

Relationships between nutrition screening checklists and the health and well-being of older Australian women

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Abstract

Objectives: To examine associations between nutrition screening checklists and the health of older women.

Design: Cross-sectional postal survey including measures of health and health service utilisation, as well as the Australian Nutrition Screening Initiative (ANSI), adapted from the Nutrition Screening Initiative (NSI).

Setting: Australia, 1996.

Subjects: In total, 12 939 women aged 70–75 years randomly selected as part of the Australian Longitudinal Study on Women's Health.

Results: Responses to individual items in the ANSI checklist, and ANSI and NSI scores, were associated with measures of health and health service utilisation. Women with high ANSI and NSI scores had poorer physical and mental health, higher health care utilisation and were less likely to be in the acceptable weight range. The performance of an unweighted score (TSI) was also examined and showed similar results. Whereas ANSI classified 30% of the women as 'high-risk', only 13% and 12% were classified as 'high-risk' by the NSI and TSI, respectively. However, for identifying women with body mass index outside the acceptable range, sensitivity, specificity and positive predictive values for all of these checklists were less than 60%.

Conclusions: Higher scores on both the ANSI and NSI are associated with poorer health. The simpler unweighted method of scoring the ANSI (TSI) showed better discrimination for the identification of 'at risk' women than the weighted ANSI method. The predictive value of individual items and the checklist scores need to be examined longitudinally.

Keywords
Nutrition assessment
Women's health
Elderly
Checklist
Health status indicators

Numerous studies have described links between malnutrition in older populations and increased levels of morbidity, and poor or delayed recovery from illness^{1–6}. However, it is difficult to define malnutrition precisely, and its prevalence among older people varies according to how it is defined and the population under investigation. In the United States, the United Kingdom and Australia, it has been estimated that up to 40% of over 60 year olds living independently in the community may be suffering from some degree of malnutrition^{6–8}. The prevalence is thought to be higher among the institutionalised⁹ and hospitalised elderly⁶. In recognition of the fact that good nutrition has major potential for improving longevity and quality of life among older people, nutritionists in the United States developed the Nutrition Screening Initiative (NSI).

The NSI is a three-level screening and diagnosis programme, whereby older persons living in the community, or their carers, complete a checklist to determine their requirements for further nutritional assessment. A moderate or high score on the checklist is meant to guide consumers to speak with their health provider who then performs the second-level screen which assesses height, weight and weight changes, and briefly reviews eating habits, functional and socio-economic status. The third level is diagnostic and involves anthropometric and biochemical assessment¹⁰.

The NSI checklist was developed from data provided by 749 participants in the New England Elders Dental Study, which included 14 items previously found to be associated with nutritional well-being of older people¹¹. Regression analysis was used to determine effect sizes for

Table 1 Australian Nutrition Screening Initiative (ANSI) and Nutrition Screening Initiative (NSI) items and their weights

Item number and question asked in survey		NSI item effect size for outcome criteria‡		Allocated weights for	
		Nutrition adequacy	Perceived health	NSI‡	ANSI§
ANSI questions (<i>n</i> = 12)		NSI questions (<i>n</i> = 10)			
1	I have an illness or condition that made me change the kind and/or amount of food I eat	Equivalent	-0.02	0.31*	2 2
2	I eat at least 3 meals a day	I eat fewer than 2 meals per day	0.52*	0.02	3 No = 3
3	I eat fruit or vegetables most days	I eat few fruits or vegetables, or milk products	0.40*	0.06	2 No = 2
4	I eat dairy products most days				
5	I have 3 or more glasses of beer, wine or spirits almost every day	Equivalent	0.07	0.16	2 3
6	I have 6 to 8 cups of fluids (e.g. water, juice, tea or coffee) most days	-	-	-	No = 1
7	I have teeth, mouth or swallowing problems which make it hard for me to eat	I have tooth or mouth problems that make it hard for me to eat	0.29	0.06	2 4
8	I always have enough money to buy food	I don't always have enough money to buy the food I need	0.72*	0.15	4 No = 3
9	I eat alone most of the time	Equivalent	0.19	-0.01	1 2
10	I take 3 or more different prescribed or over the counter medicines every day†	Equivalent	-0.17	0.35*	1 3
11a	Without wanting to, I have lost 5 kg in the last 6 months	Equivalent	-0.07	0.09	} 2 } 2
11b	Without wanting to, I have gained 5 kg in the last 6 months	Equivalent	0.11	0.26	
12	I am always able to shop, cook and/or feed myself	I am not always physically able to shop, cook and/or feed myself	0.16	0.15	2 No = 2

† Given score if answered three or more to the following question 'During the past 4 weeks, how many different types of medication have you used which were prescribed by a doctor?'

