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THE SNAQ RC, AN EASY TRAFFIC LIGHT SYSTEM AS A FIRST STEP IN THE RECOGNITION OF UNDERNUTRITION IN RESIDENTIAL CARE

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Abstract: *Objective:* Development and validation of a quick and easy screening tool for the early detection of undernourished residents in nursing homes and residential homes. *Design:* Multi-center, cross sectional observational study. *Setting:* Nursing homes and residential homes. *Participants:* The screening tool was developed in a total of 308 residents (development sample; sample A) and cross validated in a new sample of 720 residents (validation sample) consisting of 476 nursing home residents (Sample B1) and 244 residential home residents (sample B2). *Measurements:* Patients were defined severely undernourished when they met at least one of the following criteria: BMI ≤ 20 kg/m2 and/or ≥ 5% unintentional weight loss in the past month and/or ≥ 10% unintentional weight loss in the past 6 months. Patients were defined as moderately undernourished if they met the following criteria: BMI 20.1-22 kg/m2 and/or 5-10% unintentional weight loss in the past six months. The most predictive questions (originally derived from previously developed screening instruments) of undernourishment were selected in sample A and cross validated in sample B. In a second stage BMI was added to the SNAQRC in sample B. The diagnostic accuracy of the screening tool in the development and validation samples was expressed in sensitivity, specificity, and the negative and positive predictive value. *Results:* The four most predictive questions for undernutrition related to: unintentional weight loss more than 6 kg during the past 6 months and more than 3 kg in the past month, capability of eating and drinking with help, and decreased appetite during the past month. The diagnostic accuracy of these questions alone was insufficient (Se=45%, Sp=87%, PPV=50% and NPV=84%). However, combining the questions with measured BMI sufficiently improved the diagnostic accuracy (Se=87%, Sp=82%, PPV=59% and NPV=95%). *Conclusion:* Early detection of undernourished nursing- and residential home residents is possible using four screening questions and measured BMI.

Key words: Undernutrition, undernutrition screening tool, nursing home, residential home, SNAQ.

Introduction

Undernutrition in institutionalized older persons is of individual and public concern since it negatively affects health outcome and quality of life (1-3). Several studies have shown that many nursing home residents suffer from undernutrition. A yearly repeated prevalence study in Dutch nursing homes reports that, over the past five years, one-fourth of the residents was undernourished and that additionally one-third was at-risk of undernutrition (4-7). Moreover, only 50-60% of the undernourished institutionalized older persons received nutritional intervention from a dietician. In this study undernutrition was defined as BMI less than 18,5 kg/m2 and / or unintentional weight loss (6 kg in the previous 6 months or 3 kg in the previous month) and / or BMI between 18,5 and 20 kg/m2 in combination with no nutritional intake for 3 days or reduced intake for more than 10 days (4-7).

To improve early recognition of undernutrition in institutionalized older persons, weighing and screening by the nursing staff according to a standardized protocol needs to be intensified. In most nursing homes body weight is measured only four to six times a year. The staff is not properly trained to recognise patients whose nutritional status is poor or worsening and the existence of a protocolled treatment plan based on these measurements is often lacking.

Assessment tools for undernutrition are available which can be helpful for the nursing staff to identify those residents who are undernourished. The most frequently used tools are the Mini Nutritional Assessment (MNA) (8), the Mini Nutritional Assessment-Short Form (MNA-SF) (9) and the Malnutrition Universal Screening Tool (MUST) (10). The MNA is an 18-item questionnaire that identifies persons at nutritional risk and provides information for intervention planning (11-14). Its screenings variant (MNA-SF) is a 6-item screening tool. The MUST is a 3-item screening tool. Both the MNA-SF and the MUST are diagnostic screening instruments and contain measurements of weight and height and calculation of BMI and percentage of weight loss, which do involve time and training.
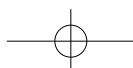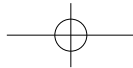
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These instruments appear to be difficult to implement because they are considered too complex by the care workers. For daily nursing and residential home practice, a quick and easy screening instrument that can be used for all institutionalised older persons would be helpful.

