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The Quality Index for Nutrition in Nursing Homes (QUINN). A new tool for evaluating diet quality in long-term care homes

El índice de calidad de la nutrición en las residencias de ancianos (QUINN). Una nueva herramienta para evaluar la calidad de la dieta en las residencias de ancianos

Ángela Hernández-Ruiz[1,2], Melisa A. Muñoz-Ruiz[3], Miguel Ruiz-Canela[4,5,6], Esther Molina-Montes[7,8,9,10], María José Soto-Méndez[1], Ángel Gil[1,5,8,9,11], María Dolores Ruiz-López[1,7,8], Reyes Artacho[7], José Antonio López-Trigo[12], Leonardo José Villavicencio-Campos[13], Rosa López-Mongil[13]

[1]Fundación Iberoamericana de Nutrición (FINUT). Armilla, Granada. Spain. [2]Nursery Department. Facultad de Enfermería. Universidad de Valladolid. Valladolid, Spain. [3]Escuela de Nutrición y Dietética. Universidad de Antioquia. Medellín, Colombia. [4]Department of Preventive Medicine and Public Health. Universidad de Navarra. Pamplona, Spain. [5]CIBER Fisiopatología de la Obesidad y Nutrición (CIBERobn). Instituto de Salud Carlos III. Madrid, Spain. [6]Instituto de Investigación Sanitaria de Navarra (IdiSNA). Pamplona, Spain. [7]Department of Nutrition and Food Sciences. Facultad de Farmacia. Universidad de Granada. Granada, Spain. [8]Instituto de Nutrición y Tecnología de los Alimentos "José Mataix". Centro de Investigación Biomédica. Universidad de Granada. Granada, Spain. [9]Instituto de Investigación Biosanitaria IBS.GRANADA. Complejo Hospitalario Universitario de Granada. Granada, Spain. [10]CIBER Epidemiología y Salud Pública (CIBERESP). Instituto de Salud Carlos III. Madrid, Spain. [11]Department of Biochemistry and Molecular Biology II. Universidad de Granada, Campus de Cartuja. Granada, Spain. [12]Ayuntamiento de Málaga. Málaga, Spain. [13]Centro Asistencial Doctor Villacián. Valladolid, Spain

Abstract

Background: the assessment of diet quality (DQ) is fundamental to the study of disease-diet associations, and it is necesary to implement an easy to-apply tool in nursing homes (NHs). Our objective was to propose and apply a novel diet quality indicator (DQIn) using an *a priori* approach for NHs.

Methods: the QUality Index for Nutrition in Nursing homes (QUINN) was implemented in a public NH located in Valladolid, Spain, during a 5-week period (n = 137 subjects). The choice of the QUINN components was based on a rapid review. The QUINN was based on 15 dietary components — 12 were basic (vegetables, fruits, legumes, olive oil, cereals, dairy, white fish and seafood, white-meat, eggs/positive; other fats, red and processed meat, and sweets/negative), and 3 were supplementary (fruits and vegetables variety, oily-fish, and whole-grains/positive). Each component was classified into 4-categories (0, 1, 2 o 3 points; range: 0-45 points).

Results: the QUINN was tested on a menu offered by a NH giving a result of 34 points (good diet). The components with the highest scores were related to the Mediterranean diet (high consumption of legumes, olive oil, white fish and shellfish; low intake of other fats; and a wide variety of fruits and vegetables), together with cereals, white meat, dairy, and eggs. The components that required a major change were red- and processed-meats, sweets, and whole grains.

Conclusion: the menu of this Spanish NH showed a good DQ according to the QUINN. The assessment of the DQ in NHs using QUINN will allow the proposal of interventions aimed at improving their diet.

Keywords:

Diet modifications. Feeding behavior. Nursing homes. Healthy diet. Food habits.

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Conflicts of interest: the authors have no financial or personal conflicts of interest to declare.

Ethics statement: the study was approved by the Drug Research Ethics Committee (CEIm) of the Valladolid Health Area West, Río Hortega University Hospital (Ref. CEIm: 21-PI061).

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Correspondence:

Ángela Hernández-Ruiz. Fundación Iberoamericana de Nutrición (FINUT). Avda. del Conocimiento 12, 3.ª pta. 18016 Armilla, Granada. Spain
e-mail: ahernandez@finut.org

Resumen

Antecedentes: la valoración de la calidad de la dieta es fundamental para el estudio de las asociaciones enfermedad-dieta, y es necesario implantar una herramienta de fácil aplicación en las residencias de ancianos. Nuestro objetivo fue proponer y aplicar un nuevo indicador de calidad de la dieta (*diet quality indicator*, DQIn) utilizando un enfoque *a priori* para su utilización en residencias de ancianos.

Métodos: el Índice de Calidad Nutricional en Residencias de Ancianos (QUality Index for Nutrition in Nursing homes, QUINN) se aplicó en una residencia pública de Valladolid durante un periodo de 5 semanas (n = 137 sujetos). La elección de los componentes del QUINN se basó en una revisión rápida. En el QUINN se consideraron 15 componentes dietéticos, 12 básicos (verduras, frutas, legumbres, aceite de oliva, cereales, lácteos, pescado blanco y marisco, carnes blancas, huevos/positivos; otras grasas, carnes rojas y procesadas, y dulces/negativos) y 3 adicionales (variedad de frutas y verduras, pescado azul, y cereales integrales/positivos). Cada componente se clasificó en 4 categorías (0, 1, 2 o 3 puntos; rango: 0-45 puntos).

Resultados: el QUINN se aplicó en el menú ofertado por una residencia de ancianos dando un resultado de 34 puntos (dieta de buena calidad). Los componentes con mayor puntuación estaban relacionados con la dieta mediterránea (alto consumo de legumbres, aceite de oliva, pescado blanco y marisco, bajo consumo de otras grasas y variedad de frutas y verduras), junto con los cereales, las carnes blancas, los lácteos y los huevos. Los componentes que requerían un cambio importante fueron las carnes rojas y procesadas, los dulces y los cereales integrales.

Conclusión: el menú de esta residencia de ancianos situada en España mostró una calidad de la dieta buena según el QUINN. La evaluación de la calidad de la dieta en las residencias de ancianos mediante el QUINN permitirá proponer intervenciones para mejorar la dieta.

Palabras clave:

Modificaciones de la dieta. Comportamiento alimentario. Residencias de ancianos. Dieta saludable. Hábitos alimentarios.

INTRODUCTION

The world faces a global challenge of malnutrition that needs to be addressed for achieving sustainable development (1). Diet quality (DQ) assessment is useful to evaluate diet in population groups at high nutritional risk, such as the institutionalized populations that present a greater risk of malnutrition, which is associated with an increase in morbidity and mortality risks (2,3). The assessment of DQ is usually performed by calculating the frequency of consumption of different food groups or by estimating dietary energy and nutrient intakes.

The definition and criteria for the Diet quality indicators (DQIns) have been reviewed and discussed by different researchers (4,5), DQIns are commonly defined by components, where each component refers to a dimension within the indicator that contributes with a specific weight to the overall score.

Several authors have reviewed the definition of DQIns or have discussed the criteria that should be considered to evaluate this concept (4,6,7). One of the main uses of DQIns is to associate certain combinations of components with the risk of geriatric syndromes (GS) and chronic diseases (8). The application of DQIns in the elderly was reviewed by Fernandes et al. (9). In this systematic review (SR), all indicators were adaptations of the original Healthy Eating Index (HEI) developed by Kennedy et al. in 1995 (10). However, it is difficult to compare DQIns between studies because of the variation in the number and type of components and the use of different scoring systems.

In 2010, Rumbak et al. (11) applied the instrument to older people in eleven nursing homes (NHs) in Croatia, including components in the form of nutrients, food portions, and two scores (diversity and moderation). In Spain, Norte et al., in 2011, adapted the HEI to the Spanish population, including the elderly *(Indice de Alimentación Saludable)* (12). Subsequently, Hernández et al. (2015) updated this index, applying it to non-institutionalized elderly (> 80 years) (13). In 2018, the Healthy Aging Diet Index was proposed to measure the adequacy of the intake of nutrients from the diet with regard to healthy aging, this index being applied in Spanish non-institutionalized elderly (14). However, despite the fact that these indicators have been developed in the elderly, they are solely applicable to estimate the individual intake of subjects.