‡ Based on outcome criteria (*, $P < 0.01$) and expert panel discussion¹¹.

§ Adapted from the NSI checklist by an expert panel⁸.

the 14 items for two outcome criteria: three or more nutrients below 75% of Recommended Dietary Allowance (assessed by 24-hour dietary recall) and fair or poor perceived health. These effect sizes and the opinions of the NSI technical advisory panel were used to eliminate four items and to allocate weights to the remaining items. However, only half of the items used in the checklist were statistically significant predictors of either nutritional inadequacy or perceived health, and the weights given to items did not always correspond with the effect sizes. Despite this, the weights were summed to give a score, and an assessment of the sensitivity (the proportion of people with the condition correctly identified as having the condition), specificity (the proportion of people without the condition correctly identified as not having the condition) and positive predictive values (the proportion of people identified as having the condition who actually have the condition) of various cut-off points was made. A cut-off point of 6 was chosen to define high risk, and the sensitivity, specificity and positive predictive value using this cut-off point were 36%, 85% and 38% for dietary inadequacy and 46%, 85% and 56% for perceived health, respectively.

The NSI checklist has been criticised for poor test characteristics, retaining items that are not significantly associated with the outcomes of interest and using outcomes that are neither well-defined pathological states nor have proven treatments¹². Reuben *et al.* also question the use of a single 24-hour dietary recall for criterion

validity, as it assumes that stability in diet is much greater in older persons than has been demonstrated in the general population⁶. The value of the individual items versus the checklist score has also been debated. A longitudinal study of elderly persons in Boston found that some NSI checklist items (eating alone, problems biting or chewing, difficulties with shopping or cooking, and taking more than three medications) were stronger predictors of mortality than the total score¹³. Despite these limitations, the importance of pursuing the development of nutritional screens and linking malnutrition to subsequent health outcomes has been recognised⁶.

In 1996 an Australian version of the checklist, the Australian Nutrition Screening Initiative (ANSI), was adapted from the NSI checklist by an expert panel who modified the wording and weights of some NSI items to reflect the Australian situation⁸. The ANSI and NSI checklists consist of 12 and 10 items, respectively (Table 1). Five items are equivalent in the two instruments (ANSI items 1, 5, 9, 10 and 11). (After the initial testing phase, two items – having lost 5 kg or having gained 5 kg – were combined to form a single item in the NSI¹¹.) For the ANSI scale, one NSI item relating to fruit, vegetables and milk products was split into two (ANSI items 3 and 4), the number of meals eaten per day (ANSI item 2) was increased to three, and an item about the number of cups of fluid consumed per day was added (ANSI item 6). Two negative items in the NSI were changed to positive ones for the ANSI items (ANSI items 8 and 12).

The NSI and ANSI checklists are being used extensively across the United States and Australia respectively, but there have been no studies comparing the performance of these two scales. There is some concern that the checklists are being used alone for purposes of diagnosis, rather than as awareness tools or prompts for older people and their carers to seek further assessment. Two recent papers, which assessed the NSI as a screening tool, found it to be of limited value in this capacity^{13,14}. In Australia, two studies have reported a significant relationship between total ANSI checklist scores and perceived health in older people^{15,16}. However, in each of the community samples studied, the ANSI identified more than half of the participants as being at moderate or high risk of malnutrition¹⁷.

There have been no large, nationally representative studies in Australia to assess eating habits and risk of malnutrition using the ANSI checklist. Neither has the usefulness of the ANSI checklist score, compared with its individual items, been investigated. This paper presents ANSI checklist data for older women (70–75 years) who participated in the baseline survey of the Australian Longitudinal Study on Women's Health (ALSWH) in 1996. It examines the relationships between individual items and various health outcomes (including perceived physical and mental health and health care utilisation) and presents an unweighted method for scoring the ANSI checklist.

