because that was when Fornés' first paper on the scores method was published. The search was restricted to the Spanish, English and Portuguese languages.

The following keywords and corresponding terms in English were selected from among the Health Sciences Descriptors (DECS): *hábitos alimentares* (food habits), *consumo de alimentos* (food consumption) and *ingestão de alimentos* (food intake). The term *escore* (score*) was also included as delimiting the method. The logical operators *AND* and *OR* were used to combine the terms chosen for the publication search.

Eligibility criteria

Studies that used the scores method proposed by Fornés et al.[10] to evaluate food consumption were considered eligible. Review articles, duplicate articles in the data bases and studies that did not use the scores method proposed by Fornés et al. were excluded.

Selection of articles

Two researchers, working independently, evaluated the articles arising from the initial

Ciência & Saúde Coletiva, 24(5):1777-1792, 2019

search strategy by title and abstract, according to the previously established eligibility and exclusion criteria. Any divergences were resolved by consensus. In the event of continuing disagreement, an evaluator with expertise was consulted.

Data extraction

For the narrative summaries of the articles of interest, the following data were extracted: year of publication; journal and study year; study location; target public; sample size; objectives; study variables; consumption patterns used, identifying the food group categories; and the associations observed between the scores formed for the food patterns and the variables (Chart 1).

The scores method

As this study focused on reviewing application of the scores method conceived by Fornés et al.[10], the authors had to consider its methodology carefully in order to understand and explain the process by which it is applied. Application was systematised step by step as illustrated in Figure 1. The flow diagram shows how the consumption frequency categories of the Food Frequency Questionnaire (FFQ) are converted into scores and consumption patterns in order to study associated factors.

Evaluating methodological quality

The articles included were evaluated by two of the authors in accordance with the criteria of the STROBE (Strengthening the Reporting of Observational Studies in Epidemiology)[14] initiative, in which scores of 1 or 0 are awarded on each of the 22 criteria, depending on whether they are considered, respectively, to be met or unmet[15]. After evaluation by the criteria, each article received a score from 0 to 22 from each reviewer. The final score was calculated as the mean of the scores awarded by all reviewers. The articles were classified in order of final scores. In order to evaluate the quality of the articles, the overall scores were converted into percentages, which were classified into 3 categories, following Mataratzis et al.[16]: A – when the study met more than 80% of the STROBE criteria; B – when 50%-80% of the STROBE criteria were met; and C – when fewer than 50% of the criteria were met.

Results

In all, 8,300 bibliographical references were found and their titles were evaluated. Of these, 433 were selected and their abstracts, read; those whose content did not meet the selection criteria were excluded. After that stage, the complete texts of 91 articles were read. After detailed review, 14 articles were considered appropriate and their results were recorded systematically (Figure 2). The evaluation of methodological quality, on the STROBE[14] criteria, revealed that 92.9% (n = 13) attained a B quality score (Table 1).

Chart 1 gives a summary of the data of interest to this review (authorship, year of publication, study location, number of participants, study objectives, study variables, food consumption patterns used and main results) drawn from the 14 articles selected after complete review. All the studies were cross-sectional in design. The first study was published in 2002, by Fornés et al.[10], who proposed the scores method and examined correlations between protective food consumption patterns and cardiovascular risk and lipid profile. The method was used by other researchers, but related publications did not begin until 2006[17,18]. Since then, an average of one article using this method has been published per year.

The scores method

Most of the articles included in this review were produced in Brazil (n = 13; 92.8%)[8-12,17,19-26] using different sample sizes (ranging from 50 to 2,866 individuals), FFQ types (semi-quantitative and qualitative) and definitions of food consumption pattern (by risk for and protection against CVDs and CNCDs, as healthy and unhealthy and also by food groups resulting from different grouping procedures).

The journals with most articles published were *Cadernos de Saúde Pública* and *Revista de Nutrição* with four (28.6%) publications each. Although the groups studied varied from children under 5 years of age through to individuals over 60 years old, in 71.4% (n = 10) of the studies, the target public was made up of adults[8,10,11,17,19-22,24,25] and "healthy" populations (n = 12;85.7%)[8-12,17,19,20,22-24,26]. In addition to describing and/or evaluating food consumption pattern scores, the studies' objectives were to relate those scores to nutritional status and sociodemographic, biochemical, cultural, lifestyle, clinical and economic variables.

Chart 1. Studies that evaluated food consumption pattern (FCP) from FFQ by the scores method conceived by Fornés et al. (2002) and published* in the prior 14 years.