Regarding the assessment of the DQ in institutionalized persons, without the application of DQIns, there are numerous Spanish studies on this issue. One example is the study by Rodriguez-Rejón et al. in 2017 (15). In this research, the DQ was evaluated by a validated index on the quality of meals and meal service, and the menus were assessed by weighed food records. This study concluded that it is necessary to ensure the implementation of regular routines for controlling the quality of meals, meal service, and nutritional value of the menus offered in NHs.

The large number of nutrition care quality indicators in hospitals and NHs highlights the importance of improving nutritional care in these institutions (16). However, the great variability of these indicators shows that there is little consensus among the nutrition community on the best way to assess and measure nutrition care quality. The limited methodological and conceptual validity of these DQIns makes international consensus a complicated goal.

Therefore, it is now necessary to develop alternative tools to assess DQ through a unidimensional measure. However, it is necessary to consider dietary components as an alternative to nutrients, due to the complexity that these would have in the evaluation of the menus offered in NHs. Consequently, it is desirable to develop an instrument that is extremely easy to apply by assessing components such as food groups, foods, and dietary characteristics.

To date, and to our knowledge, no specific *a priori* DQIn has been developed to assess dietary and nutritional DQ in NHs. Due to the importance of a proper DQ evaluation in NHs, the development of an indicator to measure the quality of the menus offered in NHs by means of DQIns is deemed necessary. Thus, the aim of the study was to propose and apply a new DQIns with *a priori* methodology to estimate the DQ of the menus offered, and one that can be easily applied in NHs.

MATERIAL AND METHODS

The QUality Index for Nutrition in Nursing homes (QUINN) is a new tool in the study: A Novel *a priori* Diet Quality Indicator and its Application in Long-Term Care Homes. This research aims to propose and apply an instrument with the conventional concept of DQIns from epidemiological studies in order to estimate the DQ of the menus offered, in a simple way and in NHs for the elderly. The study was approved by the Drug Research Ethics Committee-Medicines (CEIm) of the Valladolid Health Area, West, Río Hortega University Hospital (Ref. CEIm: 21-PI061). All residents or their legal tutors signed an informed consent form to authorize the presence of personnel of the institution in the dining areas during mealtimes.

This indicator was implemented in a public NH located in Valladolid, Spain. The study was conducted over five weeks, by establishing mean serving sizes in each recipe or food (17,18). The sample of patients who consumed the menu comprised 137 individuals. The offered menu at this NH was elaborated and supervised by a team of kitchen staff, a gerontologist, and dietitians (approximately, 10 persons). In this NH the offered menu has been adapted to the Mediterranean diet since this dietary pattern is the nutritional model of choice for the prevention and treatment of the most prevalent diseases in geriatrics (19-23).

FOOD CONSUMPTION ESTIMATION

The dietary study was performed by quantifying the frequency of consumption of foods offered in the menu of the NH, which was, as aforementioned, a regular menu adapted to the Mediterranean diet (24-27) (Table SI). The frequency of intake of ten food groups and 20 subgroups was classified as follows: 1- cereals, and potatoes; 2- vegetables; 3- fruits; 4- dairy; 5- legumes; 6- eggs; 7- meat (white meat, red meat, and processed meat); 8- fish (white fish, and oily fish); 9-fats and oils (olive oil, other vegetable oils and animal oils and fats); 10- sweets and sugars (cookies, pastries, juices, and added sugars).

Table SI. Menus offered in the nursing home during the evaluation cycle

	Breakfast	Lunch	Dinner
Monday (October 29)	Milk with soluble cereals Biscuit Fruit	Legume cream Fried egg, red sausages, and french fries Fruit	Spinach cream with cheese bits Hake in garlic sauce Macedonia in syrup
Tuesday (October 30)	Milk with soluble cereals Cupcake Fruit	Potatoes in marinara sauce Marinated ribs with peppers Fruit	Garlic soup Battered dab with salad Yoghourt
Wednesday (November 31)	Milk with soluble cereals Biscuits Fruit	Castilian stew *(cocido castellano)* Fruit	Poultry soup Tuna omelet with Italian peppers Custard
Thursday (November 1)	Milk with soluble cereals Cupcake *(sobao)* Fruit	Chicken salad Pork sirloin cooked in apple sauce Ice-cream	Zucchini cream Fried breaded chicken with tomato salad Baked apple
Friday (November 2)	Milk with soluble cereals Biscuits Fruit	Potatoes with chard Broiled cod with salad Fruit	Carrot cream Spanish omelet Liquid yoghourt
Saturday (November 3)	Milk with soluble cereals Cupcake Fruit	Guts and chickpeas Rabbit stew Fruit	Vegetables cream Ham rolls filled with crab with lettuce salad Cheese and quince
Sunday (November 4)	Hot chocolate and *churros* Fruit	Peas cream with ham bits Lemon pepper chicken wings and salad Curd with honey	Garlic soup Sardines in olive oil with tomato salad Baked apple
Monday (November 5)	Milk with soluble cereals Biscuits Fruit	Legumes Hake in green sauce Fruit	Poultry soup Cheese omelet with tomato salad Yoghourt
Tuesday (November 6)	Milk with soluble cereals Cupcake Fruit	Squid with potatoes Chicken stew with peas Fruit	Garlic soup Battered dab with salad Yoghourt

(Continues on next page)

Table SI (Cont.). Menus offered in the nursing home during the evaluation cycle

	Breakfast	Lunch	Dinner
Wednesday (November 7)	Milk with soluble cereals Biscuits Fruit	Castilian stew Fruit	Vegetable cream Scrambled eggs with prawns and peppers Custard
Thursday (November 8)	Milk with soluble cereals Cupcake *(sobao)* Fruit	Cabbage with potatoes Rabbit with artichokes Fruit	Green beans Fried breaded chicken with tomato salad Curd with honey
Friday (November 9)	Milk with soluble cereals Biscuits Fruit	Rice with chicken Meatloaf Fruit	Carrot cream Spanish omelet with zucchini Liquid yoghourt
Saturday (November 10)	Milk with soluble cereals Cupcake Fruit	Lentils with vegetables Broiled chicken with salad Fruit	Cauliflower cream Mackerel with tomato, onion, olives, and egg salad Yoghourt
Sunday (November 11)	Hot chocolate and *churros* Fruit	Artichokes and ham Broiled purloin with apple sauce and salad Macedonia in syrup	Garlic soup Ham *(lacon)* with garlic peppers Baked apple
Monday (November 12)	Milk with soluble cereals Biscuits Fruit	White beans Hake with clams and mussels Fruit	Vegetable cream Spanish omelet with salad Liquid yoghourt
Tuesday (November 13)	Milk with soluble cereals Cupcake Fruit	Pasta with tomato Chicken with mushrooms Fruit	Garlic soup Mackerel with tomato, onion, olives, and egg salad Cheese with quince
Wednesday (November 14)	Milk with soluble cereals Biscuits Fruit	Castilian stew *(cocido castellano)* Fruit	Zucchini cream Tuna omelet with peppers Curd with honey
Thursday (November 15)	Milk with soluble cereals Cupcake *(sobao)* Fruit	Green beans with potatoes and carrots Oxtail stew Fruit	Noodle soup Baked garlic hake and zucchini Baked apple
Friday (November 16)	Milk with soluble cereals Biscuits Fruit	Potage Baked cod with salad Fruit	Carrot cream Scrambled eggs and prawns and mushrooms with tomato salad Yoghourt
Saturday (November 17)	Milk with soluble cereals Cupcake fruit	Rice with vegetables Rabbit stew Fruit	Pea cream Ham rolls filled with tuna, eggs and mayonnaise with lettuce Yoghourt
Sunday (November 18)	Hot chocolate and *churros* Fruit	Fish soup Broiled chicken with pineapple and salad Macedonia in syrup	Garlic soup Ham *(lacon)* with garlic peppers Baked apple
Monday (November 19)	Milk with soluble cereals Biscuits Fruit	Rice with fried eggs and tomato sauce Fruit	Zucchini cream Cooked ham. Mackerel in olive oil with tomato salad Yoghourt
Tuesday (November 20)	Milk with soluble cereals Cupcake Fruit	Potatoes with cod Meatballs in green sauce Fruit	Chicken soup Whiting with tomato salad Curd with honey
Wednesday (November 21)	Milk with soluble cereals Biscuits Fruit	Castilian stew *(cocido castellano)* Fruit	Garlic soup Omelet with prawns and Italian peppers Baked apple

(Continues on next page)

