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Critical review of nutrition assessment tools to measure malnutrition in chronic kidney disease

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A critical review of nutrition assessment tools to measure malnutrition in chronic kidney disease

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| | |



Review

Introduction

In chronic kidney disease (CKD), uraemic symptoms and the presence of inflammation can contribute to poor dietary intake and an increase in metabolic stress¹. Collectively, this leads to a reduction in body protein synthesis, hence a decline in nutritional status, herein termed malnutrition². Malnutrition in CKD is an independent predictor of morbidity and mortality^{3, 4}.

Malnutrition remains a critical risk factor for poor outcome in CKD⁵ despite the increasing BMI of the Australian population⁶. Prospective data suggests a high BMI may be predictive of reduced morbidity and mortality compared to a lower BMI in haemodialysis populations⁷. Recent evidence indicates weight loss and reduction in appetite are key precipitating factors for malnutrition and independent predictors of poor outcome for CKD patients^{8,9}. Therefore, despite the increase in overweight and obesity in the population, there is sufficient evidence supporting the need for a consistent method of nutrition assessment to capture symptoms leading to unintentional weight loss, wasting, and the diagnosis of malnutrition.

Assessment of malnutrition is an important component of dietetic practice and improves the dietitians ability to prioritise intervention to those most at risk. A clinically useful marker should be able to identify malnutrition, assess the resulting risk of morbidity and mortality and also evaluate the response to nutrition intervention¹⁰. Interpretation of methods to assess nutrition status in CKD including anthropometric (e.g. weight change, skin-fold assessments) and biochemical (e.g. serum albumin) can have limitations due to the nature of CKD¹⁰. For example, weight change may be due to fluid shifts and hypoalbuminemia due to acute inflammation therefore, may not be true markers of nutrition status. Therefore current evidence-based practice guidelines for nutrition management in CKD guidelines recommend use of a panel of parameters in clinical practice, including the clinical tool, Subjective Global Assessment (SGA)¹¹⁻¹³.

SGA provides a comprehensive appraisal of nutrition status considering a medical and physical assessment (combining parameters of weight change, dietary intake, symptoms of gastro-intestinal distress and a physical examination) and classify's nutrition status as well-

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3 nourished (A), mild to moderately malnourished (B), or severely malnourished (C)¹⁴.
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5 Therefore, SGA is recommended to assist in determining who to target for nutrition support,
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7 as it represents quick, cost-effective, multi-disciplinary assessment, not influenced by the
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9 metabolic anomalies of CKD¹⁵.
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13 The prevalence of malnutrition in CKD as assessed by SGA has remained consistent over
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15 past 20 years. Since SGA was first introduced in CKD in 1987, international prevalence of
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17 malnutrition ranges around 30-40% (Table 1) and studies conducted over the last 5 years in
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19 Australia indicate a rate from 20 to 48%¹⁶⁻²⁰.
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23 Rating nutrition status on three broad categories has brought recent criticism of SGA's ability
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25 to measure the degree of malnutrition²⁰ and identify small, yet clinically significant changes in
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27 nutrition status²¹. A number of modified and/or scored SGA-based assessment tools have
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29 appeared in the CKD literature, creating confusion about which is the most appropriate tool to
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31 use (Table 2)¹⁵.
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35 Given the number of SGA-based tools available for use in CKD, it is critical to evaluate their
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37 validity and reliability¹⁵, to build an evidence base and promote consistency in nutrition
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39 assessment in clinical practice. There are a number of types of validity and reliability outlined
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41 in Table 3. The strength and applicability of validation studies depends on the study design,
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43 sample selection, administration and reference parameters or outcome measures used²².
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47 This review aims to critically evaluate studies investigating the SGA and associated tools to
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49 provide insight into informing best practice and consistency in methods used for nutrition
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51 assessment in CKD.
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53 54 **Methods**