Source*	Target-public	Variables studied to establish associations with FCP	Objective vs FCP	FCP Group/Score established by the authors from FFQs and presentation of data	Positive (+) and negative (-) associations observed Main findings
Fornés et al., 2002. Rev Saúde Pública[10]	♂ and ♀, ≥ 20 years, from the São Paulo metropolitan area (n=1045)	TC, LDL and HDL vs FCP/ semi-quantitative FFQ	To assess FCP evaluating by consumption scores and relating scores to levels of TC, LDL and HDL.	Group/score I: risk foods for CVDs; Group/score II: protective foods. Data in ∑, ordered by quintile (QU)	(+) Group/score I vs TC and LDL X of 176.9 mg/dL and 108.8 mg/dL for QU1, with Xs increasing in upper QUs. (-) Group/score II vs TC Xs decrease from QU1 to QU5, w/differences between QU1-QU4 and QU1-QU5, an in QU1-QU4 in relation to LDL.
Neumann et al., 2006. Rev. Nutr.[17]	♂ and ♀, >18 years, civil servants in São Paulo (n=1271)	Income and schooling vs FCP/qualitative FFQ	To describe the FCP by risk and protective foods for CVDs and ascertain associations with schooling and family income.	Group/score I: risk foods and/or preparations for CVDs; Group/score II: protective foods and/or preparations for CVDs. Data in X ± SD	Group/score I > among individuals with lower secondary schooling and income up to 3 minimum wages. Group/score II > among those with higher schooling and income > 6 minimum wages.
Moraes et al., 2006. Cad. Saúde Pública[18]	♂ and ♀, 5-13 years, from urban areas of Chilpancingo, Mexico (n=662)	Age and BMI vs FCP (NI on FFQ)	Ascertain the association between consumption of "risk" foods and BMI and age.	Group of risk foods for chronic disease ordered by risk score terciles. Data in ∑, ordered by terciles	(+) risk foods vs overweight 61.5% of obese > "risk" FCP score. Increasing frequency of "risk" FCP with increasing age.
Mondini et al., 2007. Cad. Saúde Pública[26]	Children, 6-7 years old from the 1st year of public lower secondary education in a municipality in SP state (n=1014)	BMI and origin vs FCP (NI on FFQ)	Ascertain association of scores for consumption of "healthy" and "unhealthy" foods with overweight and socio-environmental factors.	Group/score I: "healthy" foods; Group/score II: "unhealthy" foods. Data in ∑, ordered by terciles (T)	(+) FCP of "unhealthy" foods vs overweight. < frequency of FCP of "healthy" foods (T1) in more than 1/3 of children from urban area. High frequency (T3) of FCP of "unhealthy" foods did not differ between urban and rural areas.

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Oliveira et al., 2009. Cad. Saúde Pública[19]	♂ and ♀, 19-59 years, from Salvador, Bahia (n=570)	BMI and WC vs FCP/ FFQ NI	To associate FCP with abdominal fat overweight by sex.	Group/score I: legumes, fruit and vegetables; Group/score II: meats, processed meats, milk and dairy products; Group/score III: cereals and cereal products. Data in ∑, ordered by terciles (T).	Group/score I: score from 3.54-5.53 (T2). Group/score II: score ≤ 1.30 (T1). Group/score III: score 1.44-2.70 (T2). ♂: > prevalence of overweight in T1 of group I and in T3 of group II, and of abdominal fat in T2 of groups/ scores I and II. ♀: > prevalences of overweight and abdominal fat in T2 of groups/scores I and II.
Saldiva et al.,2010. Rev. Nutr.[23]	Children, < 5 years, beneficiaries (n=85) and non-beneficiaries (n=74) of the Bolsa Família family allowance programme in João Câmara, Rio Grande do Norte (n= 164)	Participation in the *Bolsa Família* programme vs FCP (NI on FFQ)	To describe the FCP of child beneficiaries of the *Bolsa Família* programme.	Group/score I: FLV; Group/score II: beans and meats; Group/score III: sweets. Data in ∑	(+) sweets vs child beneficiaries of the Bolsa Família programme.
Esteves et al., 2010. Rev. Nutr.[20]	♀ ≥ 25 and ≤ 44 years, resident in Diamantina, Minas Gerais (n=50)	HC, WHR,WC and BMI vs FCP (NI on FFQ)	To evaluate dietary calcium (Ca) intake by consumption scores and their correlation with adiposity parameters.	Group/score I: dairy products; Group/score II: vegetable sources of Ca; Group/score III: Ca bioavailability reducers. Scores in X, ordered by X, MD, SD, minimum and maximum.	No correlations found between daily Ca intake and I, II and III scores and adiposity parameters. I and II scores were significantly < III score.

