Clinical Nutrition ESPEN 15 (2016) 16–20

Contents lists available at ScienceDirect

Clinical Nutrition ESPEN

journal homepage: http://www.clinicalnutritionespen.com

Original article

Validity assessment of the nutrition screening initiative checklist in older adults

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ARTICLE INFO

Article history:
Received 28 January 2016
Accepted 5 May 2016

Keywords:
Elderly
Nutritional assessment
Risk
Screening
Validity studies

SUMMARY

Objective: To ascertain whether the NSI (Nutrition Screening Initiative Checklist) is a valid screening instrument for diagnosing nutritional risk in an older population from a medium-size city in the south of Brazil.

Methods: The study population comprised individuals aged 60 years or older selected from a population-based cross-sectional survey. Data collection was carried out at two different timepoints: first, the NSI (instrument under test) was applied and later a dietary recall (gold standard) based on the previous day. Validity analyses were performed based on sensitivity and specificity as well as the Receiver Operating Characteristic Curve.

Results: A total of 183 older adults were studied. Agreement between the dietary recall and the NSI for positive and negative results was 54.6%.The sensitivity and specificity values were low for all cut-off points of the instrument. The area under the curve was 0.52 (95%CI: 0.44–0.62) for the cut-off point ≥6.

Conclusion: Based on sensitivity and specificity values, the NSI proved ineffective for application in the population studied.

1. Introduction

The demographic transition has led to an increase in the older population, prompting the scientific community to investigate this age group further [1]. Aging, although a natural process, submits the organism to alterations, causing a range of functional changes that negatively impact health status, particularly nutritional [2]. Older adults have a greater risk of nutritional deficit than adults, requiring heightened awareness for early detection and management [3].

The purpose of nutritional screening is to allow early identification of individuals at risk of malnutrition that require intervention [4]. To this end, a number of specific instruments have been developed for use in the older population [5]. However, there is no consensus on which is the best screening instrument available. All the instruments reported in the literature have inherent specificities, limitations, advantages and disadvantages when used in specific populations [5].

One of these instruments, the Nutrition Screening Initiative Checklist (NSI), also known as DETERMINE, was published in 1991 in the United States. This constitutes a checklist comprising ten questions, originally devised and validated for American older adults [6] and later adapted for use in Australian older adults [7]. The questions included in the NSI reflect common risk factors for malnutrition, encompassing dietary assessment (number of daily meals, food and alcohol intake, independence for preparing meals), general assessment (health status, use of medications, oral health and weight loss) and social assessment (economic difficulties and reduced social interaction) [6]. The recall period differs for each question, having a maximum period of six months. Scoring for each questions ranges from 0 to 4 points and total score for the instrument is calculated by summing the values attributed to each of the participant's answers, and ranges from 0 to 21 points. Based on the resultant score, older adults are classified into one of three different nutritional risk groups. Individuals whose total score lies between zero and two are classified as having low nutritional risk; those attaining three to five points as moderate nutritional risk; and

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http://dx.doi.org/10.1016/j.clnesp.2016.05.002
2405-4577/

those with six or more points are considered high nutritional risk [6].

The NSI has been widely used internationally to identify older adults at nutritional risk for its simplicity and because it can be self-administered or applied to the elder by health professionals or family members and used in health services of different levels of complexity [8–13]. Use of the instrument in Brazil has been limited because the instrument's validity for application in the Brazilian population has not yet been determined [14,15].

Thus, given the marked growth in the older population in Brazil and the greater nutritional vulnerability inherent to this age group [2,3,16]. it is important to adequately identify older adults at nutritional risk thereby allowing interventions to be implemented as early as possible. Therefore, the objective of the present study was to ascertain whether the NSI is a valid screening instrument for diagnosing nutritional risk in an older population from a medium-size city in the south of Brazil.

