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Norwegian version of the Nutritional Form for the Elderly: sufficient psychometric properties for performing institutional screening of elderly patients

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Abstract

The objective of this study was to test if the Norwegian version of the nutritional screening instrument entitled Nutritional Form for the Elderly (NUFFE-NO) demonstrates sufficient evidence of reliability and validity, including sensitivity and specificity, when applied to a select group of elderly hospital patients. The hypothesis was that NUFFE-NO has sufficient psychometric properties to be used as a screening instrument. The model used for the testing procedure was designed to test reliability (homogeneity and stability) and validity (criterion-related, concurrent validity, and construct validity) including sensitivity and specificity in a cross-sectional study. One-hundred fifty-eight patients were interviewed using the nutritional screening instruments NUFFE-NO and Mini Nutritional Assessment (MNA). They were interviewed once again (using NUFFE-NO) 2 to 4 days afterward. Background variables were collected. Data from the patients' records were collected regarding the nutritional screening instrument Nutrition Risk Screening 2002. Anthropometric measurements were performed. A Cronbach α coefficient of .77 was obtained. A majority of the items showed good or very good agreement in a test-retest. A high correlation coefficient (as a measurement of concurrent validity) was estimated between NUFFE-NO and MNA. The NUFFE-NO could separate groups with expected high and low scores, which supported construct validity. Calculated sensitivity and specificity values for NUFFE-NO, with MNA as a criterion and receiver operating characteristic curves with areas 0.79 and 0.80, showed appropriate cutoff points for measuring low, medium, and high risk for undernutrition. In conclusion, NUFFE-NO was shown to have sufficient psychometric properties for performing an institutional screening of elderly hospital patients.

Keywords: Elderly; Instrument testing; NUFFE-NO; Nutritional screening instrument; Patients
Abbreviations: BMI, body mass index; CC, calf circumference; CI, confidence interval; MAC, mid-arm circumference; MNA, Mini Nutritional Assessment; NUFFE, Nutritional Form for the Elderly; NUFFE-NO, Norwegian version of NUFFE; NRS-2002, Nutrition Risk Screening 2002; ROC curves, receiver operating characteristic curves.

1. Introduction

It is well known that elderly hospital patients are at high risk for developing undernutrition [1-3]. Performing a nutritional screening in hospitals is therefore a recommended method for identifying at-risk patients and should be undertaken after the patients' admission [4]. Nutritional screening should be the first step that serves to identify predisposing factors and the degree of exposure, that is, identifying those at low, medium, or high risk for undernutrition [5]. In clinical practice, a nutritional screening

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instrument has to be simple, easy to use, and acceptable to the patients. Moreover, it has to meet the criteria for reliability and validity, including sensitivity and specificity [6].

Elderly people are a risk group for becoming undernourished. A screening instrument has to focus on risk factors for undernutrition pertinent to the specific group [7]. The Nutritional Form for the Elderly (NUFFE) is a nutritional screening instrument specifically developed for identifying elderly people at nutritional risk, its content focusing on nutritional risk factors for elderly individuals [8-10].

The NUFFE has been developed to be not only a simple screening instrument easily used by caregivers, but it can also be used as a self-reporting instrument [8,9]. In the study by Söderhamn and Söderhamn [8], the items in NUFFE were found to be easy to understand by the participating patients. Moreover, NUFFE has been tested regarding reliability and validity [8,9], including sensitivity and specificity [10,11]. This screening instrument was initially developed and tested in Sweden [8,9]. However, to use the instrument in a different cultural context, the translated version of the instrument's reliability and validity must also be tested [12]. The NUFFE has been translated into the Hungarian language in accordance with a procedure recommended by Streiner and Norman [12], and this Hungarian version (NUFFE-HU) has also been tested with regard to reliability and validity [13]. The NUFFE has recently been translated into the Norwegian language according to the same principles [12]. Both the Swedish and the Hungarian versions have been found to have sufficient psychometric properties [8-10,13]. The hypothesis was therefore that the Norwegian version of the nutritional screening instrument NUFFE (NUFFE-NO) has sufficient psychometric properties to be used as a screening instrument. Thus, the objective of this study was to test if the Norwegian version of the nutritional screening instrument entitled NUFFE-NO demonstrates sufficient evidence of reliability and validity, including sensitivity and specificity, when applied to a select group of elderly hospital patients. To use a nutritional screening instrument that meets the criteria for reliability and validity, including sensitivity and specificity, advances human nutrition, because it is of considerable importance that caregivers are able to identify patients' nutritional problems before these same patients become undernourished.