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Source*	Target-public	Variables studied to establish associations with FCP	Objective vs FCP	FCP Group/Score established by the authors from FFQs and presentation of data	Positive (+) and negative (-) associations observed Main findings
Silva et al., 2010. Rev Bras Epidemiol[21]	♂ and ♀, 20-70 years, w/HIV/AIDS, resident in São Paulo (n=314)	Using and not using ART vs FCP/semi-quantitative FFQ	To evaluate CVD-related FCP scores in people living with HIV/AIDS, by use of ART.	Group/score I: "Non-protective" for CVDs; Group/score II: "Protective" for CVDs. Data in ∑.	The group in ART displayed > FCP of "non-protective" foods for CVDs.
Gimeno et al., 2011. Cad. Saúde Pública [22]	♂ and ♀, 30 - >60 years, resident in Ribeirão Preto, São Paulo State (n=2197)	Sex, age group, income, schooling, WC, BMI, TC, SAH, PA, fasting glycaemia and low glucose tolerance vs FCP/Semi-quantitative FFQ	To describe and identify factors associated with FCP.	Group/score I: obesogenic (sweets, soft drinks and sugar); Group/score II: healthy (vegetables, fruit and skimmed milk dairy products); Group/score III: mixed (fried food, fish and roots); Group/score IV: popular (beans, cereals and vegetable fat). Data in ∑, ordered by P	Group/score I: more active, > schooling and age < 40 years; Group/score II: more frequent among women, w/o overweight, > elderly, with central obesity, more active and with better socioeconomic position; Group/score III: more frequent among women, younger and w/o overweight; Group/score IV: more frequent among those w/o hypercholesterolaemia and with lower family income.
Pinho et al., 2012. Rev. Nutr.[24]	♂ and ♀, 25-59 years, resident in Pernambuco (n=1580)	Sex, age, geographical area of residence, schooling, per capita family income, WC, BMI, smoking, alcohol consumption and PA vs FCP (NI on FFQ)	To evaluate consumption of protective foods and risk predictors for CVDs and associated factors.	Group/score I: source of fibres (protective); Group/score II: simple CH; Group/score III: saturated fats (risk for CVDs and excessive weight gain). Data in MD, ordered by IR.	FCP scores: Group/score II > I and III Group/score III < in those with > age, rural area and with < income. Group/score II > in underweight. Group/score III > in non-smokers and users of alcohol. Group/score I > income and < schooling.
Azevedo et al., 2014. Ciência & Saúde Coletiva[8]	♂ and ♀, > 20 years, health personnel at a public university in Recife, Pernambuco (n= 267)	Sex, age, schooling, smoking, alcohol use and PA, WC, % BF and BMI vs FCP/qualitative FFQ	To evaluate consumption of risk and protective foods for CNCDs and association with BF and BMI.	Group/score I: risk for CNCDs; Group/score II: protective against CNCDs. Data in MD, ordered by IR.	((+) Protective foods vs obese and high % BF. MD of risk food consumption scores = protective > MD of protective food FCP scores in obese and with high % BF vs eutrophics vs overweight.

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Source*	Target-public	Variables studied to establish associations with FCP	Objective vs FCP	FCP Group/Score established by the authors from FFQs and presentation of data	Positive (+) and negative (-) associations observed Main findings
Pinho et al., 2014. Rev Soc Bras Clin Med.[25]	♂ and ♀, 20-59 years, w/ and w/o metabolic syndrome (MS) Belém, Pará (n=70)	MS by IDF criteria vs FCP (NI on FFQ)	To relate MS with FCP of cardiovascular risk and protective foods.	Group/score I: risk foods for CVDs; Group/score II: protective foods against CVDs. Data in X and SD.	Group/score II > Group/score I in those with MS.
Neto et al., 2015. Rev Paul Pediatr[12]	♂ and ♀, 10-19 years, adolescents from Vitória de Santo Antão, Pernambuco (n=2866)	Sex, socioeconomic class, age group, mother's schooling, area of residence, PA, smoking and alcohol use vs FCP (NI on FFQ).	Ascertain association of FCP of risk and protective foods for CVDs with socioeconomic, demographic and lifestyle variables.	Group/score I: foods associated with risk of CVDs. Group/score II: protective foods. Data in MD, ordered by IR.	> MD of risk food consumption in adolescents whose mothers had > 9 years' schooling. MD FCP of risk foods group = MD of protective foods group, but > dispersion in protective foods group than in risk foods group.
Sotero et al., 2015. Rev Paul Pediatr[11]	Mothers with children up to 24 months old treated in the public health system (case group) and in private surgeries (comparison group) in Maceió, Alagoas (n=202)	Mother's schooling, income, hours/day in front of TV, meals in front of TV and supply of foods shown on TV vs FCP/qualitative FFQ	Examine food consumption pattern of infants and its association with mother's economic, cultural and demographic variables.	Group/score I: sources of CH; Group/score II: sources of vitamins and fibres; Group/score III: source of protein and legumes; Group/score IV: source of calcium; Group/score V: source of sugar, fat and oil; Group/score VI: processed products. Data in MD, ordered by IR.	Case group: > FCP of Group/score VI and association with supply of foods shown in TV advertising, < schooling, < income, families who ate meals and spent more hours in front of the TV. Comparison group: < FCP of Group/score II and association with families who ate meals and spent more hours in front of the TV. > FCP do Group/score II and III and association with > family income and mothers with > schooling.