2. Methods

2.1. Sample

A population-based cross-sectional study [23] assessing the health of an older population living in Pelotas, a medium-sized city situated in the south of Brazil with a population of 328,275 persons according to the 2010 demographic census, was carried out between January and August 2014 [1,17]. The study involving a sample of 1451 individuals aged 60 years or older selected for a population-based study was run by the research consortium of the Post-Graduate Program in Epidemiology of the Federal University of Pelotas [17] and assessed the health of the older adults from the city of Pelotas.

2.2. Main study sample

The older adults were selected using a two-stage sampling process. In the first stage, 469 census sectors of the city were ranked by mean income according to the Brazilian Institute of Geography and Statistics (IBGE) classification. Subsequently, 133 census sectors were randomly selected and 31 households systematically selected from each sector, commencing with a randomly selected household, to give a total of 3745 households and 1649 individuals (sample size was defined to encompass all the studies of the research consortium).

2.3. Sub-study sample

The validation study of the NSI was based on a subsample of this survey. The sampling process of the sub-study was conducted weekly, based on the flow of the interviews carried out in the main study. Older adults who reported a birth date that fell in March or September were invited to take part in the validation study.

Sample size was calculated according to the method proposed by Willett [18], which recommends that the sample for a validation study should number between 100 and 200 individuals. According to the author, the inclusion of over 200 subjects provides very little additional accuracy whereas the use of under 30 participants yields inaccurate results for this type of study. Therefore study recruitment was concluded upon reaching a sample of 200 older adults.

2.4. Data collect

The methodology employed in this study was the same used in the original investigation published by Posner et al. [6], comparing NSI results to dietary data obtained by dietary recall for the previous day, collected by trained nutritionists at the homes of the older adults or at a clinic set-up especially for the study. The maximum time interval between application of the NSI and the recall was 15 days. The dietary recall was not applied on days following a Sunday or public holidays due to potential changes in usual dietary intake. The nutritionists applying the recall were blinded to the results of the older adults on the NSI. The data obtained using the dietary recall were converted in amount of macro and micronutrients consumed.

2.5. Outcome definition

Older adults who had inadequate intake of three or more of the nutrients: protein, calcium, vitamin B1 (thiamine), C and A (retinol), were classified as at nutritional risk.

2.6. Recalls analysis

All the information on the foods consumed were recorded in household measures and subsequently converted into grams or milliliters with the aid of an appropriate table for this purpose [19]. Calculations quantifying the intake of nutrients were performed with the software tool ADS Nutri - Sistema Nutricional – 9th version, which uses the Brazilian Food Composition Table (TACO) [20] to calculate the nutritional composition of the foods and also the US food composition reference database (USDA) [21]. The assessment of adequacy of nutrient intake was performed based on the Dietary Reference Intakes - DRI, published by the Institute of Medicine (IOM). The reference values used in this study were based on the recommended daily intake value to meet the requirements of 50% of the population – EAR (Estimated Average Requirement) according to age and sex [22,23].

2.7. Back translation

In order to test the validity of the NSI in Brazil, all of the questions were translated into Portuguese by a bilingual translator. This Portuguese version was than back-translated into English by another bilingual professional [24]. The resultant English version was then compared against the original in English and the necessary adjustments made to produce an appropriate version of the instrument in Portuguese ensuring equivalence of meaning. This technique guarantees an accurate and reliable translation of the research instrument [24].

2.8. Exposures definition

The sample characteristics were determined by collecting socioeconomic, demographic and behavioral data, including the following variables: sex (male/female), age in years (60–69, 70–79 and 80 or older), skin color (white/non-white), schooling in years (0–3, 4 to 10 and 11 or more), economic level classified according to the criteria defined by the National Association of Research Companies (ABEP) (A or B, C and D or E, with A being the highest level) [25], marital status (with or without partner) and self-perceived health (very good or good/normal/poor or very poor).

2.9. Validation analysis

Combining information gathered by applying the NSI together with data on intake adequacy of five nutrients, the validation analysis included the calculation of sensitivity (proportion of individuals at nutritional risk, according to the gold standard, correctly identified as such by the NSI), specificity (proportion of individuals not at nutritional risk, according to the gold standard,

correctly identified as such by the NSI) and accuracy (proportion of true positive and true negative results obtained using the NSI compared to the gold standard). Also, 95% confidence intervals (95% CI) were calculated for all estimates. In the analyses, the points scored on the NSI were used in a continuous form.