For the hospital situation, the Short Nutritional Assessment Questionnaire (SNAQ) has been developed for this purpose (15). The SNAQ is a quick and easy 4-item screening tool consisting of simple questions that are most predictive of undernutrition, without the need to calculate percentage weight loss or BMI. The SNAQ has proven to be a valid and reproducible screening tool to detect undernourished hospital in- and outpatients. With the use of this undernutrition screening tool, the recognition of undernutrition improved from 50 to 80% in the inpatient population and from 15 to 70% in the high-risk outpatient population (15,16).

Similar to the SNAQ, a practical screening instrument for undernutrition needs to be available for the nursing and residential home setting. This study aims to develop and validate the SNAQRC (Short Nutritional Assessment Questionnaire for the Residential Care).

Methods

Subjects

This study is carried out in patients living permanently in special institutions for chronic care. We differentiate between residential homes and nursing homes. In a residential home, patients have a small private living apartment, with an alarm system and meals served at their apartment or in the home's restaurant. They receive basic nursing, social assistance and a daily program with amusement. Elderly people in residential homes (mean age, 84 years) often have some disabilities but they are still able to do most of their activities of daily living (ADL's) by themselves, contrary to nursing home residents who often are more disabled and need much help with regard to their ADL's (17).

For the development of the SNAQRC, a sample of 308 patients from three different Dutch nursing homes participated in the period of February until June 2007 (sample A) (Laurens care group Barendrecht n=110, Solis care group Deventer n= 87 Vivium care group Naarderheem n=111). Residents who were not able to give informed consent or could not be weighed were excluded from the study.

For the cross validation of the SNAQRC, from April until May 2008 a sample of 476 nursing home residents (sample B1) participated (Osira group, Amsterdam n=262, Laurens care group, Barendrecht n=78, Cicero care group, Brunsum n=84, Solis care group, Deventer n=20, Amsta Amsterdam n=16, Viva! care group Meerstate, Heemskerk n=16). In addition, the SNAQRC was cross validated in a sample of 244 residential home residents (sample B2) (Cicero care group, Brunsum n=77, Care partners Mid-Holland Goverwelle, Gouda n=60, Viva! care group Meerstate, Heemskerk n=39, Osira Group, Amsterdam n= 34, Solis care group, Deventer n=26, Carint

Reggeland group, Almelo n=8).

Anthropometric measurements

In samples A and B the measurements of knee height and body weight were performed for every resident by care workers (education level 3: completed a 3 year education and assists patients in eating, cloting, washing and coordinates the logistics of the care) who were trained and assisted by a dietician. Body weight (kg) was measured on calibrated sitting balance scales of various types. Residents were weighed without their shoes and with light indoor clothes. For clothes a correction was made by deducting 1.77 kg for men and 1.13 kg for women from their weight. An additional correction of 0.40 kg for men and 0.28 kg for women was made when a resident was unable to take off his/her shoes (18). If the resident was sitting in a wheelchair and weight could not be measured on a sitting scale, weight was measured while the resident was sitting in the wheelchair. Actual weight was calculated by substracting the weight of the wheelchair. Height was calculated based on measured knee height (cm) using Chumlea's technique and formula. Knee height, the distance from the sole of the foot to the anterior surface of the thigh, was measured using a flexible measure tape. The ankle and knee of the residents were each flexed to a 90 degree angle (19). Knee height was measured in seated position if possible and otherwise in recumbent position. Body mass index (BMI) was calculated by weight divided by height squared.

In sample A the Midarm Circumference (MAC) was measured using a flexible, nonstretchable tape measure. The MAC is the circumference of the non-dominant arm midway between the bony protrusion on the shoulder (acromion) and the point of the elbow (olecranon) and was measured (in cm) (20).
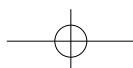
Weight loss

The objective weight loss during the last month and last six months was based on the recorded body weights in the patient records, obtained by the researcher. If this information was missing, the information was obtained by asking the patient, the family or the nursing staff.