* Medline, Lilacs and Scielo. Legend: ∑ – summation; ART – antiretroviral therapy; BF – body fat; BMI – body mass index; CH – carbohydrate; CNCDs – chronic non-communicable diseases; CVDs – cardiovascular diseases; FCP – food consumption pattern; FFQ – Food Frequency Questionnaire; FLV – fruit, legumes and vegetables; HC – hip circumference; HDL – high density lipoprotein; IDF – International Diabetes Federation; IR – interquartile range; LDL – low density lipoprotein; MD – median; NI – no information; P – percentile; PA – physical activity; QU – quintile; SAH – Systemic arterial hypertension; SD – standard deviation; T – tercile; TC – total cholesterol; WC – waist circumference ; WHR – waist-to-hip ratio; X – mean. < – less; > – more.

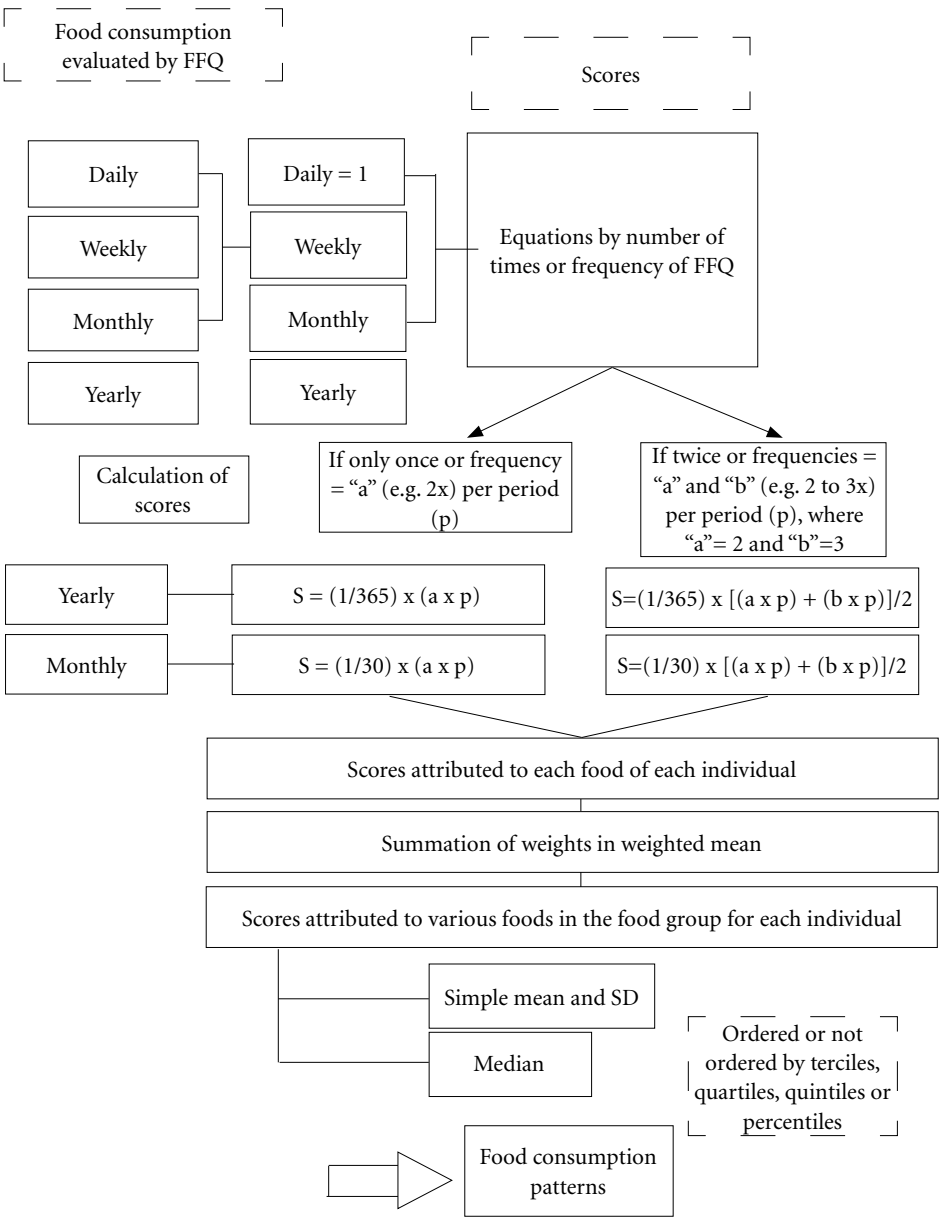

Figure 1. Flow diagram for application of the "scores method" conceived by Fornés et al. (2002), for studying food patterns on the basis of FFQs. The foods recorded by way of the FFQ can be grouped into consumption frequency (CF) categories by daily, weekly, monthly and yearly period (p) and number of times (e.g., once, once to twice etc.). In order for the FC to be converted to scores, daily corresponds to a score of 1 and, for the other periods, the equations illustrated in the figure are applied. Accordingly, the researcher should consider the period (p) adopted and the number of times in that period, established in the FFQ, in order to obtain consumption scores for the foods listed in the FFQ for each individual. Subsequently, scores are obtained for each individual, for each group of foods and, from there, for each group of foods for the groups of individuals studied. As the food consumption scores (resulting from the summation of the weights in the weighted mean for the foods in the food group) are expressed on an ordinal scale, they can be presented as simple means and standard deviations or as medians, which can then be ordered (or not) in terciles, quartiles, quintiles or percentiles so as thus to learn the food consumption scores of the food groups studied and ascertain associations between consumption scores and study variables.

