Six simple questions to detect malnutrition or malnutrition risk in elderly women.

Tranquilina Gutierrez-Gomez, Ernesto Cortes, Antonio Palazon-Bru, Isabel Penarrieta-de Cordova, Vicente F Gil-Guillen, Rosa M Ferrer-Diego

Of the numerous instruments available to detect nutritional risk, the most widely used is the Mini Nutritional Assessment (MNA), but it takes 15-20 minutes to complete and its systematic administration in primary care units is not feasible in practice. We developed a tool to evaluate malnutrition risk that can be completed more rapidly using just clinical variables. Between 2008 and 2013 we conducted a cross-sectional study of 418 women aged ≥60 years from Mexico. Our outcome was positive MNA and our secondary variables included were: physical activity, diabetes mellitus, hypertension, educational level, dentition, psychological problems, living arrangements, history of falls, age and the number of tablets taken daily. The sample was divided randomly into two groups: construction and validation. Construction: A risk table was constructed to estimate the likelihood of the outcome, and risk groups were formed. Validation: The area under the ROC curve (AUC) was calculated and we compared the expected and the observed outcomes. The following risk factors were identified: physical activity, hypertension, diabetes, dentition, psychological problems and living with the family. The AUC was 0.77 (95% CI: 0.68-0.86, $p<0.001$). No differences were found between the expected and the observed outcomes ($p=0.902$). This study presents a new malnutrition screening test for use in elderly women. The test is based on six very simple, quick and easy-to-evaluate questions, enabling the MNA to be reserved for confirmation. However, it should be used with caution until validation studies have been performed in other geographical areas.

Authors: Tranquilina Gutiérrez-Gómez[1], Ernesto Cortés[2], Antonio Palazón-Bru[3,4], María Isabel Peñarrieta-de Córdova[1], Vicente Francisco Gil-Guillén[3,4], Rosa María Ferrer-Diego[5].

[1]: Tampico School of Nursing, Autonomous University of Tamaulipas, Tampico, TAMPS, México.

[2]: Department of Pharmacology, Pediatrics and Organic Chemistry, Miguel Hernández University, San Juan de Alicante, Alicante, Spain.

[3]: Department of Clinical Medicine, Miguel Hernández University, San Juan de Alicante, Alicante, Spain.

[4]: Research Unit, Elda Hospital, Elda, Alicante, Spain.

[5]: Department of Nursing, University of Alicante, San Vicente del Raspeig, Alicante, Spain.

Corresponding author: Prof. Antonio Palazón-Bru, PhD. Clinical Medicine Department, Miguel Hernández University, Carretera de Valencia - Alicante S/N, 03550 San Juan de Alicante.

Telephone: +34 965919449. Fax: +34 965919450. E-mail: antonio.pb23@gmail.com

INTRODUCTION

Life expectancy has increased greatly over the past century (Ferreira et al., 2010), and the worldwide population of individuals aged over 60 years is expected to triple between 2000 and 2050. This increase reflects an improved health status in younger persons but it also leads to higher rates of chronic degenerative diseases and disability in the elderly (Shama et al., 2008).

Active aging requires a good health status together with a good nutritional status, both of which are necessary to maintain a low disease risk and good physical and mental health (Brigeiro, 2005). Overall health depends on disease prevention and the promotion of activities associated with healthy habits (Minkler & Fadem, 2002; Celestino, Salazar & Novelo, 2008).

Older adults are prone to nutritional deficiencies, especially in situations of stress or disease (Scheidt, Humpherys & Yorgason, 1999). Malnutrition can arise from various physiological and social factors that lead to adverse consequences, preventing proper body function and impairing the performance of everyday activities (Brownie, 2006). Malnutrition, when not treated, is costly both for the individual and for society (Visvanathan, 2009).

Most adults over the age of 60 are women (WHO, 2005), with different economic, social, political, and cultural factors influencing their aging. The earlier in life a person adopts a healthy lifestyle to prevent morbidity and mortality, the greater the benefits. For example, physical activity should be encouraged from an early age, and all barriers that prevent girls and young women from engaging in physical activity should be eliminated. This will then help elder women maintain their mobility and cope with their everyday activities (WHO, 1998).