Table SI (Cont.). Menus offered in the nursing home during the evaluation cycle

	Breakfast	Lunch	Dinner
Thursday (November 22)	Milk with soluble cereals Cupcake *(sobao)* Fruit	Vegetable stew *(purrusalda)* Tuna with salad Fruit	Vegetable cream Chicken breast with ratatouille Custards
Friday (November 23)	Milk with soluble cereals Biscuits Fruit	Pasta with tomato Hake with salad Fruit	Carrot cream Spanish omelet with salad Liquid yoghourt
Saturday (November 24)	Milk with soluble cereals Cupcake Fruit	Lentils *Ossobuco* with mushrooms Fruit	Pea cream Ham *(lacon)* with garlic peppers Yoghourt
Sunday (November 25)	Hot chocolate and churros Fruit	Vegetable stew with ham Garlic rabbit stew Macedonia in syrup	Garlic soup Loin and cured ham with tomato salad Baked apple
Monday (November 26)	Milk with soluble cereals Biscuits Fruit	Legume cream Fried egg, red sausage, and french fries Fruit	Spinach cream with cheese Hake in garlic sauce Macedonia in syrup
Tuesday (November 27)	Milk with soluble cereals Cupcake Fruit	Potatoes in marinara sauce Marinated ribs cooked with peppers Fruit	Garlic soup Breaded sole with salad Yoghourt
Wednesday (November 28)	Milk with soluble cereals Biscuits Fruit	Castilian stew *(cocido castellano)* Fruit	Poultry soup Tuna omelet with Italian peppers Custard
Thursday (November 29)	Milk with soluble cereals Cupcake *(sobao)* Fruit	Chicken salad Pork sirloin cooked in apple sauce Ice-cream	Zucchini cream Fried breaded chicken with tomato salad Baked apple
Friday (November 30)	Milk with soluble cereals Biscuits Fruit	Potatoes with chard Broiled cod with salad Fruit	Carrot cream Spanish omelet Liquid yoghourt
Saturday (December 1)	Milk with soluble cereals Cupcake Fruit	Guts with chickpeas Rabbit stew Fruit	Vegetable soup Ham rolls filled with crab and lettuce Cheese with quince
Sunday (December 2)	Hot chocolate and *churros* Fruit	Cream of peas with ham bits Lemon pepper chicken wings with salad Curd with honey	Garlic soup Sardines in olive oil with tomato salad Baked apple

Fruit: orange, apple, pear, banana, kiwi. Choice between soluble cereals, decaffeinated coffee, or coffee. In the morning a glass of unsweetened commercial juice is offered as a snack, and a coffee with milk as an afternoon snack.

METHODOLOGY OF THE QUality INDEX FOR NUTRITION IN NURSING HOMES: QUINN

In order to assess the DQ we developed an *a priori* DQIn for NHs, the so-called QUality Index for Nutrition in Nursing homes (QUINN). To initiate the project, the DQIns (components, and scoring systems) that had been applied in similar populations were extensively studied (9,12,13). The QUINN components was based on a rapid review (Rap Rev) (28,29) conducted on the foods more closely related to the prevention and treatment of the most prevalent chronic diseases and GS in the geriatric population (14,19,23,30). The Rev Rap is a synthesis of evidence that may provide more rapid information for decision support in comparison with conventional SR (28). The Rap Rev provides reviews with a systematic methodology that comply with the basic principles of SR, thus avoiding bias and following an exhaustive evaluation and synthesis of the studies (31-33). In reporting this Rap Rev, the criteria of the Preferred Reporting Items for Sys-

tematic Reviews and Meta-Analyses (PRISMA) statement from its 2020 update (34,35) have been applied. Due to the objectives and time-shortening nature of this Rev Rap, some items such as risk of bias assessment and searching at least two databases were not performed.

A reproducible search strategy was developed for the application in the MEDLINE database (PubMed), last reproduced on 27 December 2020. The search strategy for the identification of the studies of the components to be included in the QUINN was the following: ((Fruit[MeSH Terms]) OR (vegetables[MeSH Terms])) OR (Fruits)) OR (Vegetables)) OR (((Fruits)) OR (Vegetables)) AND (Variety)) OR (legumes)) OR (beans)) OR (fabaceae[MeSH Terms])) OR (Edible Grain[MeSH Terms])) OR ("Edible Grain")) OR (cereals)) OR ("Whole grains")) OR ("Whole grains"[MeSH Terms])) OR ("olive oil"[MeSH Terms])) OR (candy[MeSH Terms])) OR (Dietary Sugars[MeSH Terms])) OR (dairy products[MeSH Terms])) OR ("red meat"[MeSH Terms])) OR (poultry[MeSH Terms])) OR (seafood[MeSH Terms])) OR (eggs[MeSH Terms])) OR ("Dietary proteins"[MeSH Terms])) OR (dietary fats[MeSH Terms])) OR ("olive oil")) OR (candy)) OR ("dietary sugars")) OR (sweets)) OR (sweetened)) OR (pastry)) OR ("bakery products")) OR ("sugary drinks")) OR (biscuits)) OR (cookies)) OR ("dairy products")) OR (milk)) OR ("red meat")) OR (poultry)) OR (seafood)) OR ("oily fish")) OR (eggs)) OR ("dietary proteins")) OR ("dietary fats"))) AND ((((((((((((((((frailty[MeSH Terms]) OR (malnutrition[MeSH Terms])) OR ("Cognitive Dysfunction"[MeSH Terms])) OR (constipation[MeSH Terms])) OR ("Pressure Ulcer"[MeSH Terms])) OR ("Deglutition Disorders"[MeSH Terms])) OR (frailty)) OR (malnutrition)) OR ("Cognitive Dysfunction")) OR (constipation)) OR ("Pressure Ulcers")) OR ("Deglutition Disorders")) OR ("Cardiovascular Diseases"[MeSH Terms])) OR ("Cardiovascular Diseases")) OR (immobility)) OR ("geriatric syndromes")))). In addition, the following filters were applied: Clinical Trial, Comparative Study, Meta-Analysis, Observational Study, Systematic Review, Humans, Aged: 65+ years, and articles from 2010/1 - 2020/12.

A detailed description of the methodology of this indicator (QUINN index criteria, components and scoring system) and the main recommendations for its application are provided in this publication (47).

CHARACTERISTICS OF THE SUBJECTS

To evaluate the nutritional status of the subjects (36) two tools were used, namely the Mini Nutritional Assessment, MNA (37,38), and the Controlling Nutritional Status –CONUT instrument (39). Functional capacity was evaluated using Barthel's index (40), the Lawton and Brody scale (41), and the Short Physical Performance Battery SPPB (42). The assessment of the cognitive state was performed using the Lobo Mini Cognitive Test (43,44). These scales were selected because they are some of the most studied and validated internationally for studying these topics (45). These tools were applied by a geriatrician, nurses, and dietitians during the period of time that the diet was estimated.

STATISTICAL ANALYSIS

The descriptive analyses of variables by total sample, sex, and age groups were based on median and main percentiles (quartile 1 and quartile 3), or interquartile range (IQR) for continuous variables and frequencies for categorical variables. Median differences by sex were evaluated using the Mann-Whitney U test (p-value < 0.05 was considered as statistically significant). All analyses were performed using the statistical software package version R Studio 3.5 (46).

RESULTS

PROPOSAL OF THE QUality INDEX FOR NUTRITION IN NURSING HOMES: QUINN

After performing the search strategy designed in PubMed, 1270 articles were initially retrieved, of which 1126 were excluded after reviewing the title; of the remaining articles, after reading the abstracts 109 were also excluded; four references were added because of expert recommendations, obtaining a total of 39 articles; after reading their full text 24 were finally selected. Further details of the screening and study selection process are detailed in this publication (47).

The QUINN considered 15 dietary components, of which 12 were basic food components: vegetables, fruits, legumes, olive oil, cereals, dairy, fish, white meat, eggs, which were classed as positive, and other foods (fats, red and processed meats, and sweets), which were classed as potentially harmful. Besides, it considered additional dietary components to assess special features of DQ: variety of vegetables and fruits, oily fish intake, and whole grains consumption. A description of the justification of the dietary components included in the proposal for the QUINN is shown in table I. The main characteristics of the studies as regards the components included in the QUINN are shown in table II.

In each of the dietary components (basic and additional), all foods included in each subgroup were described, as well as their serving size depending on the specific food or whether it was used as a main dish, side dish, or ingredient. Slight modifications have been introduced to the original QUINN (47) to adapt it to the reality of NHs. These modifications have been performed on the components of vegetables, white fish and seafood, and sweets, and portion sizes have been adjusted according to the recommendations of the Spanish Society of Community Nutrition (SENC) for the elderly (Table SII).