2. Methods and materials

This cross-sectional study was carried out in 3 medical hospital wards in 2 different hospitals in southern Norway between November 2008 and April 2009. The inclusion criteria were the following: 65+ years of age and having the ability to communicate and cooperate in an interview situation. Exclusion criteria included any one of the following: experiencing hearing loss, being unable to give information about personal situation, and not having the strength to perform an interview. Individuals who could not be weighed or were amputees were also excluded due to the difficulties involved in estimating their true weight.

2.1. Study group

A convenience sample of 158 newly admitted elderly patients was recruited for the study. Nurses in the 3 medical hospital wards selected the patients who met the inclusion criteria.

2.2. Data collection

The patients were interviewed through using a questionnaire that included background variables such as age, sex, and main diagnosis and the screening instruments NUFFE-NO and Mini Nutritional Assessment (MNA) [14]. Mid-arm and calf circumferences (MAC and CC) were measured as parts of the MNA. Data were also collected from the patients' records regarding the current nutritional screening routine in the hospital wards, which included the Nutrition Risk Screening 2002 (NRS-2002) [4], weight, length, and calculation of body mass index (BMI) (also a part of the MNA [14]).

The interviews with the questionnaire were performed during the patients' first days in the wards. An additional interview was performed with NUFFE-NO 2 to 4 days after the initial interview. Most interviews were performed by a staff nurse and one of the authors (S.F.). In addition, 2 nurses, 2 nursing students, and the first author listed (U.S.) have been involved in a number of interviews. Data from the patients' records were collected by one of the authors (L.J.) in one of the hospitals and by the interviewers in the other hospital.

2.3. The instruments

The nutritional screening instrument NUFFE is an ordinal scale containing 15 three-point items reflecting functional, social, nutritional, and health-related aspects of nutritional intake, that is, weight loss, changes in dietary intake, appetite, intake of prepared food, portion size, intake of fruit or vegetables, possibility of obtaining food products, company at meals, activity, dental and swallowing difficulties, fluid intake, gastrointestinal problems, eating assistance, number of drugs, and health status [8]. The Swedish version of NUFFE has been tested concerning reliability (Cronbach α coefficient .70-.72) and validity (face validity, criterion-related validity—including concurrent and predictive validity—and construct validity) and was shown to be a fairly reliable instrument with evidence of validity. Each item score ranges between a score of 0 and 2. The most favorable option awards a score of 0, the most unfavorable option awards a score of 2. The maximum score is 30. Higher screening scores indicate higher risk for undernutrition [8,9].

The items of the nutritional screening instrument MNA are ranged on ordinal and nominal scale levels. The instrument is composed of 18 items involving anthropometric measurements (BMI, MAC, and CC), questions about appetite, weight loss, mobility, psychologic stress or acute

disease, neuropsychological diseases, type of dwelling, medication, pressure sores or skin ulcers, number of meals, food and fluid intake, autonomy of feeding and self-perception of health and nutrition. The maximum score is 30. The scoring categorizes the subject as being well nourished (24-30 points), at risk for undernutrition (17-23.5 points), or undernourished (<17 points) [14]. Mini Nutritional Assessment has been translated from English to Norwegian, and the Norwegian version has been tested regarding reliability and validity in a small group of elderly nursing home patients. Support for reliability (Cronbach α coefficients of .77-.83 and interrater reliability reflected in a correlation of $r = 0.88$; $P < .001$) and validity was shown in the study group [15].

Nutrition Risk Screening 2002 is a screening system designed to detect the presence for undernutrition or the risk for undernutrition in a hospital setting. It contains 4 questions as an initial screening, that is, BMI less than 20.5 kg/m^2, weight loss within the last 3 months, reduced dietary intake over the last week, and if the patient is severely ill. If the answer is "yes" to any question, the screening continues with a final screening step. This step contains assessment about impaired nutritional status (weight loss in percent, reduced food intake in percent, BMI) and disease severity. Each of these 2 categories awards scores from 0 (normal nutritional status and normal nutritional requirements) to 3, indicating the severity of both nutritional status and disease as a reflection of increased nutritional requirements. An additional score is awarded if the patient is 70 years or older. A total score of 3 or higher indicates that the patient is at nutritional risk [4].