FFQ: food frequency questionnaire; CF: consumption frequency; S: score; a: number of times; p: period.

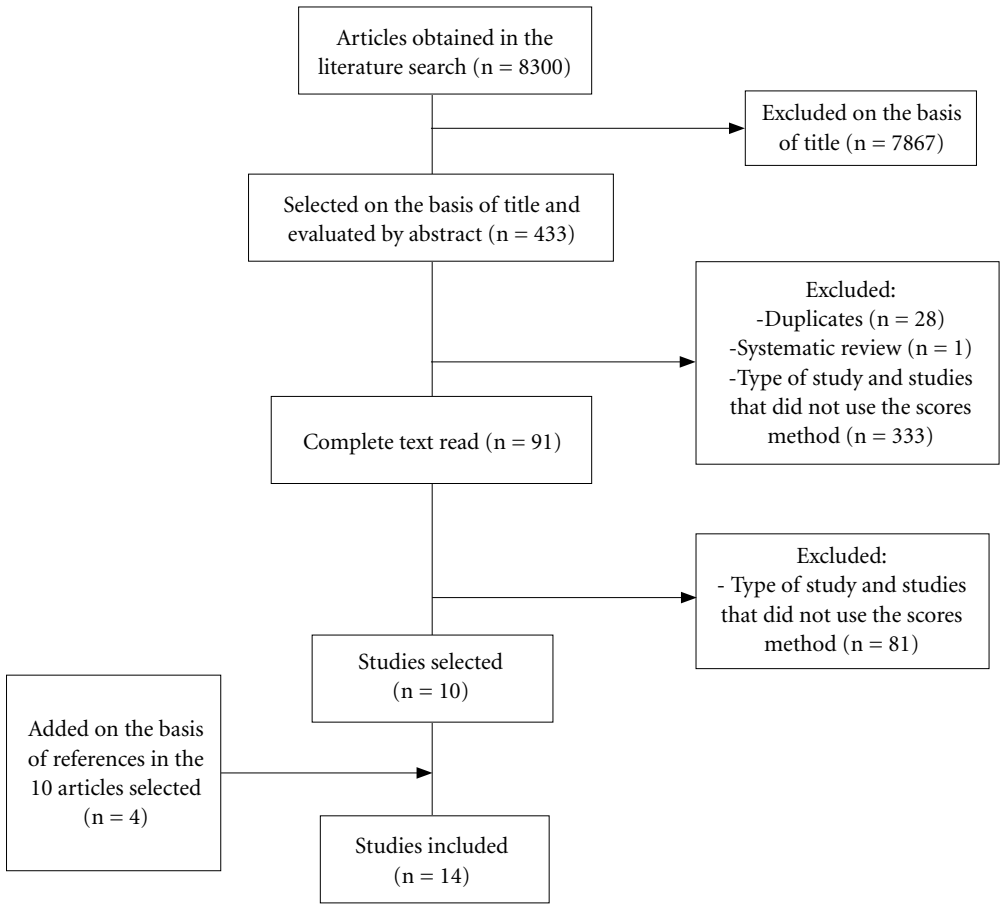

Figure 2. Flow diagram of article selection stages.

Only 3 studies (21.4%)[8,22,24] examined anthropometric, sociodemographic and economic variables simultaneously. The sociodemographic and economic variables most frequently evaluated were age (n = 5, 35.7%), sex, schooling and income (n = 4, 28.5%). Most of the studies (n = 8, 57.1%) related food consumption to anthropometric variables.

The anthropometric variables most used were body mass index (BMI) and waist circumference (WC). In all articles where anthropometric data were used (n = 8; 57.1%), weight and height were measured in order to obtain BMI. WC was examined in 6 studies (42.8%)[8,19,20,22,24,25].

Regarding the studies' prior assumptions (as the method provides for this), different food pattern distributions were observed, as well as different food group names, as appropriate to the objectives of each study (Chart 1). In half the studies, foods were classified into 2 groups (n = 7; 50%)[8,10,12,17,21,25,26] denominated "risk" and "protective" for CVDs (n = 6; 42.8%)[10,12,17,21,24,25], for CNCDs (n = 1; 7.1%)[8] and as "healthy" and "unhealthy" (n = 1; 7.1%)[26]. In 21.4% (n = 3)[19,20,23], the foods were divided into 3 groups under different denominations. Gimeno et al.[22] divided foods into 4 groups (obesogenic, healthy, mixed and popular); and Sotero et al. [11], into 6 groups, by nutrient source of sugar, fat and oil and one group of processed products. Moraes et al.[18] preferred to use only 1 group (risk foods for chronic disease).