Several instruments are available to screen for and detect nutritional risk. The most widely used is the Mini Nutritional Assessment (MNA) (Guigoz & Vellas, 1999), specifically the MNA short-form version (MNA-SF) (Rubenstein et al., 2001). This shortened version

correlates strongly with the original version, but only uses the first 6 questions. If the MNA-SF score is ≥12, the results are considered to be normal and the rest of the survey is not administered (sensitivity, 97.9%; specificity, 100%) (Rubenstein et al., 2001). However, a MNA-SF score <12 indicates the need to complete the full version of the MNA. The full and short versions require 15-20 and 5-10 minutes, respectively, to complete.

Currently, no highly reliable instrument exists that can evaluate malnutrition risk within one minute based on just clinical variables. Accordingly, we aimed to develop and validate a new instrument with these characteristics for use in Mexico. This instrument could be used to evaluate malnutrition risk in older women who visit primary care units, thereby reducing the waiting times in these units resulting, in part, from application of the currently available instruments. Thus, this instrument could favor the project suggested by the Pan American Health Organization (PAHO) (OPS, 2008).

MATERIALS & METHODS

Population, Study design, participants and Ethical issues

The study population comprised 418 women aged ≥60 years from Tampico, a city in the state of Tamaulipas (Mexico). This state has one of the highest percentages of individuals over 60 years of age (10.3%).

This cross-sectional observational study enrolled women aged ≥60 years, divided into two groups. Group 1 consisted of women who exercised regularly (at least three times per week between August and November 2008) and were members of the “golden age” club at the multidisciplinary gym of the Tampico-Madero University center, of the Autonomous University of Tamaulipas. Group 2 consisted of women who did not exercise regularly between January 15

and February 15, 2013 and who attended the family medicine clinic of the Institute for Social Security and Services for State Workers (ISSSTE). All the women were required to be literate and were asked to fast for at least 6 hours prior to their appointment for data collection.

The Autonomous University of Tamaulipas and the ISSSTE approved the study (code: 08-06-01), and all the women provided written informed consent. The study complied with the provisions of the Mexican General Health Law.

Variables and measurements

The primary study outcome was the risk of malnutrition or malnutrition itself. The women were considered to have a satisfactory nutritional status if they obtained a score ≥12 in the first 6 MNA screening questions. The women who scored fewer than 12 points in these first 6 questions continued with the rest of the questionnaire. A final score >23.5 was considered to represent a satisfactory nutritional status. Scores between 17-23.5 indicated a risk of malnutrition, and scores <17 indicated malnutrition (Guigoz, 2006).

Information about the following variables was collected during a personal interview: physical activity, personal history of diabetes mellitus or hypertension, educational level (secondary and university education, primary or no education), dentition (complete; missing teeth; denture), psychological problems (defined by the presence or absence of dementia or severe or moderate depression) (Guigoz & Vellas, 1999), living arrangements (alone; with partner; with family), history of falls over the past year, age, and the number of tablets taken daily.

Sample size and Statistical methods.

Construction sample: this included 322 women. In order to contrast an odds ratio (OR) different from 1, the contrast power was calculated from the selected sample, using psychological

problems as a factor. The following parameters were used: risk in exposed persons, 0.90; risk in unexposed persons, 0.45; number of exposed persons, 103; number of unexposed persons, 219; type I error, 5%. This all gave a power of 83.40% (Chow, Wang & Shao, 2008).

Validation sample: this included 96 women, of whom 55 were either at risk of malnutrition or in a state of malnutrition. With this sample size, setting the confidence level at 95% and expecting an area under the ROC curve (AUC) of 0.75 to detect differences from an AUC of 0.5, we obtained a power of nearly 100% (98.66%) (Hanley & McNeil, 1982).

Qualitative variables were described by their frequencies (absolute and relative), whereas means and standard deviations were used to describe quantitative variables. The patients were randomly assigned to one of the samples (construction, 80%; validation, 20%) by generating random numbers. To verify that the two samples were similar, we performed the Student t test or the X^2 test (depending on the type of variable). A confidence interval (CI) was calculated for each parameter using an α=5%. All the statistical analyses were performed using the IBM SPSS Statistics 19 software.