Subsequently, a Receiver Operating Characteristic Curve (ROC Curve) was plotted graphically representing sensitivity and 1 − specificity for each of the possible cut-off points of the test. The cut-off point with maximum sensitivity and specificity on the ROC curve was defined as the lowest value of the equation [(1 − sensitivity)^2 + (1 − specificity)^2]. The accuracy of the NSI (proportion of correct results, both positive and negative, for nutritional risk) was estimated based on the area under the ROC curve.

2.10. Ethical considerations

The research project was submitted to and approved by the Research Ethics Committee of the Federal University of Pelotas Medical School according to protocol no. 201324538513.1.0000.5317. All participants signed an Free and Informed Consent Form.

3. Results

Two hundred older adults answered the dietary recall. However, 17 recalls were excluded due to the absence of detailed information on dietary intake. Thus, the final sample comprised 187 older adults. Table 1 depicts the demographic and socioeconomic characteristics of the older adults included in this study relative to the individuals included in the main study. The characteristics of older adults in the present study were very similar to those of the individuals in the main study. The older adults were predominantly female (60.1%) and white (84.7%). Slightly over half were aged 60–69 years (51.4%) and had a socioeconomic level of C (51.6%). Around 40% of participants studied 4–10 years. Over half lived with a partner. With regard to self-perceived health, 54.1% of the older adults rated their health as very good or good (see Table 1).

The frequency of answers on the NSI and calculation of percentage adequacy of nutrient intake are shown in Table 2. Approximately 30% of the participants reported having changed the type or quantity of foods they generally consumed due to a disease or problem and 36.1% felt they consumed insufficient vegetables, legumes, fruit and dairy products. Being unable to afford to buy the foods needed was reported by around 20% of the older adults. The percentage of older adults in use of three or more different daily medications was around 70% and being dependent for shopping, cooking or eating was reported by 18% of interviewees. The maximum score attained by the older adults was 13 points and the minimum was 0 points.

On the analysis of nutrient intake (gold standard), inadequate intake of calcium, thiamine and retinol was observed in the vast majority of the older adults (75.4%, 65.6% and 96.7%, respectively). However, around 60% met the recommended intake of vitamin C whereas approximately 74% satisfied the recommended protein intake. According to the gold standard, 124 of the 183 older adults were at nutritional risk, equivalent to a rate of 67.8% (95%CI: 60.9–74.6%).

Table 1
Comparison of the older adults sample included in the validation study for the Brazilian version of the Nutrition Screening Initiative Checklist [6] versus the sample used in the main study. Pelotas, Rio Grande do Sul, Brazil, 2014 (n = 183).

Variables	Validation study	Main study
	N (%)	N (%)
Sex		
Male	73 (39.9)	538 (37.0)
Female	110 (60.1)	914 (63.0)
Age		
60–69 years	94 (51.4)	756 (52.3)
70–79 years	63 (34.4)	460 (31.8)
80 years or older	26 (14.2)	230 (15.9)
Skin color		
White	155 (84.7)	1211 (83.7)
Non-white	28 (15.3)	236 (16.3)
Schooling in years		
0–3	64 (35.0)	533 (37.0)
4–10	72 (39.3)	588 (40.9)
11 or more	47 (25.7)	316 (22.1)
Economic level		
A/B (high)	70 (38.7)	384 (27.9)
C	94 (51.9)	781 (56.8)
D/E (low)	17 (9.4)	210 (15.3)
Marital status		
With partner	98 (53.5)	763 (52.7)
Without partner	85 (46.5)	684 (47.3)
Self-perceived health		
Very good/good	99 (54.1)	765 (53.1)
Normal	67 (36.6)	545 (37.8)
Poor/very poor	17 (9.3)	132 (9.2)

Table 2
Description of sample according to the Nutrition Screening Initiative Checklist [6] and adequacy of nutrient intake assessed by the dietary recall. Pelotas, Rio Grande do Sul, Brazil, 2014 (n = 183).