Definition of severe and moderate undernutrition

Patients were defined severely undernourished when they met one or more of the following criteria: BMI ≤ 20 and/or ≥ 5% unintentional weight loss in the past month and/or ≥ 10% unintentional weight loss in the past six months. Patients were defined as moderately undernourished if they met the following criteria: BMI 20.01-22 and/or 5-10% unintentional weight loss in the past six months (21-27).

Potential screening questions for development of instrument

All patients of sample A completed a detailed self-administered questionnaire consisting of 20 questions related to eating and drinking difficulties, chronic diseases, weight,
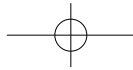
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weight loss, psychological disorders and self view of nutrition and health status. The nutrition-related questions were obtained from relevant nutritional screening tools. All questions of the Mini Nutritional Assessment (MNA) (8), the Mini Nutritional Assessment-Short Form (MNA-SF) (9), the Malnutrition Universal Screening Tool (MUST) (10) and the Short Nutritional Assessment Questionnaire (SNAQ) (15) were asked by dieticians.

Potential screening questions for cross validation of instrument

In sample B, a care giver assisted the resident with filling out the set of questions that was selected as best predictive in sample A. If the resident was not able to answer the questions, the questions were completed by the care workers and family members.

Statistical analysis

Sample A

Since all individual items of the relevant screening instruments were used in this study, the diagnostic accuracy of the MNA, MNA-SF, MUST and SNAQ were first calculated using our definition of undernutrition. The diagnostic accuracy was expressed in terms of sensitivity, specificity, positive predictive value, and negative predictive value. The sensitivity represents the proportion of undernourished residents who test positive with the screening test (true positives). The specificity represents the proportion of not undernourished residents who test negative with the screening test (true negatives). The positive predictive value represents the proportion of residents who test positive with the screening test and who are indeed undernourished. The negative predictive value represents the proportion of residents who test negative and who are indeed not undernourished.

The selection of the set of questions that was most predictive of undernutrition in the development sample was performed in two phases. The dependent variable was nutritional status in three categories: not undernourished, moderately undernourished and severely undernourished. The not undernourished category was used as reference group. First, the odds ratio was calculated for each individual question for the presence of severe undernutrition and moderate undernutrition respectively in a binary logistic regression analysis and in an ordinal logistic regression analysis with the nutritional status as dependent variable. All questions with a statistically significant odds ratio ($p < 0.05$) in any of these analyses were included in the next phase. Second, ordinal logistic regression was carried out with undernutrition as dependent variable and with all questions with a significant odds ratio as independent variables (28). The questions associated with undernutrition at a significance level of $p < 0.05$ were selected in a backward stepwise procedure.

The impact of the selected questions was expressed by the regression coefficients of these questions in the ordinal logistic regression model. The regression coefficients were transformed into a simple score that can be added up to obtain a summed score. The cut-off points for 'severely undernourished' and 'moderately undernourished' were obtained by determining the optimal cut-off point in the ROC-curve. The diagnostic accuracy of the final set of questions was calculated.

Sample B

The screening tool derived in the development samples was cross validated in sample B. In a second stage BMI was added to the set of questions in sample B. The diagnostic accuracy of the screening tool in the development and validation samples was expressed in terms of sensitivity, specificity and the negative and positive predictive value.

All analyses were performed with SPSS software package, version 15.0 (SPSS Inc., Chicago, IL, USA).

Results

Subjects

Table 1 gives the characteristics of samples A and B. In sample A 26 residents (8.4%) and in sample B1 109 residents (23%) and in sample B2 56 residents (23%) were severely undernourished.

Table 2 shows the diagnostic accuracy of the MNA, the MNA-SF, the MUST and the hospital-SNAQ in sample A. The sensitivity of the MNA-SF was very high but the specificity of both the MNA-SF and the MNA was very low. For MUST and SNAQ the sensitivity was low and the specificity was high.