Construction: A multivariate logistic regression model was constructed to identify the variables associated with malnutrition risk or malnutrition and the adjusted OR were obtained through this model. To determine the combination of variables that could best predict our main outcome, an explanatory variable was introduced into the model for every 25 outcomes (a maximum of 7 variables in the model) and all the possible combinations that fulfilled this requirement were tested (9,907). The combination selected was that with the greatest AUC. The likelihood ratio test was used to measure the goodness-of-fit of the model. Using the β coefficients of the multivariate model, a risk table based on the sum of the points was constructed to estimate the probability of malnutrition risk or malnutrition (Sullivan, Massaro &

D'Agostino, 2004). Once the points and their associated risks had been calculated, the AUC to predict malnutrition risk and malnutrition was calculated and four risk groups were defined (based on the quartiles of the points distribution) (Ramírez-Prado et al., 2015).

Validation: We calculated the AUC of the scoring system and compared the expected and the observed outcomes in each risk group using the X^2 test.

RESULTS

Table 1 shows the descriptive characteristics for the construction (n=322) and the validation (n=96) samples. We verified that there were no differences between the two samples (p: 0.055-0.631). The outcome ranged between 57.3% and 60.2%. Furthermore, 210 of the 418 women over the age of 60 [157 in the construction sample (48.8%) and 53 in the validation sample (55.2%)] performed regular physical activity. There was a high prevalence of diabetes (20.8-23.3%), hypertension (29.8-34.4%), psychological problems (32.0-37.5%) and falls during the last year (20.2-27.1%). Moreover, only 14.6% (13.7%, construction; 17.7%, validation) of the participants had their full set of teeth.

Construction: the following factors were associated with the risk of malnutrition or malnutrition itself (Table 1): physical activity, dentition, having psychological problems, hypertension, diabetes and living with family. Figure 1 shows the scoring system that was developed using the multivariate model.

Validation: Figure 2 shows that the AUC was 0.77 (95% CI: 0.68-0.86, $p<0.001$). Figure 3 shows the comparison between the expected and the observed outcomes (p=0.902).

DISCUSSION

130 Summary

131 We have designed and validated a basic 6-item questionnaire to detect malnutrition or the risk of
132 malnutrition in elderly women. The items (clinical variables) are very easy to administer and
133 proved highly reliable and simple to assess.

134 Strengths and Limitations

135 One limitation of this study concerns the possible bias associated with the study sample, as we
136 selected women from a defined area. Thus, this test still requires validation in other populations,
137 as well as in older men.

138 The strengths of this study include the high discrimination power of the constructed scale,
139 as shown by the area under the ROC curve (approximately 0.8). In addition, this test is easy to
140 give to large populations in a relatively short time, thus increasing its applicability and
141 feasibility. Finally our scoring system has been validated in our population.

142 Comparison with existing literature

143 Nutritional evaluations using the MNA-SF are widely accepted and frequently used for
144 malnutrition screening in elderly populations (Rubenstein et al., 2001; Kaiser et al., 2010;
145 Montejano et al., 2013). However, both the short 6-item version, which includes evaluations of
146 BMI, and the complete 18-item version, which includes two new anthropometric measurements
147 (arm and calf circumference), require some time to complete, placing considerable strain on
148 health centers. Consequently, the use of these instruments is not really feasible with large
149 numbers of patients, thus limiting their usefulness as a general screening instrument. Moreover,
150 there is a need to promote healthy aging policies in order to ensure the sustainability of existing
151 universal public health systems and to enable their implementation in countries that currently
152 lack them (García de Lorenzo, Álvarez & De Man, 2012). The latter requirement is supported by

153 the PAHO for the elderly. Hence, it is necessary to design and validate a new instrument to
154 evaluate malnutrition in elderly individuals. This instrument should be highly sensitive and
155 specific and be quick to administer, in order to help reduce waiting times at primary care centers.
156 The present study presents and validates a very simple instrument consisting of just six questions
157 that can be easily answered by elderly patients in a very short time. In addition, the results can be
158 evaluated by primary care personnel (i.e., nurses or physicians) very rapidly.