Variables	N	%
NSI		
Changed type of diet		
Yes	57	31.2
Prepare less than 2 meals a day		
Yes	3	1.6
Eat few vegetables, legumes, fruit or dairy products		
Yes	66	36.1
Drink 3 or more units of beer, wine or spirits every day		
Yes	4	2.2
Have mouth or teeth issues that hamper eating		
Yes	21	11.5
Cannot afford to buy the food needed		
Yes	35	19.1
Eat alone most of the time		
Yes	49	26.8
Take 3 or more different medications daily		
Yes	127	69.4
Put on or lost 5 kg or more unexpectedly		
Yes	24	13.1
Require help for shopping, cooking or eating		
Yes	33	18.0
Dietary recall (EAR recommendation)		
Inadequate calcium intake (M:800 mg, F: 1000 mg)		
Yes	138	75.4
Inadequate thiamine intake (M:0.9 mg, F: 1.0 mg)		
Yes	120	65.6
Inadequate retinol intake (M:500 mg, F: 625 mg)		
Yes	177	96.7
Inadequate vitamin C intake (M:60 mg, F: 75 mg)		
Yes	80	43.7
Inadequate protein intake (0.66 g/kg/day)		
Yes	46	25.1

Table 3
Sensitivity, specificity and 95% confidence intervals for different cut-off points of the Brazilian version of the Nutrition Screening Initiative Checklist [6]. Pelotas, Rio Grande do Sul, Brazil, 2014 (n = 183).

Cut-off point	Sensitivity	Specificity
≥1	90.3 (83.7–94.9)	17.0 (8.4–29.0)
≥2	72.6 (63.9–80.2)	27.1 (16.4–40.3)
≥3	64.5 (55.4–72.9)	33.9 (22.1–47.4)
≥4	51.6 (42.5–60.7)	50.9 (37.5–64.1)
≥5	44.4 (35.4–53.6)	64.4 (50.9–76.5)
≥6	30.7 (22.7–39.6)	76.3 (63.4–86.4)
≥7	20.2 (13.5–28.3)	81.4 (69.1–90.3)
≥8	12.9 (7.6–20.1)	84.8 (73.0–92.8)
≥9	8.9 (4.5–15.3)	91.5 (81.3–97.2)
≥10	6.5 (2.8–12.3)	96.6 (88.3–99.6)
≥11	4.8 (1.8–10.2)	96.6 (88.3–99.6)
≥12	2.4 (0.5–6.9)	98.3 (90.9–99.9)

The original validation study of this instrument employed the same methodology [6] and found 36% sensitivity and 84% specificity for the cut-off of 6 points. In the present study, 30.7% sensitivity and 76.3% specificity were found for a cut-off ≥6 points, inappropriate values for a screening instrument. In the original validation study the authors provided no parameters for the cut-off point of 3 precluded comparisons with the current findings. Such tools should provide good sensitivity, ensuring that no cases are missed in the population tested, and also high specificity leading to fewer individuals with false-positive results requiring further investigation.

In Europe, the validity of the NSI was assessed in the SENECA (Survey in Europe on Nutrition and the Elderly, a Concerted Action) cohort study [19]. The multicentric study on nutrition and health in the elderly included individuals born between 1913 and 1918 from