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56 A literature search was conducted to answer the research question: 'What SGA-based tools
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58 were available to assess the nutrition status of CKD patients?' The articles were then
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3 evaluated to answer, 'To what extent has this particular tool been tested for validity/reliability
4 in CKD patients?' The review will include nutrition assessment at all stages of CKD.
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9 **Inclusion Criteria:** Articles introducing, validating or assessing the feasibility of a SGA-
10 based assessment tool in CKD, where screening or assessment tools were completed by
11 dietitian, nurse or trained physician were included. Particular emphasis was placed on
12 articles where the assessment method is measured against a reference standard or
13 evaluated against clinical follow-up. Original research articles not fulfilling the criteria of a
14 validation study were only evaluated for prevalence of malnutrition (Table 1).
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22 **Search Strategy:** Cochrane, MEDLINE and CINAHL databases using the MeSH terms
23 "Nutrition assessment", "Malnutrition" and "Chronic Kidney Disease" OR "Kidney Failure". In
24 addition the subject "Subjective Global Assessment" or "SGA" was used in combination with
25 the MeSH terms. Limits of "Valid*"; "Reliab*" used where necessary.
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33 **Evaluation of Methodological Quality:** Each study was assessed for quality using criteria
34 guided by Quality Assessment of Diagnostic Accuracy Studies tool (QUADAS)²³ and Jones
35 (2004)²⁴. The studies were evaluated against the NHMRC draft levels of evidence (Table 3)²⁵.
36 Tools are assigned a level of diagnostic evidence depending on the study design and
37 reference standards for clinical and/or criterion validity. Tools indicating predictive validity are
38 assigned level II prognostic evidence if the tool had displayed sufficient diagnostic evidence
39 (Table 3).
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50 **Results**

51 In the CKD literature, at least eight different SGA-based tools were evident^{11, 18, 21, 26-30}. Table
52 4 is a summary of the SGA-derived tools, validity, reliability, design comments and NHMRC
53 levels of evidence for the tools featured in this article. Reference standards are used to test
54 clinical, predictive and criterion validity^{18-21, 26, 28, 31-34} and multiple raters and internal
55 consistency checks to investigate reliability^{18, 20, 27}.
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Validity

Original SGA: The original SGA was first investigated in a validation study in haemodialysis (HD) and peritoneal dialysis (PD) patients in 1993²⁶, where SGA appeared to display clinical validity with albumin, bioimpedance (BIA) phase angle, mid arm muscle circumference (MAMC), percent body fat (%BF) and normalised protein catabolic rate (nPCR) with multiple regression analysis confirming the strong relationship between SGA and the combined objective measures (multiple $r = 0.77$). Lawson et al (1999), in a 12-month follow-up study further investigated the predictive validity of the SGA in HD patients, determining SGA B or C rating results in significantly increased mortality, likelihood of acute hospitalisation, and depleted FFM (as measured by BIA)¹⁹.

In an investigation by Cooper *et al* (2000), Nitrogen Index (measured total body nitrogen compared to sex- age- height matched general population), was significantly lower in patients rated SGA B and C compared to A²⁰. However, when criterion validity was assessed using <85% of expected Nitrogen Index (NI) as a gold-standard for malnutrition, SGA could not confidently differentiate between well-nourished, malnourished and degree of malnutrition (B and C)²⁰. According to this criterion, 29% of the subjects were malnourished (NI <85% of predicted), compared to >40% by the SGA²⁰. However, as malnutrition is a progressive wasting disease, there is a risk with using cross-sectional body composition measures to “diagnose” malnutrition. Significant wasting by an overweight patient (BMI > 25kg/m²), and/or moderate weight loss with significant uraemic symptoms, anorexia and lethargy contributing to a legitimate SGA B rating, is unlikely to register under the reference cut-off of a low NI (i.e. <85% of predicted).

Retrospective modified-SGA: Pifer *et al* (1999) reported the mSGA predicted 25% increased mortality for SGA C, compared to SGA A and B at 6 months³¹. In this study, there was a greater proportion of “severely malnourished” (11%) than “moderately malnourished” (7%)³¹ patients.

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3 **7-point SGA:** The introduction of the 7-point SGA, revealed predictive validity for 12-month
4 survival, indicating a reduction in one category of the 7-point scale equating to a 25%
5 increased relative risk of death³³ determined by Cox proportional hazard model. In a more
6 recent paper, Jones *et al* (2004) investigated the criterion validity of both the original SGA,
7 and the 7-point SGA by a “composite nutrition score” (higher score, lower nutrition status;
8 derived from parameters including BMI, albumin and anthropometry)³². The mean difference
9 in composite scores of SGA A vs. B and each of the categories 3 to 7 was statistically
10 significant (using correlation analysis), however, both tools had considerable overlap of
11 composite scores between categories, particularly for 7-point SGA³³.
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23 **Scored-SGA:** In its initial investigation, the Dialysis Malnutrition Score (DMS) significantly
24 correlated with a number of nutrition-related biochemical parameters²¹. In a 12-month
25 prospective study, the DMS was included in an investigation of the Malnutrition Inflammation
26 Score (MIS) and SGA and were compared with a range of biochemical indices and
27 morbidity/mortality outcomes. The MIS correlated the most significantly with 12-month
28 survival and hospitalisation, creatinine level, hematocrit, and CRP, which is not surprising
29 considering it contains biochemical parameters related to iron and inflammatory status (TIBC,
30 Alb)²⁸. A more recent paper of 378 HD subjects with a similar study design confirmed the
31 predictive validity of MIS >8 to predict poor clinical outcome (mortality and hospitalisation)³⁴.
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43 The Patient-Generated SGA (PG-SGA), previously validated in oncology patients, was
44 published in HD by Desbrow *et al* (2005)¹⁸ investigating criterion and clinical validity. Criterion
45 validity, using the original SGA as the gold-standard, was demonstrated by a significant
46 difference in PG-SGA scores between well-nourished (A, median (range) = 2 (0-13) and
47 malnourished (B, median score = 16(7-26))¹⁸. Clinical validity to serum albumin was
48 demonstrated by a significant correlation with the PG-SGA score (Table 4).
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56 **Reliability**