The analytical pathways taken varied greatly: authors used the summation of weights (Sp) as such[21,23], ordered these Sp in terciles[18,19,26], quintiles[10] and percentiles[22], Sp by medians and subsequently by interquartile ranges[8,11,12,24]; Sp by medians and means and standard deviations[20] ; and Sp by means and standard deviations[17,25].

Table 1. Quality of the studies reviewed, by STROBE criteria.

Reference	Score	%	Classification*
Azevedo et al., 2014[8]	15	68	B
Esteves et al., 2010[20]	12	54.5	B
Fornés et al., 2002[10]	13	59.1	B
Gimeno et al., 2011[22]	15.5	70.5	B
Mondini et al., 2007[26]	14.5	66	B
Moraes et al., 2006[18]	15	68	B
Neto et al., 2015[12]	18	81.8	A
Neumann et al., 2006[17]	15.5	70.5	B
Oliveira et al., 2009[19]	15	68	B
Pinho et al., 2012[24]	17.5	79.5	B
Pinho et al., 2014[25]	13.5	61.4	B
Saldiva et al., 2010[23]	16.5	75	B
Silva et al., 2010[21]	12	54.5	B
Sotero et al., 2015[11]	14	63.6	B

STROBE: Strengthening the Reporting of Observational Studies in Epidemiology
*Mataratzis et al. - A: > meets 80% of the STROBE criteria; B: meets 50%-80% of the STROBE criteria; and C: meets < 50% of the STROBE criteria.

By applying the scores method, the studies revealed greater consumption of "protective/healthy/cardio-protective" foods among obese individuals[8,22], children with higher family income and with mothers with higher levels of schooling[11] and among individuals with metabolic syndrome[25]. Meanwhile, greater consumption of foods that are "non-protective or risk for CVDs" was found in individuals on ART[21], in child beneficiaries of the *Bolsa Família* family allowance programme[23], in children whose mothers had higher levels of schooling[12] and in those whose mothers had lower levels of schooling and family income[11].

In addition, as the method enables associations or correlations to be made with study variables, positive correlations were observed between risk foods for CVDs and biochemical variables (serum lipids[10,22], impaired glucose tolerance[22]), anthropometric variables (overweight)[18,22] and sociodemographic variables (urban background[24] and lower age group)[22].

Discussion

Scores method

Not only is the scores method for assessing food consumption patterns used to examine diets as cardiovascular risk practices[10,12,17,21,24,25] (it originated in the study of diets as potentially atherogenic and cardiovascular risk practices)[10], but also offers the opportunity to group foods by a pattern that is to be investigated, as shown by the diversity of different possibilities found in the studies reviewed. In addition to characterising food patterns, the scores method has the advantage of permitting statistical analyses to evaluate diet quality, because it makes it possible to establish associations with explanatory variables relating to eating habits.

The WHO suggests that populations' food consumption would be better represented and assessed by food patterns[5], considering that individuals do not consume either nutrients or foods in isolation[27]. In that light, there is growing interest in this line of investigation into consumption of groups of foods considered to define healthy and unhealthy food patterns[28].

Food patterns are known to differ widely among different populations and are thus difficult to generalise about, as they result from complex interactions among multidimensional characteristics, including environmental, demographic, social, economic and cultural factors[22]. Studies intending to discuss this complexity in the light of the relation between diet and health outcomes have come to focus on identifying food patterns[1,29,30].

The association between food patterns and CNCD-related factors has been the object of a number of studies[8,10-12,17-26]. Many point to a positive association between inappropriate food pattern and factors such as overweight and obesity, high levels of glucose, total cholesterol, HDL and LDL cholesterol, triglycerides and others[31].

The analyses of demographic, socioeconomic, anthropometric and clinical variables presented in the studies justify saying that this is an aspect considered an important influence on food consumption.

Food pattern and demographic and socioeconomic variables

A positive correlation was observed between risk foods for CVDs and sociodemographic variables (urban background[24] and lower age group[22]). Of particular note was that the development of new lifestyles in urban areas, the distances between home and workplace, the relative ease with which processed food products are purchased, the influence of the media on diet, and the popularisation of information were con-

Ciência & Saúde Coletiva, 24(5):1777-1792, 2019

junctural determinants of the supply, consumption and availability of risk foods for CVDs[32].

As regards associations between socioeconomic variables and food consumption, the food groups comprising processed foods and those associated with cardiovascular risk were found to associate with individuals with low income[17] and whose mothers had less schooling[11], a finding that diverges from Lioret et al.[33], who observed that individuals whose mothers had less schooling consumed more of the fruits and vegetables group.