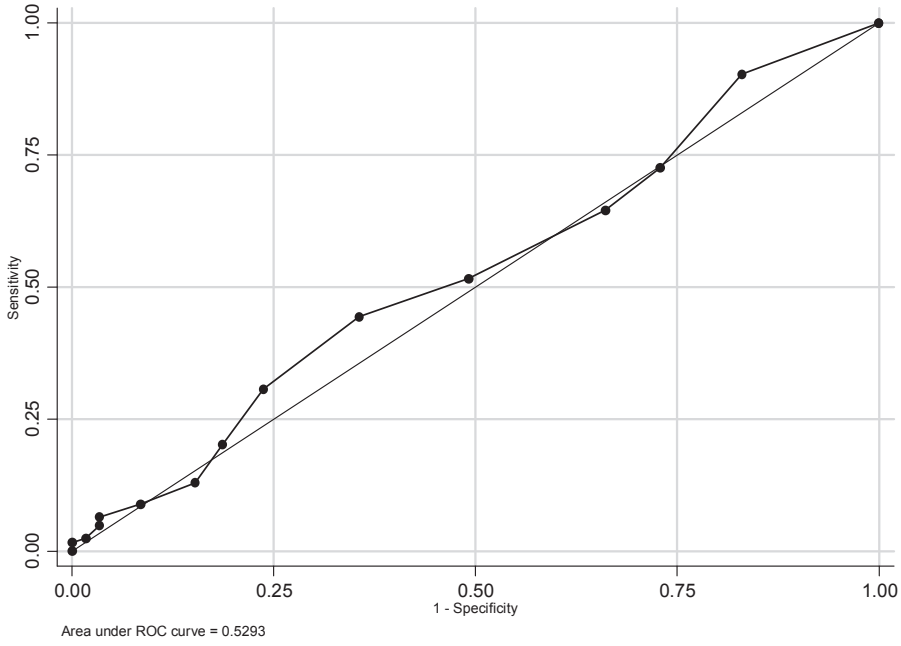

Fig. 1. ROC curve for classifying nutritional risk on the Nutrition Screening Initiative Checklist [6] compared with dietary recall.

The results of sensitivity and specificity analyses are given in Table 3. These two validity measures were observed for several cut-off scores on the NSI, and the values determined were low (see Table 3). Agreement between the dietary recall and the NSI for positive and negative results was 54.6%.Fig. 1 depicts the ROC curve for sensitivity and specificity values given in Table 3. The area under the curve was 0.52 (95%CI: 0.44–0.62) for the cut-off point ≥6.

4. Discussion

The present study assessed the validity of a nutritional screening instrument developed in the USA for application in an older population from the south of Brazil. The results showed that all the cut-off points of the instrument had low sensitivity and specificity values, covering a small area under the ROC curve (0.52). In addition, the likelihood of nutritional risk after a positive result on the NSI (≥3) was very close to the prevalence of nutritional risk, indicating that the instrument improved little on pre-test predictive values. Visually, the ROC curve clearly illustrates that the instrument is inappropriate since it fails to measure what it was designed to measure.

nine cities. In the study, the validity of the NSI was tested based on lymphocyte count, sera albumin, body mass index and loss of 10% or more of body weight in the past four years, where each item was tested independently. Sensitivity and specificity values were found to be low, improving when a weight loss of 10% or over was used as the gold standard, yielding values of 75% and 54%, respectively. Despite limited performance for detecting nutritional risk among older adults, the NSI has been used in numerous countries [8,12–15,19,26–31] including Brazil [14,15].

Limitations of the present study include the gold standard chosen for assessing nutritional risk, which was based on the intake of five nutrients. The application of a single recall is insufficient to measure usual intake of most micronutrients, furthermore, a dietary recall memory depends on the interviewee and interviewer's ability to establish good communication and prevent the induction of responses [32]. Use of anthropometric parameters such as weight loss and biochemical parameters, such as albumin and transferrin, in conjunction with dietary recall might enhance accuracy for detecting nutritional risk. However, it is not certain yet, albumin and transferrin are questionable parameters in assessing adequacy of protein and there was a desire to reproduce the same methodology adopted in the original study,

which did not include biochemical and anthropometric parameters [19,6].

The purpose of the instrument assessed is to detect nutritional problems sufficiently early to allow interventions to be implemented and deficits corrected. However, this instrument was shown to be ineffective for application in the population studied, underscoring the importance of local validity assessment of instruments used in research, where the use of non-validated instruments can produce distorted results.

Conflict of interest

None.

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