Selection of the set of questions for the SNAQRC

In the first phase of the selection nine individual questions showed a statistically significant odds ratio for the binary and / or ordinal logistic regression analysis (table 3). The question "Did you have psychological stress or acute disease in the past 3 months?" was excluded from the next phase because the items psychological stress and acute disease can be interpreted in different ways. Because that question is difficult to answer it is not suitable for a quick and easy screening tool.

The selection of the set of questions for the final questionnaire, was based on the combination of questions which were most predictive for both the severely and the moderately undernourished residents. The final set of questions for the SNAQRC were: "Have you unintentionally lost more than 3 kg in the last month" ($\beta = 1.3$ $p < 0.001$; 1.5 points), "Have you unintentionally lost more than 6 kg in the last 6 months" ($\beta = 1.5$ $p < 0.001$; 1.5 points), "Are you only capable of eating and drinking with help?" ($\beta = 0.7$ $p = 0.05$; 0.5 point), "Have you experienced a decreased appetite in the last month? ($\beta = 1.2$ $p = 0.003$; 1 point).

The ROC-curves were used to determine a cut-off point for both the moderately as the severely undernourished older persons. The cut-off points for the severely undernourished residents was ≥1.5 and for the moderately undernourished residents ≥ 0.5. The ROC-curve for severely undernourished
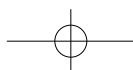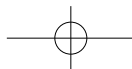
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Table 1

Characteristics of the development sample (A) and the cross validation sample (B1: nursing home, B2: residential home)

	A (n=308)			B1 (n= 476			B2 (n=244)		
	Severely UN	Moderately UN	Not UN	Severely UN	Moderately UN	Not UN	Severely UN	Moderately UN	Not UN
N	26 (8%)	34 (11%)	248 (81%)	109 (23%)	77 (16%)	290 (61%)	56 (23%)	40 (16%)	148 (61%)
Sex (female n)	16 (61%)	9 (27%)	171 (69%)	82 (75%)	58 (75%)	212 (73%)	38 (68%)	25 (63%)	108 (73%)
Age mean (y) ± SD	83.9 ± 8.4	86.5 ± 6.2	81.8 ± 13.5	81.9 ± 4.7	84.3 ± 9.0	81.2 ± 10.4	85.3 ± 6.9	82.8 ± 9.1	81.4 ± 8.7
BMI (kg/m2)	23.5 ± 5.0	22.9 ± 3.2	30.1 ± 5.5	21.8 ± 5.8	23.2 ± 5.0	28.8 ± 4.7	21.8 ± 5.8	23.2 ± 5.0	28.8 ± 4.7
BMI ≤ 20	37%	0%	0%	63%	0%	0%	55%	0%	0%
BMI 20.01-22	11%	53%	0%	9%	60%	0%	9%	68%	0%
BMI 22.01-28	30%	38%	41%	19%	27%	54%	20%	25%	49%
BMI ≥ 28.01	22%	9%	59%	9%	13%	46%	16%	8%	51%
> 5% WL in past M	48%	0%	0%	36%	0%	0%	45%	0%	0%
5-10% WL in past 6 M	20%	62%	0%	6%	46%	0%	7%	38%	0%
> 10% WL in past 6 M	64%	0%	0%	29%	0%	0%	32%	0%	0%

Table 2

Diagnostic accuracy of the MNA, the MNA-SF, the MUST and the SNAQ in sample A of nursing home residents (n=308)