Methods

Study sample

The sample for this study comprised 12 939 women aged 70–75 years (the older cohort of the Australian Longitudinal Study on Women's Health¹⁸). Baseline surveys were conducted in 1996, with follow up in 1999. Participants were randomly selected from women registered on the national Medicare database, which includes almost all people who are resident in Australia, including migrants and refugees. Women living in rural and remote areas were over-sampled. Allowing for inaccuracies in the Medicare database, it has been estimated that 37–40% of the older women chose to participate in the study¹⁹. Contact by telephone to encourage participation was not possible because the identities of the selected women remained confidential until they consented to participate. The response rate compares favourably with previous studies that depended solely on postal recruitment, and the respondents in the older cohort have been shown to be broadly representative of the national population of women aged 70–75 years, with some over-representation of married women¹⁹.

Questionnaire and measures

The baseline survey of the ALSWH contained items relating to the main themes of the study, including

general health and well-being; health service utilisation; smoking and alcohol; weight, exercise and eating; time use and social support. The self-completed postal survey also contained demographic information such as country of birth, marital status, education and living arrangements.

The MOS Short Form Health Survey (SF-36) was included to measure perceived general health and well-being²⁰. The SF-36 contains 36 items that are scored as eight multi-item scales and two overall summary scores: the Physical Component Summary score (PCS) and the Mental Component Summary score (MCS). The summary scores are compared with norms for the reference population, such that the population average is set at 50²¹. Thus for PCS and MCS scores, a score below 50 indicates worse physical or mental health, while a score above 50 indicates better health than the reference population. PCS and MCS are standardised and exhibit normal distributions.

Another measure of health, the number of chronic conditions, was defined by summing positive responses to the questions 'Have you ever been told by a doctor that you have': diabetes, heart disease, hypertension, stroke, thrombosis, asthma, bronchitis/emphysema, osteoporosis or breast, cervical, lung, bowel or skin cancer. The women also recorded the number of times they had consulted a general practitioner, and whether they had been admitted to hospital, in the last year.

Body mass index (BMI) was calculated from height and weight. BMI ranges representing *underweight* (<20 kg m⁻²), *acceptable weight* (20–24.9 kg m⁻²) and *overweight* (25 kg m⁻² or more) were based on the Australian National Health and Medical Research Council guidelines²².

The baseline survey contained items from which both the NSI and ANSI scores could be estimated. The ANSI items were used with their exact wording except for the item relating to number of medications taken every day. This was estimated from the answer to the question 'During the past 4 weeks, how many different types of medication have you used which were prescribed by a doctor?' Use of three or more medications was taken as a positive response. Also, having lost or gained weight (item 11) was asked as two separate items, in order to examine the magnitude and direction of their effects in bivariate analyses, although the items were combined in the calculation of the checklist scores.

The individual items and weights used to calculate the ANSI and NSI scores, as defined during their development, are shown in Table 1. Cut-off scores for low, moderate and high nutritional risk were 0–3, 4–5 and 6 or more for ANSI⁸ and 0–2, 3–5 and 6 or more for NSI¹¹. To explore and evaluate a simpler approach to calculating a risk score, the unweighted ANSI items were also summed to calculate a total summed item score (TSI) (possible range 0 to 12). Ninety-six per cent of the TSI scores were between 0 and 4, so an upper limit was set at 4 or more.

ANSI, NSI and TSI scores were set to missing if the answers to more than two items were missing.

Statistical analysis

To correct for over-sampling of women from rural and remote areas, all responses were weighted for area so that the study population was representative of the Australian population for women of this age group.

With large sample sizes, small differences in means are often statistically significant, although these differences may not be clinically significant. Although no definitive guidelines for clinical significance exist as yet, normative data from the 1995 Australian National Health Survey show that the presence of one serious physical condition (e.g. cancer, heart disease, diabetes, hypertension, asthma, arthritis) results in decreases of physical and mental component scores of 3.3 and 2.1, respectively²³.

Means were calculated using the MEANS procedure in SAS and the FREQ procedure was used to calculate weighted percentages²⁴.