159 The first question in the proposed model aims to determine the patient's level of physical
160 activity. A sedentary lifestyle has been described as an important risk factor for malnutrition
161 (Olivares et al., 2011), and daily physical activity can be a protective factor (Campos et al.,
162 2003). The current study also identified oral health as a risk factor for malnutrition, as previously
163 reported by others (Porras, 2010). Psychological problems, such as depression, have also been
164 described as risk factors for malnutrition (Gutiérrez et al., 2011). General disease status, as
165 measured by diabetes and hypertension, was confirmed to be a malnutrition risk factor, as has
166 been previously suggested (Jürschik et al., 2008; Vischer et al., 2010; Sanz París et al., 2013).
167 Finally, in this new version of the scoring system living with family was a protective factor for
168 our outcome. We consider this result to be logical, as the family pays more attention to the
169 nutritional status of the elderly.

170 Implications for research and/or practice

171 These six questions and the scoring system shown in Figure 1 constitute a new scale of
172 malnutrition risk. According to this scale, individuals who obtain fewer than zero points have a
173 low risk (first quartile) and do not require additional screening. Those who obtain zero points
174 have a moderate risk (second quartile) and should proceed to the first 6 questions of the MNA
175 test (short-form version). Those who obtain between one and three points are at high risk (third

quartile) and should proceed to the complete MNA test. Finally, individuals with scores over four have a very high risk (forth quartile) and should be considered to be malnourished. Application of this instrument now requires validation in other geographical areas.

CONCLUSIONS

A screening test for malnutrition in elderly women is presented. The test is based on six very simple questions regarding physical activity, living with family, hypertension, diabetes, dentition and psychological problems. Because these questions are very quick and easy to evaluate, they can replace more complex tests, such as the MNA, as a preferred diagnostic confirmation instrument. However, the test should be used with caution until additional validation studies in other geographical areas have been performed to support the present findings.

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Table 1 (on next page)

Descriptive characteristics and analyses of 418 women over the age of 60 years from Tampico (Tamaulipas, Mexico). Data from 2013.

n (%): absolute frequency (relative frequency); x±s: mean±standard deviation; Adj. OR: adjusted odds ratio; CI: confidence interval; N/A; not applicable; N/M: not in the model. In the model *Dentition* and *Living arrangements* were transformed into two dummy variables. Goodness-of-fit of the model: X^2=97.01, p<0.001, area under the ROC curve=0.804.

Variable	Construction sample n=322 n(%)/x±s	Validation sample n=96 n(%)/x±s	p-value	Adj. OR for Malnutrition risk or malnutrition (95% CI)	p-value
Malnutrition risk or malnutrition	194(60.2)	55(57.3)	0.604	N/A	N/A
Physical activity	157(48.8)	53(55.2)	0.267	0.32(0.17-0.62)	0.001
Diabetes	75(23.3)	20(20.8)	0.614	1.71(0.87-3.36)	0.120
Hypertension	96(29.8)	33(34.4)	0.396	1.98 (1.09-3.61)	0.026
Higher educational level	190(59.0)	54(56.3)	0.631	N/M	N/M
Dentition:					
Complete	44(13.7)	17(17.7)	0.319	1	
Missing teeth	126(39.1)	30(31.3)		2.02(0.88-4.66)	0.100
Denture	152(47.2)	49(51.0)		2.49(1.06-5.82)	0.035
Psychological problems	103(32.0)	36(37.5)	0.314	9.30(4.35-19.86)	<0.001
Living arrangements:					
Alone	49(15.2)	12(12.5)	0.628	1	
With partner	115(35.7)	39(40.6)		1	
With family	158(49.1)	45(46.9)		0.67(0.39-1.15)	0.146
Falls during the last year	65(20.2)	26(27.1)	0.151	N/M	N/M
Age (years)	66.9±4.8	67.3±5.4	0.540	N/M	N/M
Number of medications taken daily	2.5±2.7	2.0±2.3	0.055	N/M	N/M

1

1

Prediction scoring system to evaluate malnutrition or the risk of malnutrition in women aged over 60 years in Tampico (Tamaulipas, Mexico). Data from 2013.