2.4. Statistical analyses

Most analyses were performed using the Statistical Package for Social Sciences (SPSS) for Windows, version 16.0 (SPSS, Chicago, Ill). A P value <.05 was considered statistically significant. A power analysis was performed for the sample size used in this study by using data gathered from previous studies using the Swedish version of NUFFE [8,9]. A bivariate correlation test between NUFFE and MNA was used to determine concurrent validity, and the power analysis showed that a sample in the vicinity of 150 individuals was sufficient for obtaining an association between the instruments at $P < .01$ with an effect size of 0.25 and a power of 0.70 [16].

Reliability of NUFFE-NO was assessed as homogeneity or internal consistency by calculating the Cronbach α coefficient [17] and the item-to-total correlations by Spearman rank correlations [18] between each item and the scale total. The correlation between the individual item and total scale was calculated when the particular item was omitted from the total scale [12]. Reliability was also assessed as stability by evaluating the test-retest of the 2 performed interviews with NUFFE-NO. Spearman rank correlation was calculated between the total scores of the 2 interviews as a measure of association [18]. Weighted kappa (κ_w), which is a recommended analysis for ordinal scales [18,19], and 95% confidence interval (CI) [19] were calculated to assess the agreement between the 2 interviews. The formula used was in accordance with that of Fleiss and Cohen [20] and Fleiss et al [21]. The analyses of κ_w and CI were performed in Microsoft Excel. The obtained κ_w coefficients were interpreted in accordance with Altman [18], who has categorized κ_w coefficients as follows: 0.81-1.00, very good agreement; 0.61-0.80, good agreement; 0.41-0.60, moderate agreement; 0.21-0.40, fair agreement; and <0.21, poor agreement.

Validity of NUFFE-NO was assessed as criterion-related validity and construct validity [12]. Criterion-related validity was assessed by using Spearman rank correlations between the scale total of NUFFE-NO and the 3 criteria BMI, MAC, and CC. Concurrent validity (likewise a measure of criterion-related validity) was assessed by using Spearman rank correlations between scale totals for NUFFE-NO and MNA as well as between scale totals for NUFFE-NO and NRS-2002.

Construct validity was assessed by comparing median scores of NUFFE-NO for groups with expected high and low scores, respectively, that is, for so-called "known groups" [12,16]. Such groups were patients having a BMI lower than 24 kg/m^2 and those with a higher BMI [22], patients with a cancer diagnosis and without cancer diagnosis, and patients with small CC (<31 cm) and high CC (≥31 cm), as measured by MNA. Differences between these groups were tested with Mann-Whitney U test [18].

Sensitivity, specificity, and positive and negative predictive values were estimated [12,16,23] to determine cutoff points for identifying individuals at low, medium, and high risk for undernutrition of NUFFE-NO with MNA as a criterion. For identifying individuals at medium or high risk for undernutrition, the MNA score of 23.5 or lower (indicating risk for undernutrition) and less than 17 (indicating undernutrition), respectively, were used. Sensitivity, specificity, and positive and negative predictive values were estimated for each cutoff point of NUFFE-NO. Receiver operating characteristic curves (ROC curves) were also constructed. The sensitivity values for each cutoff point of NUFFE-NO were plotted (y axis) against 1 − specificity values of each cutoff point of NUFFE-NO (x axis), as an aid in determining appropriate cutoff points. The optimum cutoff point will be found near a "shoulder" of the ROC curve in the upper left corner [12,16,23]. The area under the ROC curves was calculated.

2.5. Ethical considerations

The study was carried out in concordance with important ethical principles [24,25] and in compliance with the Declaration of Helsinki [26]. Permission to perform the data collection in the hospital wards was obtained from the responsible physicians and research unit for the hospitals.

Patients who fulfilled the criteria for participating in the study received oral and written information. Written consent was obtained. The study was approved by the Regional Committee for Medical Research Ethics in southern Norway (REK sør-øst C, registration number 420-08569c, 2008/14093) and by the Norwegian Social Science Data Services (Project Number 19761).