Regarding the scoring method, each component was classified into four categories (scores: 0, 1, 2, and 3 points per component), using fixed cut-off levels of consumption of each component. For example in the case of vegetables component 0 points, < 0.5 servings/day; 1 point, 0,5-1 servings/day; 2 points, 1.5 servings/day, and 3 points, ≥ 2 servings/day; for the red and processed meat component it would be 0 points, ≥ 5 servings/week; 1 point, 4 servings/week; 2 points, 3 servings/week, and 3 points, ≤ 2 servings/week; finally, or the variety of vegetables and fruits every three days, 0 points, ≤ 2; 1 point, 3-4; 2 points, 5-7, and 3 points, ≥ 8.

Table I. Justification of the dietary components included in the proposal of QUINN for NHs

Dietary components	Authors (year), reference	Positive or negative effect
Vegetables	Oude Griep M et al. (2011) (48)	↓ Stroke
Fruits	Mottaghi T et al. (2017) (49)	↓ Cognitive impairment
	Miller V et al. (2017) (50)	↓ Non-CVD mortality ↓ Total mortality
	Buil-Cosiales P et al. (2014) (51)	↓ All-cause mortality ↓ CVD mortality
Legumes	Becerra-Tomás N et al. (2019) (52)	↓ CVD ↓ T2DM
Olive oil	Guasch-Ferré M et al. (2014) (53)	↓ CVD
	Martínez-Lapiscina EH et al. (2013) (22)	↓ Mild cognitive impairment
Milk and dairy products	Cuesta-Triana F et al. (2019) (54)	↓ Frailty ↓ Sarcopenia
	Key TJ et al. (2019) (55)	↓ HD
White fish and shellfish	Zhao W et al. (2019) (56)	↓ Stroke
White meats	Coelho-Júnior HJ et al. (2018) (57)	↓ Frailty (protein)
	Key TJ et al. (2019) (55)	No association with IHD
	Abete I et al. (2014) (58)	No association with CVD, IHD or all-cause mortality
Eggs	Coelho-Júnior HJ et al. (2018) (57)	↓ Frailty (protein)
	Godos J et al. (2020) (59)	No association with CVD, CHD, stroke
	Dehghan M et al. (2020) (60)	No association with blood lipids, major CVD or total mortality
Other fats	Zhuang P et al. (2019) (61)	↑ Mortality from CVD, cancer, RD, and diabetes *mellitus* (saturated fatty acids) ↑ Mortality from CVD, RD, and kidney disease (animal monounsaturated fatty acids)
	Guasch-Ferré M et al. (2015) (53)	↑ CVD (saturated fatty acids from processed food and *trans* fat)
Red meat and processed meat	Key TJ et al. (2019) (55)	↑ IHD
	Abete I et al. (2014) (58)	↑ CVD mortality (processed meat and red meat) ↑ All-cause mortality (processed meat)
Sweets and sugars	Laclaustra M et al. (2018) (62)	↑ Frailty
	Narain A et al. (2016) (63)	↑ Myocardial infarction ↑ Stroke
Variety of vegetables and fruits	Ye X et al. (2013) (64)	↑ Mini Mental State Examination score ↑ Scores in executive function, memory, and attention.
	Cooper AJ et al. (2012) (65)	↓ T2DM
Oily fish	Zhuang P et al. (2019) (61)	↓ Mortality from CVD, cancer, RD, Alzheimer disease and chronic liver disease
	Sala-Vila A et al. (2016) (66)	↓ Fatal CVD ↓ Fatal CHD
	Koh AS et al. (2013) (67)	↓ CVD
Whole grains	Chen GC et al. (2016) (68)	↓ CVD mortality ↓ Cancer mortality ↓ Total mortality
	Li Y et al. (2015) (69)	↓ CHD

CVD: cardiovascular disease; CHD: coronary heart disease; IHD: ischemic heart disease; QUINN: QUality Index for Nutrition in Nursing homes; NH: nursing home; RD: respiratory disease; T2DM: type 2 diabetes mellitus.

Table II. Main characteristics of the studies on the dietary components included in the proposal of the Quality Index of Nutrition in Nursing homes (QUINN)

Dietary components	Authors (year), reference	Study design; follow up	Study population N sex (% sex) (age) other characteristics. Country/Region	Positive or negative effect	HR/RR/OR* (95 % CI); p-value (I^2; p for heterogeneity)
Vegetables	Oude Griep M et al. (2011) (48)	Prospective cohort study; 10.3 years	8988 men and 11,081 women (20-65 years at baseline) free of CVD at baseline. Netherlands	↓ Stroke incidence	> 48 g/day vs ≤ 14 g/day of raw vegetables HR: 0.53 (0.36-0.80)
Fruits	Mottaghi T et al. (2017) (49)	Meta-analysis (3 cross sectional, 2 cohort, 1 nested case control)	17,537 men and women (> 65 years). China, France, USA, Brazil	↓ Cognitive impairment	High vs low fruit and vegetable intake OR = 0.79 (0.67- 0.93); p = 0.006 (I^2= 67.6 %; p = 0.001). High vs low fruit intake OR = 0.84 (0.73-0.97); p = 0.019 (I^2 = 67.6 %; p = 0.563)
	Miller V et al. (2017) (50)	Prospective cohort study; median 7.4 (5·5-9·3) years	135 335 men and women (35-70 years) from PURE cohort North America, Europe, South America, the Middle East, Asia, and Africa	↓ Non-CVD mortality ↓ Total mortality	> 3 servings/day vs < 3 servings/week Non-CVD: HR = 0·82 (0·70-0·97); p-trend = 0.0008 Total: HR = 0·81 (0·72-0·93); p-trend < 0.0001
	Buil-Cosiales P et al. (2014) (51)	Cohort study; mean of 5.9 years	7216 men (55–75 years) and women (60–75 years) at high CVD risk from PREDIMED Study. Spain	↓ All-cause mortality ↓ CVD mortality	First (153 g/day) vs fourth (439 g/day) quintiles of fruit consumption at baseline. All-cause: HR = 0.61 (0.44, 0.84); p-trend = 0.004 CVD: HR = 0.33 (0.17, 0.66); p-trend = 0.015
Legumes	Becerra-Tomás N et al. (2019) (52)	Meta-analysis of prospective cohort studies (4 for CVD and 13 for T2DM); > 1 year	CVD meta-analysis= 163,974 adult men and women (age not specified). T2DM meta-analysis = 539,752 adults (age not specified). Different countries	↓ CVD ↓ T2DM	Highest vs lowest categories of: Total legume CVD: RR = 0.86 (0.80, 0.94); p = 0.0003 (I^2 = 0 %) Non-soy legume T2D: RR = 0.85 (0.75, 0.95); p = 0.0006 (I^2 = 58 %)
Olive oil	Guasch-Ferré M et al. (2014) (53)	Multicenter, randomized, controlled, clinical trial; median of 4.8 y	7216 men and women (55-80 y) at high cardiovascular risk, from the PREDIMED Study. Spain	↓ CVD	Highest vs lowest tertile of baseline Total olive oil: HR = 0.65 (0.47,0.89); p-trend = 0.01 EVOO: HR = 0.61 (0.44, 0.85); p-trend < 0.01 For each 10 g/d increase in: Total olive oil: HR = 0.87 (0.81, 0.94) EVOO: HR = 0.90 (0.85, 0.95)
	Martinez-Lapiscina EH et al. (2013) (22)	Multicenter, randomized, controlled, clinical trial; 6.5 years	268 men and women (mean age 74.1 ± 5.7 y) at high cardiovascular risk, from a subsample of the PREDIMED Study. Spain	↓ Mild cognitive impairment	Intervention with EVOO-rich vs intervention with low fat diet OR = 0.34 (0.12-0.97); p = 0.044

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Table II (Cont.). Main characteristics of the studies on the dietary components included in the proposal of the Quality Index of Nutrition in Nursing homes (QUINN)