Levy et al.[4], studying the regional and socioeconomic distribution of household availability of foods in Brazil from secondary data in the 2008-2009 family budget survey (*Pesquisa de Orçamentos Familiares*, POF), observed that the participation by food groups comprising milk and dairy products, fruit, vegetables and legumes, animal fat, alcoholic beverages and ready meals tended to increase uniformly with rising family income level, while food groups comprising beans and other pulses, cereals and cereal products and roots and tubers displayed the inverse trend. They also found that consumption of table sugar decreased and consumption of soft drinks increased with rising income, while consumption of beef and processed meats increased and consumption of other types of meat decreased or held stable.

Studies indicate that social determinants, including lack of schooling, low income, married and widowed marital status, aging and others, are preponderant in the genesis of obesity[34-36]. The relationship between social determinants and obesity is complex and still not totally clear. It is hypothesised that obesity can result as a sequela of early protein-energy malnutrition, from imbalance between energy expenditure and calorie intake or be connected with genetic factors[37,38].

Food pattern and anthropometric nutritional status

CNCD-risk and obesogenic food patterns were observed to associate with overweight[22,26] and central obesity[26]. Diets that are high calorie density, rich in fats (particularly those of animal origin) and low in food fibre content can explain a substantial portion of cases of some chronic diseases, such as obesity, CVDs, diabetes mellitus and metabolic syndrome[17,39].

Also, data from the 2008-2009 family budget survey revealed that in Brazil, in the population over 20 years of age, prevalence of overweight, in that period was 50.0% in men and 48.0% in women[40]. That fact is connected with the new lifestyle pattern in Brazilian society, characterised by the presence of unhealthy diets and sedentarism. This is confirmed by the food consumption assessment data in the family budget survey, which reveals various adverse features in the Brazilian population's diet[4].

Food pattern and risk factors for CVDs/CNCDs

In this regard, the studies that were reviewed evaluated associations of food consumption patterns with lifestyle, biochemical profile, clinical profile and age as a risk factor.

As regards lifestyle, an "obesogenic" pattern was observed only in active individuals, which could result from a lifestyle in the process of changing. Meanwhile, the habit of spending hours watching television and eating meals in front of the television – which is emerging as an important factor risk for CNCDs[41,42], especially among children and adolescents[43], because it is accompanied by unsuitable food patterns (ready meals, fast food and the like) – was observed in one of the articles of this review[11]. Studies that investigate early onset of obesity underline the importance of the influence of the family environment on the risk of a child becoming obese. Family attitudes to the purchase and presentation of foods, to eating and physical activity habits and the support offered to promote leisure activities can influence children's food and physical activity patterns[44,45].

The diet-related atherogenicity found by Fornés et al.[10] corroborated the well-known, traditional, cause-and-effect relationship, because serum cholesterol levels are influenced by the amount of cholesterol – and particularly the quantity of saturated and trans fat – in the diet. People who consume larger amounts of animal fats are have higher levels of serum cholesterol and display greater incidence of coronary atherosclerosis[46], independently of country, culture and ethnicity.

Olindo et al.[47] found a positive association between a "processed" food pattern (hot dog, cheeseburger, beer, beef, processed meats, savouries, soft drinks, pizza, barbecue, potato chips and savoury snacks) and biochemical markers for cardiovascular risk (low HDL, and high cholesterol and LDL).

From the clinical standpoint, in one study, individuals undergoing ART, generally accompa-

nied by lipodystrophy (and thus having CNCDs), displayed food pattern consumption characterised by foods that were not protective against CVDs. Moraes et al.[18], meanwhile, observed consumption of such foods increasing in frequency with advancing age.

Eyken et al.[48] found that, the older the age group, the higher the proportion of sedentary individuals and the greater the use of cigarettes. They stressed that, at more advanced age, there is a much stronger likelihood of increasing risk factors for CVDs/CNCDs, which demands constant assessment of related factors. These data evidence the importance of studies, with representative samples, designed to specify food patterns and their associations with risk or protective factors for CVDs and CNCDs.

Other means of defining food patterns

The DASH (Dietary Approaches to Stop Hypertension) study conducted in 1995 by Sacks et al.[49] revealed that a dietary pattern rich in fruit, vegetables, legumes and grains, milk and skimmed milk products, fish, poultry and lean meats, and poor in sweets and sugar-rich beverages, reduces blood pressure even in healthy individuals[50]. Paula et al.[51] adopted such a food pattern in type-II diabetics and observed reduced blood pressure levels, as compared with individuals with type-II diabetics without that type of diet.

The Nurse's Health Study identified two food patterns in women from 38 to 63 years old: the "prudent" food pattern (comprising fruit, vegetables, legumes, fish and grains) was found among women who smoked less, used more vitamin supplements, consumed more fibres and proteins and less saturated fats; on the other hand, women who consumed the "western" pattern (comprising red and processed meats, confectionary, desserts and refined grains) displayed less sound health-related habits[52].