Sensitivity, specificity and positive predictive value were calculated for the moderate- and high-risk cut-off points for the ANSI, NSI and TSI scores. There is no gold standard for defining malnutrition in an epidemiological setting, so greater than six general practitioner visits and self-reported BMI outside the acceptable range (20–24.9 kg m⁻²) were used as surrogate measures of malnutrition.

Results

The demographic and health characteristics of the women have been reported elsewhere¹⁹. Briefly, the majority (73%) of the women were Australian born, more than half (55%) were married and one-third were widowed. Thirty-five per cent of the women lived alone and, of these, three-quarters were widowed. While 34% had no formal educational qualifications, 51% had completed secondary school and the remainder had post-school qualifications.

Thirty-two per cent of the women made more than six visits to a general practitioner in the previous year and 28% felt their health was only fair or poor. Twenty-four per cent of the women reported having two or more chronic conditions, and 23% had been admitted to hospital in the previous year. Fewer than half the women were in the healthy weight range, with 9% underweight and 47% overweight.

The frequency of responses to each of the ANSI items is shown in Table 2. Almost half the women took three or more prescribed medications, more than one-third ate alone most of the time and more than a quarter had changed their diet because of an illness. The NSI and the ANSI identified approximately half of the women to be at low nutritional risk. Using a TSI score of 0 or 1, 46% of women were identified as 'low-risk'. However, ANSI defined 30% of the women to be at high nutritional risk,

Table 2 Prevalence for individual ANSI items, estimated checklist scores for ANSI and NSI, and TSI (sum of unweighted items)

Item	Prevalence* (%)
Changed diet due to illness	27
Do not eat at least 3 meals a day	8
Do not eat fruit or vegetables most days	3
Do not eat dairy products most days	13
Have 3 or more alcoholic drinks a day	6
Do not have 6 to 8 cups of fluid most days	11
Have teeth, mouth, swallowing problems	8
Do not have enough money to buy food	4
Eat alone most of the time	39
Take 3 or more prescribed medications	45
Lost 5 kg without wanting to	6
Gained 5 kg without wanting to	10
Not always able to shop, cook, feed myself	6
ANSI score (range 0–29)	
0–3 Low risk	48
4–5 Moderate risk	23
≥6 High risk	30
NSI score (range 0–21)	
0–2 Low risk	54
3–5 Moderate risk	33
≥6 High risk	13
TSI score (range 0–12)	
0 No items } 'Low' risk	17
1 One item } 'Low' risk	29
2 Two items } 'Moderate' risk	26
3 Three items } 'Moderate' risk	16
≥4 Four or more items 'High' risk	12

* Weighted to allow for over-sampling of women living in rural and remote areas.

compared with 13% using NSI and 12% using a cut-off of 4 or more for high TSI. Eighty-nine per cent of women with high TSI were also in the high NSI group. In comparison, approximately 40% of women in the high ANSI group were in the high NSI and TSI groups. For 2.4% of women, checklist scores were not calculated due to missing data.

The most common checklist items for women with 'high-risk' ANSI, NSI and TSI scores were: taking three or more medications (71–80%); changing their diet due to illness (54–66%); and eating alone (55–66%).

The SF-36 physical and mental health component scores for women who answered 'yes' and 'no' to each ANSI item are shown in Table 3. Five of the items were associated with both poorer physical and mental health: change of diet due to illness; teeth, mouth or swallowing problems; taking three or more medications; losing 5 kg without wanting to; and the inability to shop, cook or feed herself. Women reporting any of these items were also more likely to have more than two chronic conditions and to use health services more often (more than six visits to a general practitioner and admission to hospital in the previous year) (data not shown). Mean mental health component scores were at least 2.1 points lower for women who ate less than three meals a day, who did not eat fruit or vegetables or dairy products most days and who did not have enough money to buy food. Three items were not associated with differences in physical or mental component scores: three or more alcoholic drinks per day; fewer than six to eight cups of

Table 3 Mean SF-36 physical health component score (PCS) and mental health component score (MCS) for individual ANSI items†