Dietary components	Authors (year), reference	Study design; follow up	Study population N sex (% sex) (age) other characteristics. Country/Region	Positive or negative effect	HR/RR/OR* (95 % CI); p-value (I^2; p for heterogeneity)
Milk and dairy products	Cuesta-Triana F et al. (2019) (54)	Systematic review of 5 prospective cohort and 1 randomized clinical trial; from 3.5 to 20 years	24,689 community-dwelling older people > 60 y. France, Spain, Mexico, USA, Japan	↓ Frailty ↓ Sarcopenia	The consumption of low-fat milk and yogurt may reduce the risk of frailty. The addition of nutrient-rich dairy proteins (ricotta cheese) to the habitual diet may reduce the risk of sarcopenia by improving skeletal muscle mass
	Key TJ et al. (2019) (55)	Prospective cohort study; mean of 12.6 years	409,885 men aged 52.7 (10.3) years and women aged 51.3 (9.8) years from EPIC cohort. Europe	↓ IHD	The top fifth vs the bottom fifth of intake Yogurt: HR = 0.90 (0.84-0.97); p-trend = 0.0004 Cheese: HR = 0.88 (0.80-0.96); p-trend = 0.003
White fish and shellfish	Zhao W et al. (2019) (56)	Meta-analysis of 33 prospective cohort studies (4 to 22.7 years)	6,469,824 adult women and men (age not specified). North America, Asia-Pacific, and Europe	↓ Stroke	Highest vs lowest categories of fish consumption HR = 0.90 (0.85-0.96) (I^2 = 39.2 %)
White meats	Coelho-Júnior HJ et al. (2018) (57)	Systematic review of 3 longitudinal studies; 3.7 (3.0-4.6) years) Meta-analysis of 3 cross sectional studies	Longitudinal studies = 32,164 community-dwelling older adults USA and Spain. Cross sectional studies = 9091 community-dwelling older adults (mean age from 73.2 to 75.6 years). Japan and France	↓ Frailty (protein)	Two longitudinal studies observed that higher protein intake was negatively associated with frailty risk. Highest vs lowest category of protein intake (cross sectional studies) OR = 0.67 (0.56-0.82); p = 0.0001 (I^2 = 39 %; p = 0.18)
	Key TJ et al. (2019) (55)	Prospective cohort study; mean of 12.6 years	409,885 men (2.7 (SD 10.3) years) and women (51.3 (SD 9.8) years) from EPIC cohort. Europe	No association with IHD	The top fifth vs the bottom fifth of poultry intake HR = 1.01 (0.94-1.10); p = 0.77 HR per 20 g/day increment in poultry meat = 0.99 (0.94-1.04); p = 0.68
	Abete I et al. (2014) (58)	Meta-analysis of 13 prospective cohort studies; 6 to 28 years	1,674,272 women and men (16-92 years). Europe, USA, Australia, Asia	No association with CVD, IHD or all-cause mortality	Highest vs lowest category of intake CVD: RR = 1.01 (0.96-1.07) (I^2 = 10·6 %; p = 0.348) IHD: RR = 1.00 (0.82-1.21) (I^2 = 0; p = 0.780) All-cause: RR = 0·92 (0·84-1·05) (I^2 = 0 %; p = 0.63)
Eggs	Coelho-Júnior HJ et al. (2018) (57)	Systematic review of 3 longitudinal studies; 3.7 (3.0-4.6 years) Meta-analysis of 3 cross sectional studies	Longitudinal studies = 32,164 community-dwelling older adults USA and Spain Cross sectional studies = 9091 community-dwelling older adults (mean age from 73.2 to 75.6 years). Japan and France	↓ Frailty (protein)	Two longitudinal studies observed that higher protein intake was negatively associated with frailty risk. Highest vs lowest category of protein intake (cross sectional studies) OR = 0.67 (0.56-0.82); p = 0.0001 (I^2 = 39 %; p = 0.18)

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Table II (Cont.). Main characteristics of the studies on the dietary components included in the proposal of the Quality Index of Nutrition in Nursing homes (QUINN)

Dietary components	Authors (year), reference	Study design; follow up	Study population N sex (% sex) (age) other characteristics. Country/Region	Positive or negative effect	HR/RR/OR* (95 % CI); p-value (I^2; p for heterogeneity)
Eggs	Godos J et al. (2020) (59)	Meta-analysis of 38 prospective cohort studies; from 3 to 32 years	Almost 2 million of men and women (age not specified). North America, Europe, Asia, Iran, and 3 multinational cohorts	No association with CVD, CHD, stroke	7 eggs/week vs 0 eggs/week (RRs for incidence/mortality) CVD = 0.96 (0.92; 1.01) (I^2 = 71 %; p < 0.001) CHD = 0.98 (0.91, 1.07) (I^2 = 82 %; p < 0.001) Stroke = 0.95 (0.88; 1.01) (I^2 = 46 %; p < 0.001)
	Dehghan M et al. (2020) (60)	Prospective cohort study; from a median of 56 months to 9.5 years	114,615 (41.9 % men) (50.6 ± 9.9 years). Europe, North America, South America, Africa, Middle East, South Asia, South East Asia, and China	No association with blood lipids, total mortality, major CVD	≥ 7 eggs/week vs < 1 egg/week intake Blood lipids: HR = 0.96 (0.89-1.04); p-trend = 0.74 Total mortality: HR = 1.04 (0.94-1.15); p-trend = 0.38 Major CVD: HR = 0.92 (0.83-1.01); p-trend = 0.20
Other fats	Zhuang P et al. (2019) (61)	Cohort study; 16 years	521,120 women and men (50-71 y) from the National Institutes of Health-American Association of Retired Persons Diet and Health Study. USA	Saturated fat: ↑ Mortality from CVD, cancer, respiratory disease, and diabetes *mellitus* Animal MUFA: ↑ Mortality from: CVD, respiratory disease, and kidney disease	Highest vs lowest quintiles of saturated fat (HRs) CVD = 1.27 (1.21-1.34); p < 0.0001 Cancer = 1.26 (1.20, 1.32); p < 0.0001 Respiratory disease = 1.76 (1.58, 1.96); p < 0.0001 Diabetes *mellitus* = 1.26 (1.06, 1.51); p = 0.024 Highest vs lowest quintiles of animal MUFA (HRs) CVD = 1.09 (1.03, 1.16); p = 0.0015 Respiratory disease = 1.18 (1.03, 1.34); p = 0.010 Kidney disease = 1.58 (1.17, 2.14); p = 0.0007
	Guasch-Ferré M et al. (2015) (53)	Prospective cohort study; median of 6 years	7038 men (55-80 years) and women (60-80 years) at high CVD risk from the PREDIMED. Spain	↑ CVD	Highest vs lowest quintiles of Trans fat: HR = 1.67 (1.09, 2.57); p < 0.01 Saturated fat from processed foods: HR = 1.46 (1.01, 2.13); p = 0.04
Red meat and processed meat	Key TJ et al. (2019) (55)	Prospective cohort study; mean of 12.6 years	409,885 men (52.7 (SD 10.3) years) and women (51.3 (9.8) years) from EPIC cohort. Europe	↑ IHD	The top fifth of intake vs the bottom fifth of red and processed meat HR = 1.13 (1.02, 1.26); p-trend = 0.014 HR per 100 g/day increment in red and processed meat = 1.19 (1.06, 1.33); p-trend = 0.001
	Abete I et al. (2014) (58)	Meta-analysis of 13 prospective cohort studies; from 6 to 28 years	1 674 272 women and men (16 – 92 years). Europe, USA, Australia, Asia	Processed meat and red meat: ↑ CVD mortality Processed meat: ↑ All-cause mortality	Highest vs lowest category of Red meat CVD: RR = 1·16 (1·03, 1·32) (I^2 = 82·5; p < 0.001) Processed meat All-cause: RR = 1·22 (1·16, 1·29) (I^2 = 44·4; p = 0.126) CVD: RR = 1·18 (1·05, 1·32) (I^2 = 73·5; p = 0.002)

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Table II (Cont.). Main characteristics of the studies on the dietary components included in the proposal of the Quality Index of Nutrition in Nursing homes (QUINN)