Physical activity	Points
No	0
Yes	-2

Living with family	Points
No	0
Yes	-1

Dentition	Points
Complete	0
Missing teeth	1
Denture	2

Diabetes	Points
No	0
Yes	1

Psychological problems	Points
No	0
Yes	4

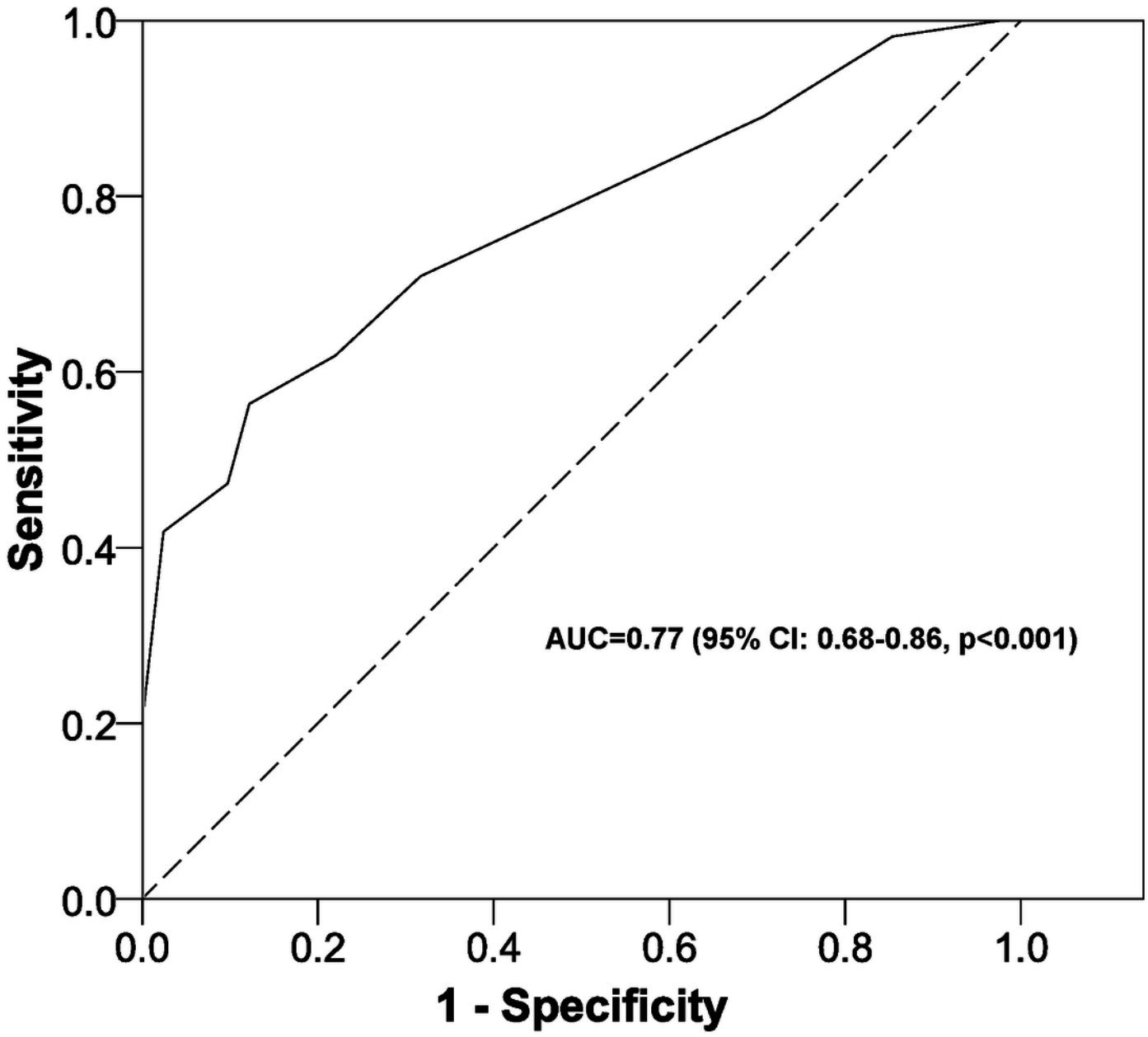
Hypertension	Points
No	0
Yes	1

Points Sum	Risk (%)
Low (≤-1)	13.25-29.40
Medium (0)	40.65-40.70
High (1 to 3)	53.05-75.50
Very high (≥4)	83.50-98.45