	MNA		MNA-SF		MUST		SNAQ	
	<23.5 points (UN 1 and 2)*	<17 points (UN 2)**	≤11 points (UN 1)*	≤11 points (UN 1)**	1 point (UN 1)*	≥2 points (UN 2)**	2 points (UN 1 and 2)*	≥3 points (UN 2)**
Sensitivity (95% CI)	90% (79-96)	56% (33-73)	98% (91-99)	96% (80-99)	53% (40-66)	39% (20-59)	50% (37-63)	62% (41-80)
Specificity (95% CI)	36% (31-44)	58% (80-88)	18% (14-24)	16% (12-21)	94% (90-98)	96% (93-98)	85% (80-89)	89% (84-92)
Pos. predictive value (95% CI)	26% (20-32)	26% (14-37)	23% (18-28)	10% (6-14)	67% (52-80)	48% (26-70)	44% (32-57)	33% (20-48)
Neg. predictive value (95% CI)	94% (87-98)	95% (92-98)	98% (88-99)	98% (88-99)	89% (85-93)	94% (91-97)	88% (83-91)	96% (93-98)

UN 1 = moderately undernourished / at risk of undernutrition; UN 2 = severely undernourished; * Diagnostic accuracy with severely undernourished persons and moderately undernourished versus not undernourished persons; ** Diagnostic accuracy with severely undernourished persons versus moderately undernourished and not undernourished persons

residents (cut-off ≥ 1.5) showed an area under the curve of 0.80 (95% CI 0.68-0.90; p<0.001). The area under the curve for the moderately undernourished residents (cut-off ≥0.5) was 0.74 (95% CI 0.66-0.82; p<0.001). The diagnostic performance of the set of questions for both the severely and moderately undernourished residents (cut-off ≥1.5 and cut-off ≥0.5) is presented in table 4 (sample A).

Cross validation of the SNAQRC sample B

Separate analyses for the nursing home sample and residential home sample revealed similar results in sample B1 and B2 (Sensitivity B1: 44%, B2: 46%, specificity B1: 84%, B2: 89%). Therefore, in the cross-validation the diagnostic accuracy of the set of questions was determined for the complete sample B as shown in table 4. It showed a low sensitivity and positive predictive value in the severely undernourished group, respectively 45% and 50%. The specificity and negative predictive value were respectively 87% and 84%.

In post-hoc analyses we explored whether the selected questions were also best predictive of undernutrition in sample B. All questions had significant Wald scores and the regression coefficients were in agreement with the regression coefficients in sample A. ('' Have you lost unintentionally more than 3 kg

in 1 month'' (β= 1.6, p<0.001), '' Have you lost unintentionally more than 6 kg in 6 months" (β= 1.5, p<0.001, "Are you only capable of eating and drinking with help?" (β=0.5 p=0.01) and "Have you experienced a decreased appetite in the last month?" (β=0.4 p=0.05)

Set of questions combined with the value of BMI sample B

Since the diagnostic accuracy of the set of questions alone was inadequate, the score on the questions was, in a post-hoc analysis, combined with measured BMI. Then the diagnostic accuracy of this combination was determined (Table 4). BMI≤20 corresponded to severely undernourished, BMI 20.01-22 corresponded to moderately undernourished, BMI 22.01-28 corresponded to not undernourished and BMI> 28 corresponded to overweight. Combining the questions with these BMI cut-off values resulted in a sufficient diagnostic accuracy of a sensitivity of 87%, a specificity of 82%, a positive predictive value of 59% and an negative predictive value of 95%.

Traffic light system

The SNAQRC score is visualised by a traffic light system (Figure 1). A red score (question 1 or 2 or BMI <20) alerts the physician to consider to consult a dietician in the medical
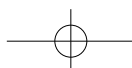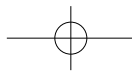
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Table 3
Selection of the SNAQRC-items