ANSI item	Mean PCS		Mean MCS	
	Risk‡	No risk	Risk‡	No risk
Changed diet due to illness	46.2*	51.5	48.4*	50.9
Do not eat at least 3 meals a day	48.9	50.1	47.2*	50.4
Do not eat fruit or vegetables most days	48.0	50.1	44.8*	50.3
Do not eat dairy products most days	49.2	50.1	48.4*	50.5
Have 3 or more alcoholic drinks a day	51.4	49.9	49.7	50.2
Do not have 6 to 8 cups of fluid most days	49.6	50.1	48.6	50.4
Have teeth, mouth, swallowing problems	44.4*	50.5	45.6*	50.6
Do not have enough money to buy food	48.3	50.1	47.5*	50.3
Eat alone most of the time	50.0	50.0	49.5	50.6
Take 3 or more prescribed medications	45.6*	53.6	48.7*	51.4
Lost or gained 5 kg without wanting to	46.0*	50.7	47.2*	50.7
Lost 5 kg without wanting to	44.6*	50.3	44.8*	50.6
Gained 5 kg without wanting to	46.9*	50.4	48.6	50.5
Not always able to shop, cook, feed myself	41.3*	50.5	43.7*	50.5

* Means for risk versus no risk likely to be clinically significantly different²³.
 † Weighted to allow for over-sampling of women living in rural and remote areas.
 ‡ Risk = answered 'yes' to this item.

fluid; and eating alone most of the time. Women who reported involuntary weight gain of 5 kg, taking three or more medications, being unable to shop, cook or feed themselves or not eating fruit or vegetables most days were more likely to be overweight (data not shown). Women who had lost 5 kg involuntarily were more likely to be underweight.

There were decreases in mean physical and mental health component scores, increases in number of chronic conditions and health service utilisation with each extra checklist item reported (data not shown). Women identified as at high risk by NSI had similar physical and mental health component scores and reported similar rates of underweight and other health outcomes to women with high TSI. All health measures deteriorated as ANSI, NSI and TSI scores increased. However, the women in the high NSI and TSI groups appeared to have worse health than those in the high ANSI group (Table 4).

Sensitivities were poor for the high cut-off point on all checklists. The sensitivities were better when moderate

cut-off points were used. However, the positive predictive values were worse, particularly for GP visits (Table 5).

Discussion

Several studies, each with relatively small samples, have documented the prevalence of the individual ANSI or NSI items in community dwelling men and women in Australia^{15,16} and elsewhere^{11,13,14}. Data from the Australian Longitudinal Study on Women's Health provided an opportunity to investigate these items in a large, nationally representative sample of women aged 70–75 years. In this community sample of 12 939 women, the most common responses to these checklist items were taking three or more medications per day, eating alone most of the time and change of diet due to illness. These results are consistent with those found in other studies. In contrast, this and other Australian studies have demonstrated that eating few fruit, vegetables or milk products is far less common in Australia than elsewhere^{11,13–16}.

Table 4 Mean physical and mental health component scores (PCS and MCS), chronic conditions, health service utilisation and weight by categories of nutrition score for ANSI, NSI and TSI†

	PCS (mean)	MCS (mean)	>6 general practitioner visits (%)	>2 chronic conditions (%)	Admitted to hospital (%)	Underweight (BMI < 20 kg m ⁻²) (%)	Overweight (BMI ≥ 25 kg m ⁻²) (%)
ANSI risk score (range 0–29)							
0–3 Low (n = 6186)	53.2	52.2	18	14	16	8	43
4–5 Moderate (n = 2818)	48.8	50.0	37	27	25	7	50
≥6 High (n = 3626)	45.7	47.0	51	39	33	10	50
NSI risk score (range 0–21)							
0–2 Low (n = 7028)	52.5	51.9	21	16	17	8	44
3–5 Moderate (n = 4078)	47.8	49.1	42	33	27	8	50
≥6 High (n = 1558)	44.9	45.4	51	39	38	11	48
TSI risk score (range 0–12)							
0–1 Low (n = 6079)	53.2	52.2	18	14	16	8	43
2–3 Moderate (n = 5189)	48.0	49.4	41	31	26	8	50
≥4 High (n = 1362)	44.2	44.9	55	44	41	12	49

† Weighted to allow for over-sampling of women living in rural and remote areas.