Dietary components	Authors (year), reference	Study design; follow up	Study population N sex (% sex) (age) other characteristics. Country/Region	Positive or negative effect	HR/RR/OR* (95 % CI); p-value (I^2; p for heterogeneity)
Sweets and sugars	Laclaustra M et al. (2018) (62)	Cohort study; 3 years	1973 men (49 %) and women (≥ 60 years) from the Seniors-ENRICA cohort. Spain	↑ Frailty	The highest (≥ 36 g) vs the lowest tertile (< 15 g) of added sugar OR = 2.27 (1.34, 3.90); p-trend = 0.003
	Narain A et al. (2016) (63)	Meta-analysis of 7 prospective cohort studies; from 9.8 to 24 years	308,420 participants (34-75 years). USA, Japan, Sweden, and Singapore	↑ Myocardial infarction ↑ Stroke	Highest vs lowest category of sweetened beverages Myocardial infarction: RR = 1.19 (1.09,1.31); p = 0.0002 (I^2 = 0 %; p = 0.56) One-serving/day increase in sweetened beverages Myocardial infarction: RR = 1.22 (1.14,1.30); p < 0.0001 (I^2 = 8 %; p = 0.3) Stroke: RR = 1.13 (1.02, 1.24); p = 0.02 (I^2 = 0 %; p = 0.64)
Variety of vegetables and fruits	Ye X et al. (2013) (64)	Cross sectional analysis	1412 women and men (45-75 years) from the Boston Puerto Rican Health Study. USA	↑Mini Mental State Examination (MMSE) score ↑Scores in executive function, memory, and attention	MMSE score from highest vs lowest quintile of variety (23·8 (SD 0.2) vs 23·2 (SD 0·2);P-trend = 0.018) There was a similar trend in executive function, memory, and attention (P <0.05 for all of them)
	Cooper AJ et al. (2012) (65)	Prospective cohort study; median 10.9 (IQR 9.8-11.8) years	3704 women and men from a subsample of EPIC cohort. European countries	↓T2DM	Highest vs lowest tertiles of Fruit: HR=0.70 (0.53, 0.91); P-trend=0.002 Vegetable: HR=0.77 (0.61, 0.98); P- trend=0.03 Fruit +vegetable: HR= 0.61(0.48,0.78); P-trend= 0.001
Oily fish	Zhuang P et al. (2019) (61)	Cohort study; 16 years	521,120 women and men (50-71 y) from the National Institutes of Health-American Association of Retired Persons Diet and Health Study. USA	↓ Mortality from CVD, cancer, RD, Alzheimer disease, chronic liver disease	Highest vs lowest quintile of marine omega-3 CVD = 0.90 (0.87-0.94); p < 0.0001, Cancer = 0.96 (0.92-0.99); p = 0.0071, RD = 0.78 (0.72-0.84); p < 0.0001, Alzheimer disease = 0.60 (0.51-0.71); p < 0.0001, chronic liver disease = 0.80 (0.63-1.02); p = 0.043
	Sala-Vila A et al. (2016) (66)	Cohort study; 5.9 years	7202 (57.5 % women) (67.0 (66.9-67.2) and at baseline) from PREDIMED study. Spain	↓ Fatal CVD ↓ Fatal CHD	≥ 500 mg/day vs < 500 mg/day of long chain omega-3 (mainly from seafood) Fatal CVD: HR = 0.61 (0.39-0.96); p = 0.032 Fatal CHD: HR = 0.54 (0.29-0.99); p = 0.046

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Table II (Cont.). Main characteristics of the studies on the dietary components included in the proposal of the Quality Index of Nutrition in Nursing homes (QUINN)

Dietary components	Authors (year), reference	Study design; follow up	Study population N sex (% sex) (age) other characteristics. Country/Region	Positive or negative effect	HR/RR/OR* (95 % CI); p-value (I^2; p for heterogeneity)
Oily fish	Koh AS et al. (2013) (67)	Cohort study; not specified	35,303 women and 27,954 men (45-74 years at baseline) from the Singapore Chinese Health Study. China	↓ CVD	Highest vs lowest quartile of marine omega-3 HR = 0.86 (0.77-0.96); p-trend = 0.004
Whole grains	Chen GC et al. (2016) (68)	Meta-analysis; from 5.5 to 26 years	Adult women and men (between 30-98 y). USA, Europe, China	↓ CVD mortality ↓ Cancer mortality ↓ Total mortality	High compared with low intake (RR): CVD = 0.82 (0.78, 0.85) (I^2 = 0 %; p = 0.579). Cancer = 0.89 (0.84, 0.95) (I^2 =53.6 %; p = 0.04). Total = 0.83 (0.80, 0.88) (I^2 = 70.6 %; p < 0.001). RR for each 50-g/day increment: CVD = 0.70 (0.61, 0.79) (I^2 = 64.8 %; p = 0.002). Cancer = 0.82 (0.69, 0.96) (I^2 = 85.3 %; p < 0.001). Total = 0.78 (0.67, 0.91) (I^2 = 94.3 %; p < 0.001)
	Li Y et al. (2015) (69)	Cohort study; 30 years for women and 24 years for men	84,628 women from Nurses' Health Study, and 42,908 men from Health Professionals Follow-up Study. USA	↓ CHD	Highest vs lowest quintiles HR = 0.90 (0.83,0.98); p-trend = 0.003

CHD: coronary heart disease; CVD: cardiovascular disease; ENRICA: study on nutrition and cardiovascular risk in Spain (Estudio sobre Nutrición y RIesgo CArdiovascular en España); EPIC: European Prospective Investigation into Cancer and Nutrition; EVOO : extra virgin olive oil; HR: hazard ratio; IHD: Ischemic heart disease; MMSE: mini-mental state examination; MUFA: monounsaturated fatty acids; OR: odds ratio; PREDIMED: PREvención con DIeta MEDiterránea; PURE: Prospective Urban and Rural Epidemiological study; RD: respiratory disease; RR: relative risk; T2DM: type 2 diabetes mellitus*; USA: United States of America.*

Table SII. Description of consumed portion sizes

Description of dietary components — basic foods
1. Vegetables: main dish (150-200 g), and side dish (40-50 g)
2. Fruits (150-200 g)
3. Legumes: main dish (50 g); side dish (10-15 g)
4. Olive oil (10 g)
5. Cereals: bread (30-60 g), pasta and rice (main dish 50 g, side dish 30 g).
6. Milk and dairy products. Sweetened dairy products are not included. Milk (200-250 ml), yoghurt (125 g), fresh cheese (60 g), and hard chesse (30-40 g)
7. White fish and shellfish: main dish (100-150 g), and side dish (30-40 g)
8. White meats: main dish (125 g) and side dish (30-40 g)
9. Eggs (60 g)
10. Other fats (10 g)
11. Red and processed meats: main dish (100 g) and side dish (25 g)
12. Sweets: biscuits (25 g), pastries (60 g), sugary drinks (200 ml), ice cream (125 g) and sugar (5-10 g)
Description of dietary components — additional foods
1. Variety of vegetables and fruits (variety every 3 days)
2. Oily fish: main dish (150 g) and side dish (30-40 g)
3. Whole grains (% of whole grains as a percentage of total intake)

The QUINN ranged from 0 to 45 points, the highest values of the score meaning compliance with each index component. The overall DQ categories were established as follows: very low (0-8 points), low (9-17 points), moderate (18-26 points), good (27-35 points), and very good (≥ 36 points). A detailed description of a dietary quality indicator for application in NH, QUINN, is shown in table III. More details on how to apply this tool can be found in this recent publication (47).

MENU OFFERED BY THE NURSING HOME

The menu offered by this NH was found to supply a higher number of plant-based food items, such as vegetables, fruits, legumes, and relatively important amounts of extra virgin olive oil (a median of 4.3 servings). By studying the consumption frequencies of the offered menu, bread was the most consumed food within the cereals group. Dairy and eggs were the two food groups that were consumed most by the subjects. Concerning protein foods such as meat and fish, high intakes were observed. A description of the food groups and subgroups counted in each week of the centre menu is shown in table IV.