In Brazil, one of the first studies to identify food patterns *a posteriori* on the basis of data from the national household sample survey (*Pesquisa Nacional de Amostragem Domiciliar*, 1995) was conducted by Sichieri[53]. The study of found two food patterns: a "traditional" one comprising predominantly foods that are typical of Brazilian culture, such as rice and beans, and another, "western" pattern, characterised by the consumption of industrialised foods. They also observed an inverse association between the "traditional" pattern and increasing BMI, indicating that this pattern is protective against obesity[52].

In 2012, Weber et al.[54] published the findings of a pilot study of a cardio-protective Brazilian diet (DICA-Br) conducted at the Hospital do Coração (HCOR) in São Paulo for application in a multicentre study. One of the purposes of the study was to adapt the Mediterranean diet to a Brazilian pattern, while encouraging consumption of regional foods accessible to a large part of Brazil's population. The clinical trial was conducted with individuals in secondary prevention of CVDs, who were monitored for 12 weeks. Those in the DICA-Br group were benefited by greater reductions in blood pressure, glycaemia and BMI than those who received general guidance in line with the Brazilian directives for CVDs. Those findings were attributed mainly to the inclusion of foods that are protective against CVDs and widely available in Brazil, showing that it is possible and necessary to adapt the "Mediterranean" food pattern and that this has a positive impact on individuals at high risk of coronary disease.

Also in Brazil, Marchioni et al.[55] examined data from the 2002-03 family budget survey and identified two patterns, a "dual pattern" – which comprised foods recognised as being beneficial to health, such as fruit, vegetables and yoghurt, but also contained a contribution from foods with adverse health effects, such as sweets and desserts, processed meats, ready meals – and, on the other hand, a "traditional pattern" comprising foods normally used in home preparations, such as rice, beans, eggs, roots and tubers. In their results, they highlighted the existence of a dual type of food pattern, i.e., of healthy and unhealthy foods, very like consumption patterns already observed in other studies and associated with higher risk of CVDs[54].

A meta-analysis of controlled, randomised prospective studies demonstrated the relation between high adherence to a Mediterranean food pattern (based on consumption of fresh foods, such as legumes, fruit, and olive oil) and lower risk of CVDs and metabolic syndrome[56,57].

From the foregoing, it can be seen that a number of epidemiological studies have used food patterns to evaluate risk of chronic diseases and variation in biomarkers related to overall diet exposure[17,21,58]. This has followed from the assumption that evaluating the effect of isolated nutrients is not equivalent to evaluating the effect of a food item with a variety of nutrients or of foods consumed as part of a habitual food pattern containing various different foods[59].

Identifying populations' foods patterns is an important study objective of nutritional epide-

Ciência & Saúde Coletiva, 24(5):1777-1792, 2019

miology, with a view to understanding the factors responsible for health[60]. Meanwhile, there is a need to refine how food patterns are evaluated by way of new methodologies. That is, use of the scores method to evaluate food consumption frequency can be a useful instrument in assessing the quality of food consumed by individuals.

This is the first systematic review to examine studies that have used the scores method proposed by Fornés et al. to evaluate food consumption. This strategy of applying scores offers the advantage of maximising the utilisation of information on food consumption. Understanding patterns of food consumption and nutrient intake and their associations with human health is important to dietary guidance, particularly for developing countries, which are increasingly adopting western food patterns[61].

Limitations of the studies

The main limitation identified by the reviewers was the lack of standardisation in specifying food consumption patterns, which made it difficult to compare findings of among studies. However, the range of analytical options that the method offers gives researchers the freedom to apply it as best suits their research object, which constitutes an incomparable advantage.

Conclusion

This review of studies applying the scores method led to the conclusion that it constitutes a tool capable of evaluating food consumption and of establishing associations between food patterns and study variables. The review of studies showed that this method enables individual exposure to nutrients or components of the diet or food group investigated to be analysed at different stages of the lifecycle and that anthropometric, biochemical, socioeconomic, demographic and clinical variables were the most studied to establish associations with food consumption.

Collaborations

RC Ferreira and L Bezerra reviewed the literature and analysed and interpreted the studies, and helped draft the article; and SML Vasconcelos contributed to drafting the article, important critical review of intellectual content and approval of the final version for publication.

Acknowledgments

To the following funding institutions *Ministério da Saúde/ Departamento de Ciência e Tecnologia* (MS-DECIT), *Fundação de Amparo à Pesquisa do Estado de Alagoas* (FAPEAL), *Secretaria de Estado da Saúde de Alagoas* (SESAU), *Conselho Nacional de Desenvolvimento Científico e Tecnológico* (CNPq) and *Coordenação de Aperfeiçoamento de Pessoal de Nível Superior* (Capes).

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Article submitted 04/02/2017
Approved 07/08/2017
Final version submitted 09/08/2017