57 The initial reliability study for the original SGA in surgical patients revealed good inter-rater
58 reliability (kappa = 0.78)¹⁴. In CKD, agreements between the ratings of the SGA categories
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3 appear to be not as sensitive. Cooper *et al* (2002) attained fair agreement between a
4 physician and dietitian (weighted kappa = 0.60)²⁰. Visser *et al* (1999) investigated the
5 reliability of the 7-point SGA administered by nursing staff on a small number of dialysis
6 patients indicating fair inter-rater reliability (ICC=0.72)²⁷ (Table 4). Of the scored tools, the
7 DMS, inter-rater reliability was good, with a kappa of 0.83 investigated on approximately 30%
8 of the sample²¹. Satisfactory internal reliability of the PG-SGA components was determined
9 by α -Cronbach coefficient of 0.73¹⁸.
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19 Discussion

20 SGA is a core assessment tool evidenced by the volume of studies utilising SGA.
21 Modifications of the SGA present in the CKD literature include tools that expand the scale of
22 the SGA to a larger number of categories (4-point³⁰, 7-point³³), allow retrospective
23 assessment³¹, provide a continuous score for components of the SGA^{18, 21} and incorporate
24 objective measures²⁸. SGA along with modified versions have shown clinical and/or
25 predictive validity in CKD for both dialysis and non-dialysis populations^{4, 19, 28, 33-35}.
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35 When considering which tool is best to apply, it is important to consider the purpose of the
36 nutrition assessment. Tools displaying diagnostic evidence indicate the ability to distinguish
37 between other known measures of nutrition status, by clinical and/or criterion validity.
38 Prognostic evidence refers to the ability of the tool to predict negative outcomes, such as
39 morbidity and mortality, achieved via predictive validity (Table 3 and 4).
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48 **Presence of malnutrition:** As a prognostic and diagnostic tool, SGA has level II and III-1
49 evidence, respectively. Merging the SGA groups representing "malnourished" (B & C, or <5
50 on 7-point or >2 on 4 point scales) appears adequate for clinical and predictive validity, with
51 reasonable reliability (Table 4). Using the scored tools, an MIS >8 appears to predict greater
52 morbidity and mortality over 12 months³⁴, and PG score >9 has good reliability with SGA B
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3 By definition, the SGA in its original and modified categorical form (ABC, 4 or 7-point) rank
4 nutrition status on an ordinal scale. This means the rating is given relative to the distribution
5 of nutrition status and cannot be assigned a number on a scale, as nutrition status may not be
6 of equal value across the rating spectrum. In all studies, the 7-point SGA, has been treated
7 as an *interval* or *continuous* score^{27, 32, 33, 35} (Table 4). Therefore, relative validity and
8 reliability results are based on the assumption that the 7-point scale of the SGA is directly
9 linear (interval), which is debateable. Jones *et al* (2004) investigated the criterion validity of 7-
10 point SGA against a composite nutrition score, containing a variety of measures, including the
11 original SGA³². Although statistically there appeared to be agreement, the composite score
12 distribution between the 7 categories had a large overlap, and non-systematic distribution of
13 scores, particularly over ratings 4 to 6 (representing the spectrum of moderate malnutrition)
14 therefore the 7-point SGA did not appear linear with this score as the measure of nutrition
15 status.
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31 **Monitoring nutrition status over time** It appears tools providing a continuous score, such
32 as the PG-SGA, DMS and MIS have added merit for use in the clinical setting to monitor
33 small changes in nutrition status over time, all appear to have clinical validity to key nutrition-
34 related variables, and reach Level III-2 evidence^{18, 21}. The MIS shows promise as a potential
35 predictor of outcome and indicate the degree of Malnutrition Inflammation Cachexia
36 Syndrome³⁴. Similarly, small changes in PG-SGA score has previously reflected important
37 clinical changes, such as quality of life in oncology³⁶ and length of hospitalisation for general
38 medical patients³⁷. The recent study in HD patients indicates the scored PG-SGA may have
39 similar merit for use in CKD as it has for oncology patients¹⁸. Tools that monitor nutrition
40 status on a continuous scale are also beneficial in research, with less reliance on subjectivity,
41 and provide greater statistical power than a categorical rating of nutrition status (Table 1).
42 However, the linearity of these scored tools has yet to be confirmed, and may have similar
43 issues as stated for the 7-point SGA.
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Conclusion