3. Results

3.1. The study group

Of the total number (n = 158) of participating patients, 83 (52.5%) were men and 75 (47.5%) were women, with a mean (SD) age of 78 (8) years. A group of 92 patients answered NUFFE-NO the second time.

3.2. Reliability

Reliability of NUFFE-NO, measured as homogeneity, in the total study group was shown in a Cronbach α coefficient of 0.77 and in significant correlations of 13 of the 15 items in the item-to-total correlations (Table 1). Stability as a measure of NUFFE-NO's reliability in the test-retest (n = 92) was reflected in a Spearman rank correlation coefficient of 0.92 ($P < .001$) between the score totals. As regarded the κ_w coefficients, the agreement between test-retest scores was found to be very good for 2 of the items, good for 7 of the items, moderate for 4 of the items, and fair to poor for 1 of the items, respectively (Table 2).

3.3. Validity

Criterion-related validity of NUFFE-NO was shown in significant Spearman rank correlations between the total scale and BMI ($r_s = –0.29$, $P < .001$, n = 154), MAC ($r_s = –0.39$, $P < .001$, n = 120), and CC ($r_s = –0.38$, $P < .001$, n = 119), respectively. Concurrent validity (likewise as a measure of criterion-related validity) reached significant Spearman rank correlations between the total scale of NUFFE-NO and the total scales of MNA ($r_s = −0.74$, $P < .001$, n = 153) and NRS-2002 ($r_s = 0.39$, $P < .001$, n = 104), respectively.

Construct validity of NUFFE-NO was reflected in significant differences between obtained median scores for groups with expected high and low scores, respectively (Table 3).

3.4. Sensitivity and specificity

Based on the values for sensitivity, specificity, positive and negative predictive values, and the ROC curves, the following cutoff points for NUFFE-NO were chosen: <6 (indicating low risk for undernutrition), ≥6 (indicating medium risk for undernutrition), and ≥ 11 (indicating high risk for undernutrition). The area under the ROC curves for the cutoff points 6 and 11 were 0.79 (95% CI, 0.707−0.865) and 0.80 (95% CI = 0.701−0.903), respectively. Sensitivity, specificity, and positive and negative predictive values (according to these cutoff points) are displayed in Table 4.

Table 1
Item-to-total correlations of NUFFE-NO (n = 158)

Item no.	Item content	r_s	P
1	Weight loss	0.45	<.001
2	Changes in dietary intake	0.60	<.001
3	Appetite	0.56	<.001
4	Intake of cooked food	0.33	<.001
5	Portion size	0.55	<.001
6	Intake of fruit or vegetables	0.34	<.001
7	Possibility of obtaining food products	0.25	.002
8	Company of meals	0.24	.003
9	Activity	0.44	<.001
10	Tooth/mouth and swallowing difficulties	0.30	<.001
11	Fluid intake	0.20	.011
12	Gastrointestinal problems	0.34	<.001
13	Eating assistance	0.02	.780
14	Number of drugs	0.08	.323
15	Health state	0.47	<.001

r_s; Spearman rank correlations; P values < .05 were considered statistically significant.

Table 2
Agreements between test-retest of NUFFE-NO (n = 92)

Item	Item content	κ_w	CI
Item 1	Weight loss	0.72	0.607-0.838
Item 2	Changes in dietary intake	0.63	0.511-0.755
Item 3	Appetite	0.61	0.477-0.742
Item 4	Intake of cooked food	0.57	0.355-0.783
Item 5	Portion size	0.74	0.622-0.863
Item 6	Intake of fruit and vegetables	0.60	0.440-0.757
Item 7	Possibility of obtaining food products	0.36	0.015-0.702
Item 8	Company at meals	0.81	0.699-0.921
Item 9	Activity	0.74	0.626-0.852
Item 10	Tooth/mouth and swallowing difficulties	0.72	0.572-0.866
Item 11	Fluid intake	0.56	0.427-0.703
Item 12	Gastrointestinal problems	0.58	0.394-0.759
Item 13	Eating assistance	–0.01	–0.156-0.127
Item 14	Number of drugs	0.86	0.761-0.953
Item 15	Health state	0.65	0.511-0.792

κ_w: weighted κ coefficients: 0.81-1.00, very good agreement; 0.61-0.80, good agreement; 0.41-0.60, moderate agreement; 0.21-0.40, fair agreement; <0.21, poor agreement.