|	Moderately undernourished vs. not undernourished OR (95% CI)	Severely undernourished vs. not undernourished OR (95% CI)	Ordinal regression analysis OR (95% CI)	Final SNAQRC set of questions SNAQRC score (β (SE))
Have you experienced a decreased appetite over the last month?	5.0 (2.3-10.8)	3.0 (1.4-6.8)	3.6 (2.0-6.5)	1 point (1.18 (0.32))
Have you experienced nausea in the last month?	0.7 (0.2-2.0)	1.5 (0.6-3.1)	1.1 (0.4-2.0)	
Have you experienced difficulty chewing in the last month?	1.4 (0.6-3.7)	2.9 (1.2-7.3)	1.9 (0.9-3.9)	
Have you experienced difficulty swallowing in the last month?	2.1 (1.0-4.6)	2.2 (0.9-5.2)	2.2 (1.2-4.0)	
Did you have diarrhea in the last month?	0.7 (0.3-1.8)	2.0 (0.8-4.5)	1.2 (0.6-2.2)	
Did you skip a meal occasionally in the last month?	0.6 (0.1-4.7)	2.7 (0.7-10.3)	1.1 (0.3-3.9)	
Did you have an adequate protein intake in the last month?	2.2 (0.8-6.4)	3.8 (1.4-10.7)	3.0 (1.3-6.5)	
Did you have an adequate fruit and vegetables intake in the last month?	0.8 (0.4-1.7)	0.6 (0.3-1.4)	0.9(0.5-1.5)	
Are you only capable of eating and drinking with help?	0.7 (0.2-2.3)	4.0 (1.7-9.4)	2.2 (1.1-4.4)	0.5 point (0.73 (0.38))
Did you consume less than 3 cups of fluid per day?	1.0 (0.2-8.0)	0.7 (0.1-6.1)	0.8 (0.2-4.0)	
Did you use supplemental drinks or tube feeding in the last month?	2.4 (1.0-5.9)	3.3 (1.3-8.2)	2.9 (1.5-5.7)	
Are you severe ill AND didn't you have more than 5 days food intake?	100% no	1.9 (0.4-9.1)	0.9 (0.2-4.1)	
Do you consider your own health status as "not good"?	0.7 (0.3-1.4)	0.6 (0.3-1.4)	0.6 (0.4-1.1)	
Have you unintentionally lost more than 3 kg in the last month?	2.7 (0.9-7.9)	14.3 (5.7-36.0)	8.3 (4.0-17.2)	1.5 points (1.27 (0.43))
Have you unintentionally lost more than 6 kg in the last 6 months?	4.9 (2.0-12.1)	13.4 (5.4-33.3)	7.6 (3.8-15.2)	1.5 points (1.49 (0.41))
Did you take more than 3 prescriptions of drugs per day in the last month?	1.2 (0.4-3.6)	0.6 (0.2-1.5)	0.8 (0.4-1.6)	
Did you have psychological stress or acute disease in the past 3 months?	3.3 (1.4-7.9)	3.0 (1.2-7.8)	3.1 (1.6-6.0)	
Are you bed or chair bound?	1.4 (0.3-6.3)	100% no	2.7 (0.6-11.9)	
Do you have severe dementia or depression in the last month?	0.6 (0.3-1.4)	0.6 (0.2-1.3)	0.6 (0.4-1.2)	
Did you have pressure sores in the last months?	1.2 (0.5-2.8)	0.8 (0.3-1.8)	0.9 (0.5-1.7)	

Table 4
Diagnostic accuracy of the SNAQRC in sample A and the cross validity of the SNAQRC in sample B

	Score orange (cut-off ≥ 0.5) (moderately and severely undernourished residents) (severely undernourished residents)			Score red (cut-off ≥ 0.5)		
	Sample A SNAQ[RC] questions	B SNAQ[RC] questions	B SNAQ[RC] + BMI	Sample A SNAQ[RC] questions	B SNAQ[RC] questions	B SNAQ[RC] + BMI
Sensitivity	78% (66-88)	59% (55-63)	87% (84-89)	69% (48-86)	45% (41-49)	87% (84-89)
Specificity	56% (50-62)	64% (60-68)	64% (60-68)	83% (79-88)	87% (84-89)	82% (79-85)
Positive predictive value	30% (23-38)	52% (48-56)	61% (57-65)	28% (17-40)	50% (46-54)	59% (55-63)
Negative predictive value	91% (85-95	71% (68-74)	89% (87-91)	97% (93-99).	84% (81-87)	95% (93-96)

treatment of the patient. An orange score (question 3 or 4 or BMI 20-22) alerts the nursing staff and the nutritional assistant to pay extra attention to the food intake of these residents and monitor their intake and weight change extensively. A green light means: safe from nutritional point of view.