Table 5 Diagnostic statistics for medium and high cut-off points for ANSI, NSI and TSI†

	>6 general practitioner visits (%)		BMI <20 kg m ⁻² or ≥25 kg m ⁻² (%)	
	Moderate cut-off point	High cut-off point	Moderate cut-off point	High cut-off point
ANSI				
Sensitivity	73	47	56	32
Specificity	58	79	52	74
Positive predictive value	45	51	59	60
NSI				
Sensitivity	64	21	48	14
Specificity	63	91	58	88
Positive predictive value	45	51	59	59
TSI				
Sensitivity	74	20	56	12
Specificity	57	92	51	90
Positive predictive value	44	55	59	61

† Weighted to allow for over-sampling of women living in rural and remote areas.

Differences in the wording of, and/or estimation of positive responses to, some ANSI and NSI items make comparison with previous studies difficult. Firstly, Sahyoun *et al.*¹³ and de Groot *et al.*¹⁴ estimated fruit, vegetable and milk consumption from food frequency data. Secondly, the item about number of meals eaten per day scores a positive response in ANSI if less than three meals are eaten and in NSI if less than two meals are eaten. Thirdly, in the present study, women were asked how many medications they had taken in the last four weeks rather than the number taken per day. Despite this, the prevalence of these last two items was similar in all studies.

Few studies have examined the relationship between individual items in these scales and health. In this study, five items were found to be strongly related to perceived general health and well-being, number of chronic conditions and health care utilisation. These were: the woman's inability to shop, cook or feed herself; having teeth, mouth or swallowing problems; taking three or more medications per day; change of diet due to illness; and involuntary change in weight. Sahyoun *et al.* also found the first three of these items, as well as eating meals alone, to be positively associated with mortality and to have better predictive value than the overall NSI score for men and women¹³. In Posner *et al.*'s analysis, taking three or more medications and change of diet were the best predictors of perceived health. This study may not, however, have had the power to detect the importance of other items and the measure of health was based on a single question¹¹. It appears that the real value of the checklist as a predictive tool may lie with the individual items.

In this sample of women, three of the items – eating alone; alcohol consumption; and fluid consumption – did not appear to be related to physical or mental health, suggesting that these items may be redundant for women. However, since men are more likely to have three or more

alcoholic drinks a day and less likely to eat alone^{11,13,15,16}, these items may have more relevance in studies that include men.

Involuntarily losing 5 kg is associated with worse perceived physical and mental health, more than two chronic conditions and higher health care utilisation. As the effects of involuntary weight loss and weight gain differ, this study has demonstrated the value of monitoring the magnitude and direction of weight change.

In this study, the recommended cut-off points of 6 for NSI and ANSI scores identified 13% and 30% of women to be at high nutritional risk, respectively, which would suggest that the changes made to the NSI weightings for the ANSI may be inappropriate. The NSI and ANSI were originally established to increase public awareness of the importance of nutrition in the elderly, but the high proportion of the elderly defined as being 'at risk' by the ANSI is a cause for concern. It may result in unnecessary stress for elderly people and place excess burden on the health care system through self-referrals. The unweighted TSI score offers a simpler way to score the ANSI checklist, and a score of 4 or more identifies the majority of the women in the high NSI group.

Based on values for sensitivity, specificity and positive predictive values, none of these checklists is particularly good at identifying malnutrition in this cross-sectional study. At least 40% of women would be falsely identified as being at risk of malnutrition. However, the ANSI and NSI are widely used. The longitudinal nature of the present study will allow the value of the continued use of these checklists to be studied.

In the interim, these cross-sectional results show that women in the high-risk groups for ANSI, NSI and TSI were more likely to have poorer levels of physical and mental health and higher health service utilisation. Whether this is due to nutrition or their underlying medical conditions is not clear. Further, whether women in poor health are more at risk of malnutrition or whether

poor nutrition leads to a decline in health is also unclear. These relationships can only be determined by longitudinal studies that include a measure of nutrition.

No studies have demonstrated that nutrition risk screening and intervention lead to better health outcomes⁶. While the ALSWH currently has no nutritional data, an advantage of the study is that the predictive value of the checklist items, as well as of the ANSI, NSI and TSI scores, can be examined in terms of health-related quality of life, general practitioner visits, hospitalisation and mortality. Hence the value of continuing the widespread use of nutrition screening checklists in the community, and the potential impact of interventions targeted to high-risk groups, can be assessed.

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