2

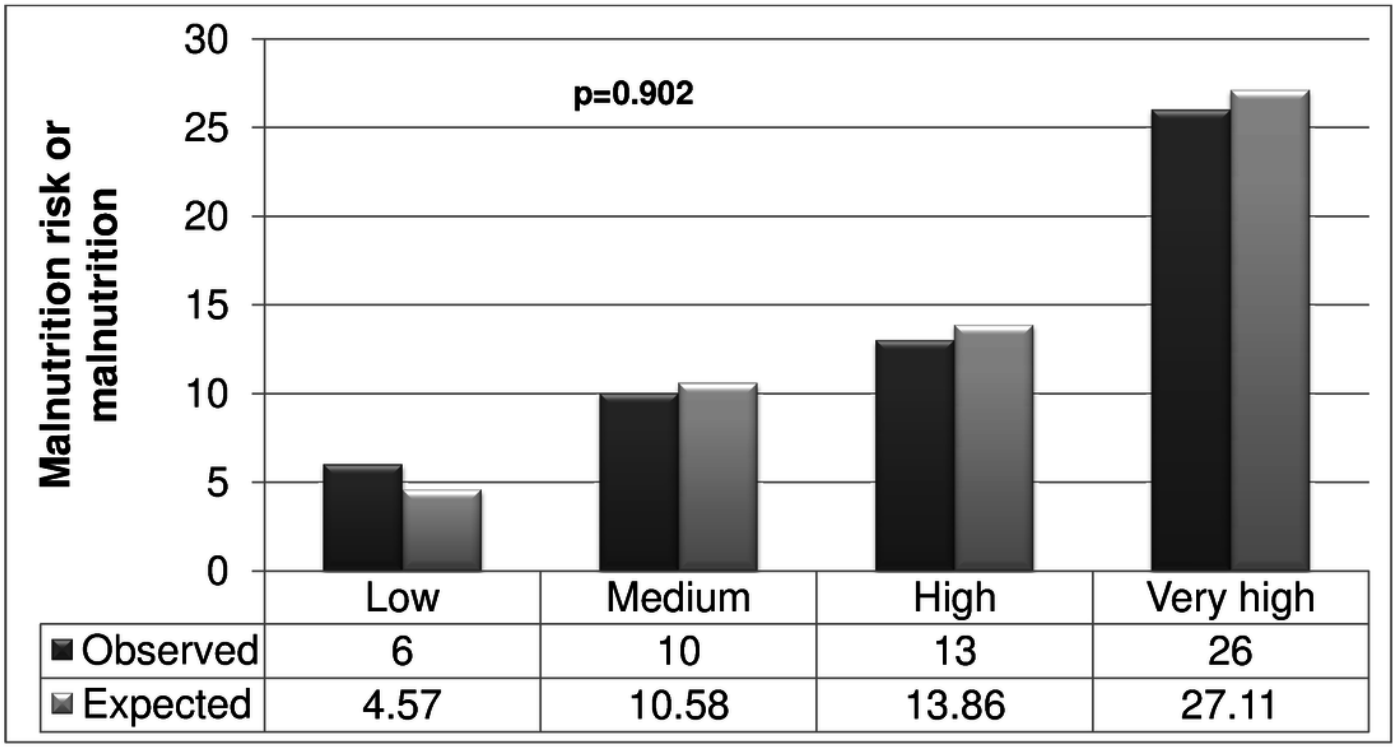
ROC curve for the scoring system to predict malnutrition or the risk of malnutrition in women aged over 60 years in Tampico (Tamaulipas, México). Data from 2013.

ROC, receiver operating characteristic; AUC, area under the ROC curve; CI, confidence interval.



3

Expected and observed outcomes (malnutrition or the risk of malnutrition) in women aged over 60 years in Tampico (Tamaulipas, México). Data from 2013.



	Low	Medium	High	Very high
Observed	6	10	13	26
Expected	4.57	10.58	13.86	27.11