Two times orange equals red: the combinations of BMI 20-22 AND question 3 or 4 and question 3 AND 4 results in a red score and therefore consultation of a dietician.
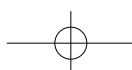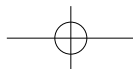
THE SNAQ^RC FOR RECOGNITION OF UNDERNUTRITION IN RESIDENTIAL CARE

Figure 1
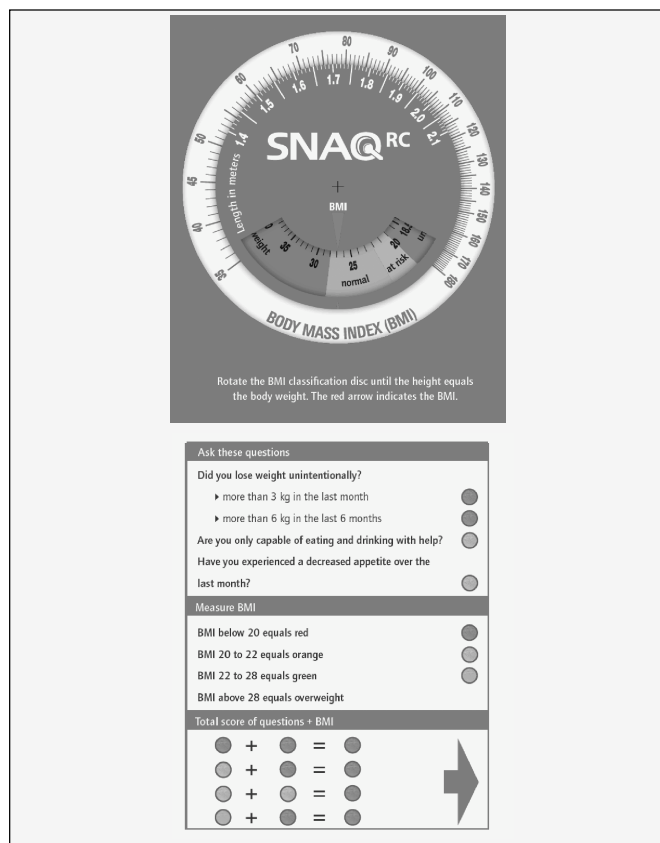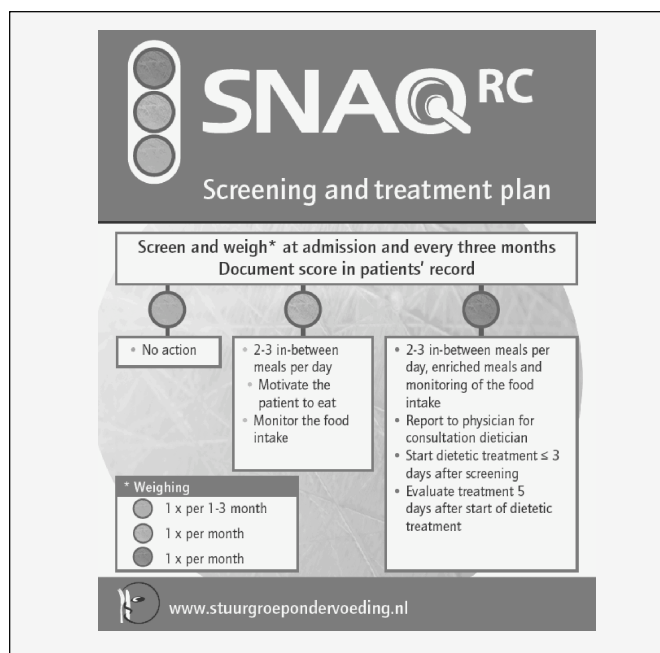SNAQRC as a traffic light system


Figure 2
The SNAQRC treatment plan

Discussion

The SNAQRC traffic light system appears to be an useful screening instrument for the early detection of undernutrition in a nursing and residential home setting. The SNAQRC traffic light system combines BMI with four questions related to involuntary weight loss, loss of appetite, and eating with help. The sensitivity and specificity to detect severely undernutrition is above 80%.