Table 3
NUFFE-NO scores for groups with expected high and low scores, respectively

Groups with expected high scores	n	Median (interquartile range)	Groups with expected low scores	n	Median (interquartile range)	P
BMI <24 kg/m^2	77	10 (6-13)	BMI ≥24 kg/m^2	77	7 (4-11)	<.001
Cancer diagnosis	31	11 (7-14)	Noncancer diagnosis	127	7 (4-11)	.001
CCs <31 cm	33	10 (7-13.50)	CCs ≥31 cm	86	6 (4-11)	.002

Mann-Whitney U test was used, and P values <.05 were considered statistically significant.

4. Discussion

In the present study, NUFFE-NO was tested regarding reliability and validity, including sensitivity and specificity. Such testing is necessary because a clinical screening instrument has to meet these quality criteria [6] to be useful in both research and practice. According to these initial testing results, NUFFE-NO was shown to have sufficient evidence of reliability and validity, including sensitivity and specificity, for identifying elderly hospital patients at nutritional risk.

An obtained Cronbach α coefficient of .77 as a measure of homogeneity is an acceptable value because a recommended interval is 0.70 to 0.90 [12]. It is a slightly higher value than was reached in the test studies of the original Swedish version of NUFFE [8,9] and the Hungarian version [13]. In the item-to-total correlations, 13 items ranged between 0.20 and 0.60 in statistically significant correlations. This is an increase in the number of significant item-to-total correlations compared with previous studies in Sweden and Hungary [8,9,13]. A possible explanation may be that the actual study group was a fairly heterogeneous group, and obtaining a heterogeneous study group is the optimum regarding instrument testing. If many patients answer the same option of an item (which may take place if the study group is a homogenous one), that particular item will show a low correlation to the total scale. The items 13 (eating assistance) and 14 (number of drugs) showed a low item-to-total correlation because almost all participating patients did not need assistance to eat, and most of them took several different drugs. Patients who needed eating assistance could have been excluded from the study because they were sick and lacked strength. These 2 items, which showed low correlations with the entire scale, award a lower Cronbach α coefficient than if all items had shown significant correlations to the total scale [27]. Item-to-total correlations should be between 0.20 and 0.80, but when the items may be seen as causal indicators (which items 13 and 14 may be considered to be), the demand for high homogeneity is not as great as it is for effect variables that have to reflect the underlying construct [12]. In other words, when the items of an instrument reflect a complex clinical phenomenon, the homogeneity is not very relevant [27].

In the test-retest situations assessing stability as a measure of reliability, NUFFE-NO was found to demonstrate good or very good agreement in most items using κ_w. Two of the items (7 and 13) showed fair and poor agreement, respectively. A reason for this was that not all of the 3 options in the items were used as response alternatives by the patients. For example, in item 13 (eating assistance), 89 of 92 patients answered in both test and retest situations that they did not need help eating. This may be regarded as a stable result, but because the formula used for calculating κ_w coefficients was constructed in order that all 3 options were represented, the result showed a poor agreement. Obtaining very good agreement for all items in a test-retest is of course the optimum to obtain a highly stable screening instrument. When assessing the present test-retest result, it must be considered if the interviewer could influence the result. However, the test-retest was performed by the same interviewer in 79 of the 92 test-retest interviews, and it may therefore be assumed that this factor did not exert great influence. Another possible bias is if the nutritional state of the participated patients changed between the performed test-retest interviews, although a brief interval of 2 to 4 days was used between the interviews. (The recommended interval between test-retest is 2 to 14 days [12].) The reasons for choosing a shorter interval were that the nutritional status of patients should not alter too much and that the patients should remain in the same wards. Of the participating 158 patients, 92 patients were interviewed the second time, due to short stays in the hospital.