Table III. Description of the components, criteria, and scoring system of the QUality Index for Nutrition in Nursing homes (QUINN)

Components	Criteria for 0 points	Criteria for 1 point	Criteria for 2 points	Criteria for 3 points
Basic foods components				
1. Vegetables[a]	< 0.5 servings/ day	0.5-1 servings/ day	1.5 servings/ day	≥ 2 servings/ day
2. Fruits[b]	< 1 serving/ day	1 serving/ day	2 servings/ day	≥ 3 servings/ day
3. Legumes	< 1 serving/ week	1 serving/ week	2 servings/ week	≥ 3 servings/ week
4. Olive oil	< 1 serving/ day	1.5 servings/ day	2 servings/ day	≥ 3 servings/ day
5. Cereals[c]	< 1 serving/ day	1 serving/ day	2 servings/ day	≥ 3 servings/ day
6. Milk and dairy products[d]	< 1 serving/ day	1 serving/ day	1.5 servings/ day	≥ 2 servings/ day
7. White fish and shellfish	< 0.5 serving/ week	1 serving/ week	1.5 servings/ week	≥ 2 servings/ week

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Table III (Cont.). Description of the components, criteria, and scoring system of the QUality Index for Nutrition in Nursing homes (QUINN)

Components	Criteria for 0 points	Criteria for 1 point	Criteria for 2 points	Criteria for 3points
Basic foods components				
8. White meat	> 5 servings/ week	5 servings/ week	4 servings/ week	≤ 3 servings/ week
9. Eggs	< 2 servings/ week	2 servings/ week	3 servings/ week	≥ 4 servings/ week
10. Other fats[e]	> 3 servings/ day	3 servings/ day	2 servings/ day	≤ 1 serving/ day
11. Red and processed meat	≥ 5 servings/ week	4 servings/ week	3 servings/ week	≤ 2 servings/ week
12. Sweets[f]	≥ 15 servings/ week	10-14 servings/ week	4-9 servings/ week	≤ 3 servings/ week
Additional dietary components				
13. Variety of vegetables and fruits (variety every 3 days)	≤ 2	3-4	5-7	≥ 8
14. Oily fish	0.5 servings/ week	1 serving/ week	1.5 servings/ week	≥ 2 servings/ week
15. Whole grains[g] (% of whole grains respect to total cereal intake)	< 20	20-< 40	40-< 60	≥ 60

The overall diet quality categories were established as follows: very low (0-8 points), low (9-17 points), moderate (18-26 points), good (27-35 points), and very good (≥ 36 points). Modified from Hernández-Ruiz et al., 2022 (47). [a]Cooked and raw vegetables. [b]Does not include juices. [c]Total consumption of cereals (whole and refined). Does not include bakery or pastry. [d]Does not include sugary dairy or sugary dairy desserts. [e]Includes all types of fats and oils except olive oil. [f]Includes cookies, pastries, sugary drinks, ice cream, and sugar. [g]Whole grain bread, brown pasta, and rice.

Table IV. Total servings per week of the menu offered by the nursing home

	Week 1	Week 2	Week 3	Week 4	Week 5	Median[a]	Median adapted to the recommended frequency[b]
Vegetables	11.0	11.5	11.5	10.5	11.0	11.0 (11.0-11.5)	1.6 (1.6-1.6)
Fruit	14.5	16.0	16.5	16.0	14.5	16.0 (14.5-16.0)	2.3 (2.1-2.3)
Legumes	3.0	3.0	4.5	2.5	3.0	3.0 (3.0-3.0)	3.0 (3.0-3.0)
Extra virgin olive oil	30.0	30.0	29.0	28.0	30.0	30.0 (29.0-30.0)	4.3 (4.1-4.3)
Bread	21.0	21.0	21.0	21.0	21.0	21.0 (21.0-21.0)	3.0 (3.0-3.0)
Potato	5.5	3.0	2.0	3.0	5.5	3.0 (3.0-5.5)	0.4 (0.4-0.8)
Pasta	0.0	0.0	1.5	1.0	0.0	0.0 (0.0-1.0)	0.0 (0.0-0.1)
Rice	1.0	1.0	1.0	1.0	1.0	1.0 (1.0-1.0)	0.1 (0.1-0.1)
Dairy	19.5	17.5	16.5	17.5	19.5	17.5 (17.5-19.5)	2.5 (2.5-2.8)
White fish	2.0	2.5	3.0	4.0	2.0	2.5 (2.0-3.0)	2.5 (2.0-3.0)
Shellfish	1.5	0.5	1.0	0.5	1.5	1.0 (0.5-1.5)	1.0 (0.5-1.5)
White meat	3.0	4.5	3.0	2.5	3.0	3.0 (3.0-3.0)	3.0 (3.0-3.0)
Eggs	4.0	4.5	4.0	3.5	4.0	4.0 (4.0-4-0)	4.0 (4.0-4-0)
Red meat	5.5	4.5	3.0	6.0	5.5	5.5 (4.5-5.5)	5.5 (4.5-5.5)

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Table IV (Cont.). Total servings per week of the menu offered by the nursing home

	Week 1	Week 2	Week 3	Week 4	Week 5	Median[a]	Median adapted to the recommended frequency[b]
Processed meat	1.0	0.5	1.0	1.0	1.0	1.0 (1.0-1.0)	1.0 (1.0-1.0)
Pastry and bakery	7.0	7.0	7.0	7.0	7.0	7.0 (7.0-7.0)	7.0 (7.0-7.0)
Added sugars	4.0	3.0	4.0	2.0	4.0	4.0 (3.0-4.0)	4.0 (3.0-4.0)
Oily fish	1.5	0.5	1.5	1.0	1.5	1.5 (1.0-1.5)	1.5 (1.0-1.5)

[a]Median (Q1-Q3) consumption over the five weeks assessed. [b]Foods with recommended weekly intake or limited consumption: legumes, white fish, shellfish, white meat, eggs, red meat, processed meat, pastry and bakery, added sugars, and oily fish) or divided by seven for foods with recommendations given in servings per day (vegetable, fruit, olive oil, bread, potato, pasta, rice, milk, and dairy products).

CHARACTERISTICS OF THE PARTICIPANTS

Table V shows the main characteristics of the total sample, by sex and age groups. Among the participants, $n = 87$ (64 %) were women, and the median age was 87 years (IQR = 12.0). Based on the BMI, significant differences were observed by sex (p-value < 0.001). According to the Barthel index, the median score was 65 points (IQR = 60.0), moderate dependence. In relation to the assessment of the risk of malnutrition by MNA, a median score of 21.5 points (risk of malnutrition) was obtained (IQR = 5.5). The median score of the CONUT index was 2 points, (IQR = 4.0), light malnutrition.

APPLICATION OF QUality INDEX FOR NUTRITION IN NURSING HOMES

The mean value of the QUINN was 34 points; thus, the menu was classified as good diet, within the overall DQ categories were established as follows: very low (0-8 points), low (9-17 points), moderate (18-26 points), good (27-35 points), and very good (≥ 36 points). (Table VI). The components contributing more importantly to the total score were those items related to the Mediterranean diet (high consumption of legumes, extra virgen olive oil, white fish and shellfish, low intake of other fats, and a wide variety of fruits and vegetables), together

Table V. Main basic characteristics of the total sample, by sex and age groups (n = 137)

	Total	By sex		By age groups		
		Men (*n* = 50)	Women (*n* = 87)	< 80 y (*n* = 35)	80-89 y (*n* = 58)	≥ 90 y (*n* = 44)
Age (y)	87.0 (12.0)	85.0 (14.3)	88.0 (9.0)	--	--	--
BMI (kg/m^2) (*n* =126)	27.4 (5.7)	26.9 (6.0)*	27.9 (6.4)*	28.0 (7.1)	27.1 (5.2)	27.7 (6.0)
Functional, cognitive, and nutritional status assessment						
Barthel (*n* = 136)	65.0 (60.0)	70.0 (63.8)†	62.5 (55.0)†	85.0 (20.0)	55.0 (68.8)	50.0 (50.0)
Lawton-Brody (*n* = 130)	1.5 (3.0)	2.0 (3.0)	1.0 (3.0)	2.0 (2.0)	1.0 (3.0)	1.0 (3.0)
SPPB (*n* = 86)	1.0 (5.0)	4.0 (8.8)	0.0 (5.0)	6.0 (3.0)	0.0 (5.0)	0.0 (5.0)
MEC Lobo	20.0 (15.0)	22.0 (19.0)	18.0 (13.0)	24.0 (9.0)	16.5 (17.0)	18.0 (16.5)
MNA (*n* = 128)	21.5 (5.5)	21.0 (5.8)	22.0 (5.0)	21.5 (4.3)	21.5 (6.0)	21.0 (7.0)
CONUT	2.0 (4.0)	2.0 (2.8)	2.0 (3.5)	1.0 (3.0)	2.0 (3.0)	2.0 (4.0)

*Adapted and modified from Hernández-Ruiz et al., 2021 (70). Results expressed as median and interquartile range (IQR). CONUT: CONtrolling NUTritional status score range (0-12 points); MEC Lobo: Lobo Mini Cognitive Test score range (0-35 points); MNA: Mini Nutritional Assessment score range (0-30 points); SPPB: Short Physical Performance Battery (0-12 points). *(< 0.05), †(> 0.001).*

with cereals, white meat, dairy, and eggs (23). Overall, these components met the maximum score criteria (3 points/component). The food items offered in the menu belonging to the vegetables, fruits, sweets, and oily fish groups were classified in the intermediate score categories, as these foods did not achieve the above recommendation (1-2 points/component). The components that showed a greater need for change were red meat and processed meat, and whole grains (minimum score, 0 point per component). The main results of the QUINN and its components relative to the mean intake of the subjects are shown in table VI.