Screening on undernutrition without inclusion of the BMI appeared not possible with sufficient sensitivity. The sensitivity of the set of questions without BMI was fair to good in sample A but was clearly insufficient in sample B. Two factors may potentially have contributed to this result. In sample B, 67% of the residents had no unintentional weight loss in the past month or the past 6 months and were therefore not detected by the set of questions alone. Moreover, 61% of the residents in sample B had a BMI<20 kg/m² versus 37% in sample A. Inclusion of a BMI was necessary to detect these low BMI residents as malnourished. Secondly, in sample B the questions were filled out with the help of care workers. Even though the data of the weight loss were available in the patient record, answering these questions correctly appeared to be very difficult. 49 residents scored false positive and 32 residents scored false negative on question 1 (weight loss in the last month) and in question 2 (weight loss in the last 6 months) 28 residents scored false positive and 19 residents scored false negative. This illustrates the need for a quick and easy instrument in which no calculation is needed. Much effort has to be put in education of the care workers on this point. The sensitivity of the set of questions increased from 45% up to 53% when the variable of weight loss calculated by the care worker, was exchanged for measured weight loss.

Screening instruments for residents are the MNA (12), the MNA-SF (30), and the MUST (31). All screening instruments had low diagnostic accuracy values compared to the definition of undernutrition as defined in this study. The MNA identified more residents as undernourished (very low specificity) and the MUST identified fewer residents as undernourished (low sensitivity). Since sensitivity is the most important component of the diagnostic accuracy in this population MNA-SF is applicable. In our study sample A the specificity of the MNA-SF is lower than the specificity of the SNAQRC.

Undernutrition can be defined in different ways. Both weight loss and low BMI are generally accepted indicators of undernutrition. No consensus exists on the cut-off value of BMI for underweight for older persons. In literature, optimal BMI ranges from 17-28 kg/m². Residents with BMI values below 20 kg/m² are more at risk of functional limitations, have more complications, a longer stay in hospital and a higher mortality rate compared to residents with a BMI ≥ 20 kg/m² (21;23;29). For this reason we used the cut-off value of BMI 20 kg/m² for the severely undernourished group and BMI 22 kg/m² for the moderately undernourished group. Although we believe that the
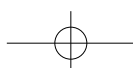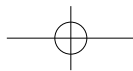
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used definition of undernutrition is clinically relevant for this population of older persons, there is a need for consensus and more empirical support for a definition of undernutrition in this age group and care setting. The number of patients whose weight 6 months and 1 month ago was not available in the patients record is not recorded. Another limitation of the current study is that no information is available on how many residents were excluded because they were not able to give informed consent or could not be weighed. This could have biased the results.

Adding BMI to a set of four simple questions seemed to make the screening instrument less quick and easy but more adequate. The development of a traffic light dial disk for the BMI calculation will improve the feasibility (figure 1). Woo et al (2005) describes that lower staff education levels were associated with an increased risk of undernutrition (32). Education of the care workers in the weighing and screening is essential. In order to prevent undernutrition, attention for the meal ambiance is also important. Is it known that the atmosphere of the social and physical environment during a meal, stimulate eating behavior of the residents (33).

With a weighing protocol, regular screening, the SNAQRC treatment plan (figure 2) and optimal meal ambiance, care workers should be able to respond to the needs of those undernourished residents. A orange or red SNAQRC score should be a signal for the care giver to activate the treatment plan.

Conclusion

Early detection of undernourished nursing- and residential home residents is only possible when simple screening questions are combined with measured BMI. The developed SNAQRC is a validated screening instrument to be used by nursing staff and other care providers.

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