Criterion-related validity of NUFFE-NO was supported in the present study when the criteria BMI, MAC and CC were used. These criteria are common anthropometric measurements and often used in nutritional assessments, for example, in the instrument MNA [14]. Body mass index, MAC, and CC were also used as criteria in a previous Swedish study [9], and BMI and MAC in the Hungarian study [13], to test criterion-related validity of these versions of NUFFE, with similar results. The intention with NUFFE was to obtain an instrument that was easy to use; therefore, anthropometric measurements were not included [8], but rather have been used to test validity. Another reason to exclude anthropometric measurements (eg, BMI) in NUFFE is that these measurements may be difficult to take in all elderly people. This may be compared with the study by Tsai et al [28], who found that a modified MNA without BMI can maintain the full functionality of the instrument, enhancing in turn the usefulness of the instrument. However, BMI is not able to distinguish overweight patients who involuntarily lose weight [29] and is not sensitive enough to recognize small weight losses [30]. Therefore, it may be a weakness to use BMI as a criterion to validate NUFFE-NO as a nutritional screening instrument. Another weakness is that no biochemical parameters have been used for validating the screening instrument, for example, prealbumin, which is considered to be a sensitive denoter of undernutrition [31].

Concurrent validity was confirmed by a high Spearman rank correlation coefficient between NUFFE-NO and MNA. The attained value, $r_s = -0.74$, was exactly the same as in a

Table 4
Cutoff points of NUFFE-NO for medium and high risk for undernutrition and sensitivity, specificity, and positive and negative predictive values

Cutoff point	Sensitivity (%)	Specificity (%)	Positive predictive value (%)	Negative predictive value (%)
Score 6, indicating medium risk	83	73	83	75
Score 11, indicating high risk	77	83	49	95

previous Swedish study [9]. However, a lower Spearman rank correlation coefficient was obtained when NUFFE-NO was correlated with NRS-2002. One assumed reason for this may be that NUFFE and MNA have a quite similar number of items (15 and 18, respectively) and NRS-2002 has few items. In this testing study, MNA may be seen as the "gold standard" when relating an instrument to NUFFE. According to Terwee et al [27], validity is shown if the used standard is "gold" and if the correlation with the "gold standard" is at least 0.70.

Construct validity of NUFFE-NO was supported when assumed patient groups with higher and lower risk for undernutrition could be separated. It is well known that elderly people with a BMI lower than 24 kg/m^2 may be at nutritional risk [22], and also, patients with cancer diagnoses are at greater risk for developing undernutrition than are other patients [32]. Furthermore, a lower value of CC may be seen as an indicator for risk of undernutrition, as CC is a variable in MNA [14].

The chosen cutoff values for NUFFE-NO, <6 indicating low risk, ≥6 indicating medium risk and ≥11 indicating high risk for undernutrition, were determined using an interpretation of the best estimated values for sensitivity, specificity, and positive and negative predictive values with MNA as a criterion. Mini Nutritional Assessment [14] was chosen because it is one of the most well-known and often used, reliable, and valid nutritional instruments for elderly people. The cutoff values of 6 and 11 for medium and high risk for undernutrition, respectively, were also obtained by the performed ROC curves, which showed the highest area under the curves for these cutoff values. The obtained values (0.79 and 0.80) for the area under the ROC curves indicate that NUFFE-NO has the ability to discriminate between elderly people at low, medium, and high nutritional risk and those who are not, respectively, according to an external criterion. According to Terwee et al [27], the area under the curve has to be at least 0.70 to be acceptable.

The obtained cutoff value for high risk for undernutrition for NUFFE-NO (≥11) is lower than the obtained value for the original Swedish version of NUFFE (≥13). The cutoff value of NUFFE-NO for medium risk for undernutrition (≥6) is the same as was found for the Swedish version of NUFFE [10,11]. When using NUFFE-NO as a clinical screening instrument, the cutoff value of 6 or higher may be regarded as being the most important cutoff value, because elderly people at both medium and high risk will be identified. Early identification of elderly people at nutritional risk is of considerable importance to investigate and treat nutritional problems before they lead to undernutrition. Due to the described and discussed results, the hypothesis stating that the NUFFE-NO has sufficient psychometric properties to be used as a screening instrument was accepted.

In conclusion, NUFFE-NO was, in the present study, shown to have sufficient psychometric properties for performing an institutional screening of elderly hospital patients. However, further studies must be conducted in other groups of elderly people to establish the reliability and validity of NUFFE-NO.

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