Table VI. Evaluation of the components and overall score of the QUINN from the menu offered for 5 weeks

Basic foods components	Score / component[a]
Vegetables	2
Fruits	2
Legumes	3
Olive oil	3
Cereals	3
Milk and dairy products	3
White fish and shellfish	3
White meats	3
Eggs	3
Other fats	3
Red and processed meat	0
Sweets	1
Additional dietary components	**Score / Component[a]**
Variety of fruits and vegetables	3
Oily fish	2
Whole grains (whole grain bread whole wheat pasta. brown rice and whole grains	0
Overall score	**34**

The overall diet quality categories were established as follows: very low (0-8 points), low (9-17 points), moderate (18-26 points), good (27-35 points), and very good (≥ 36 points). [a]Score according mean of the menu offered by the nursing home for 5 weeks - scores for each component (0 to 3 points).

DISCUSSION

This study proposes an easily applied instrument to determine the DQ, the so-called QUality Index for Nutrition in Nursing homes — QUINN. An *a priori* methodology was applied for its development. Therefore, a first novel proposal has been developed that is extremely easy to apply to assess the quality of the diet involving the menus offered in nursing homes. The selection of the types of components (food groups, foods, and characteristics of the diet) has allowed the application of this instrument in a remarkably simple approach compared to other indicators previously described with nutrient components. The use of prefixed cut-off points will facilitate the comparison of health outcomes through their application in several NHs. The application of this tool in NHs allows to easily assess the DQ of the offered menu without the need to transform food intake into nutrients. Therefore, this instrument provides information on the DQ of a menu and might be useful to implement intervention strategies to improve the institutions' diet in a simple way.

Several reviews have collected the most applied indicators, especially those developed in adults and elderly with the aim of measuring the individual intake of the population (71,72). The most applied indicators in this population are HEIs, DQIs, and Mediterranean diet indexes (4,19,23). However, although this is the main objective for which these tools are usually used, we considered to propose an *a priori*-derived DQ tool to assess the DQ of the menus offered by NHs.

Owing to the increasing interest in studying dietary patterns, several indicators are constantly being developed. These tools have been applied and validated in several populations in recent years (73). This fact has caused an increase in the number of indicators developed, resulting in a high variability between these instruments (4). On the other hand, the evolution of scientific knowledge about different groups of foods, specific foods, and nutrients concerning the risk of developing GS (74,75), and chronic diseases makes it necessary to continuously update such tools (76). To update these tools it is important to consider issues related to the choice of components to be included and their methodology; i.e., criteria and scoring methods (4).

Concerning the application of DQIns in the elderly, it is important to remark the SR published by Fernandes et al., 2015. This SR found that the median score of the HEIs in most studies ranged between 51-80 points (maximum 100 points), indicating the need for dietary changes. In 2011 Norte et al. reported that 72 % of the Spanish population requires changes in their diet (12). In 2015 Hernández-Galiot and Cambrodón described that by HEI, 64 % of non-institutionalized Spanish adults over 80 years required modifications in their dietary pattern (13). The study by Lozano et al. showed that the Spanish elderly obtained a score similar to that obtained when assessing DQ with previously developed DQIns (6/14 points) (14). The previous results indicated that individuals had a low compliance with nutrient requirements related to healthy ageing: fiber, folate, calcium, vitamin D, monounsaturated fatty acids, omega-3 fatty acids, total proteins, and liquids; and an excessive consumption of saturated fatty acids,

sodium, cholesterol, and added sugars (15). However, although these indicators have been proposed in the elderly, they only estimate the individual intake of the participants, whereas the tool that we propose measures the overall DQ of the menus offered by NH.

It should be noted that the validated nutritional screening tools in NHs, such as the Mini Nutritional Assessment – Short Form, MNA®-SF or complete MNA® (77,78), as well as the FRAIL-NH (79,80), are recommended to be applied every three months, as they are useful as geriatric assessment instruments. It might be possible that with the simultaneous application of QUINN and MNA, every three months, the residents will benefit from a comprehensive nutritional intervention. Therefore, in future studies, both tools (MNA and QUINN) could be used to assess the DQ of the menus offered in a much more straightforward method than the previously developed DQIns.

In the context of this study, an increased offer of whole grains, a reduction in the quantity of sweets, and a decrease in the offer of red meat and processed meat, are the main dietary components that should be considered to improve the DQ of the menus offered. It is worth noting that in previously mentioned HEIs, important dietary components for elderly patients are not considered, such as dairy (54), eggs (59,60), and foods that are a good source of low-cost protein, widely accepted by this population, also providing calcium, vitamin D, and other micronutrients. The Healthy Aging Diet Index evaluated nutrient intake related to healthy aging; nevertheless, it requires a detailed nutritional analysis for its application. This instrument considers dietary components in the form of nutrients rather than specific food groups or food items, which could hamper their quick and easy application in NHs. In this sense, the QUINN could be a tool suitable for assessing the DQs in NH because this instrument considers groups of foods of special interest, and in turn, it is easy to apply without presenting the need to transform food consumption into nutrient intakes.

This study has main limitation is that the instrument has only been applied in one center and with a five-week menu offering. It is necessary to consider slight modifications in some of the components focusing on the season in which the instrument is applied. This is an issue that is not considered in these tools but may need to be considered in the development of future DQIns. This aspect is particularly important in the case of the development of DQIns with components in the form of subgroups or specific foods due to their specific nutrient content. The application of an instrument based on these considerations could provide useful information to institutions where seasonal foods are selected as in the present NH. The QUINN does not include beverage components (water, coffee, or infusions, unsweetened), since these are components that are not generally included in these indicators. In addition, it could be of interest to include a component to estimate the consumption of ready to cook foods in NHs where food is not cooked in the kitchens themselves and is served by external caterers.

Among the strengths of this study, the following should be noted. The main contribution of this research is the novelty of this indicator development. Among this instrument's utilities, due to its simplicity and concision, the applicability in NHs is noteworthy. Based on the proposal of the QUINN, the simple application of this tool will allow comparing the DQ between different NHs. Since fixed cut-off levels have been set for this indicator, the same amounts of the different food groups and the food items included as components in this instrument and their health benefits could be compared among several NHs.

In future research, it would be desirable to assess whether modifications of the menus to adopt higher QUINN scores result in health improvements. Future studies should also apply this indicator and explore its association with the risk of developing chronic diseases that are highly prevalent in the geriatric population.

It would be interesting to evaluate the real intake with regard to the menus offered in order to determine the real food consumption of the residents of the NHs, by applying a precise double-weighing method (15,81). Also, it would be desirable to propose an easily applicable DQIns to monitor the amounts consumed. Therefore, it would be desirable in future studies to include a component in the QUINN that will evaluate the amount of the menu that the subjects in the residences have consumed because the portions that are served are not always completely consumed or the subjects might consume double portions of some dishes, side dishes or other intakes throughout the day. Subsequently, it would be interesting to include other dietary components in the QUINN such as the calculation of the calorie density of the menu per day and the distribution of macronutrients based on the real quantities consumed.

An overly critical issue for the elderly is appropriate beverage consumption to support an adequate state of hydration, considering the consumption of water and other fluids, as well as the intrinsic water contained in food (82). In future research, it would be appropriate to develop an indicator to evaluate the quality of NHs dietary liquids.

In future studies, it would be also desirable to use the QUINN to evaluate the quality of other menus in centers that generally have lower nutritional quality, such as triturated diets (3,15). The inclusion of this instrument in the quality criteria of NHs is fundamental because the offer of menus and the study of their adequacy are the basis to achieve an acceptable offer of foods in these institutions, with the aim of to treat and prevent the main chronic diseases and GS.

CONCLUSIONS

The menu of this NH in Spain showed a good DQ according to the QUINN. The QUINN is an easy-to-apply tool that allows to assess DQ in NHs. Furthermore, it allows to detect improvements in the menu offered by any given HN. The fifteen components of this instrument can capture the complexity of the diet through a one-dimensional measure by assessing basic and special components. This tool might be useful to evaluate the association of the DQ in NHs with health-related aspects and chronic diseases in geriatrics and GS. The DQ evaluated by this indicator will be useful to propose intervention strategies aimed at improving the diet in this setting, which in turn may lead to reduce risk factors associated with ageing-related diseases.

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