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3 SGA (A vs. B & C) is a valid method for assessing the presence of malnutrition for diagnostic
4 and prognostic purposes. Continuous scores may improve the clinician's ability to assess
5 small changes in nutrition status, as an ideal nutritional marker should reliably measure
6 change in nutrition status, not just predict clinically important outcomes. In combination,
7 these tools can provide a comprehensive assessment for both clinical and research settings.
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15 **Recommendations for future research:** Future validation studies need to focus on how
16 change in nutrition status can be adequately measured. Longitudinal assessments of
17 nutrition status are necessary to determine most appropriate tool for use in CKD to measure
18 nutrition status prospectively.
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25 References

- 26 1. Pupim LB, Ikizler TA: Assessment and monitoring of uremic malnutrition: *J Ren Nutr*
27 2004 **14**(1):6-19.
- 28 2. Pupim LB, Cuppari L: Malnutrition in end-stage renal disease: beyond inadequate
29 nutrient intake: *Nephrol News Issues* 2003 **17**(7):66-71.
- 30 3. Lowrie EG, Lew NL: Death risk in hemodialysis patients: the predictive value of
31 commonly measured variables and an evaluation of death rate differences between facilities:
32 *Am J Kidney Dis* 1990 **15**(5):458-482.
- 33 4. Stenvinkel P, Barany P, Chung SH, et al.: A comparative analysis of nutritional
34 parameters as predictors of outcome in male and female ESRD patients: *Nephrol Dial*
35 *Transplant* 2002 **17**(7):1266-1274.
- 36 5. Pupim LB, Caglar K, Hakim RM, et al.: Uremic malnutrition is a predictor of death
37 independent of inflammatory status: *Kidney Int* 2004 **66**(5):2054-2060.
- 38 6. Thorburn AW: Prevalence of obesity in Australia: *Obes Rev* 2005 **6**(3):187-189.
- 39 7. Kalantar-Zadeh K, Abbott KC, Salahudeen AK, et al.: Survival advantages of obesity
40 in dialysis patients: *Am J Clin Nutr* 2005 **81**(3):543-554.
- 41 8. Burrowes JD, Larive B, Chertow GM, et al.: Self-reported appetite, hospitalization and
42 death in haemodialysis patients: findings from the Hemodialysis (HEMO) Study: *Nephrol Dial*
43 *Transplant* 2005 **20**(12):2765-74.
44
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3 9. de Mutsert R, Boeschoten EW, Krediet RT, et al. Weight loss increases all-cause
4 mortality in hemodialysis patients. In: *XIII ICNMRD*; 2006; Merida, Mexico; 2006.
- 5
6
7 10. Jeejeebhoy KN: Nutritional assessment: *Nutrition* 2000 **16**:585-590.
- 8
9 11. K/DOQI: Clinical practice guideline for nutrition in chronic renal failure: *Am J Kidney*
10 *Dis* 2000 **39**(supp 2):s1-s140.
- 11
12 12. Ash S, Campbell KL, MacLaughlin H, et al.: Evidence Based Practice Guidelines for
13 Nutritional Management of Chronic Kidney Disease: *Nutr Diet* 2006 **In press**
- 14
15 13. McCann L: Using subjective global assessment to identify malnutrition in the ESRD
16 patient: *Nephrol News Issues* 1999 **13**(2):18-19.
- 17
18 14. Detsky AS, McLaughlin JR, Baker JP, et al.: What is subjective global assessment of
19 nutritional status?: *J Parenter Enteral Nutr* 1987 **11**(1):8-13.
- 20
21 15. Steiber AL, Kalantar-Zadeh K, Secker D, et al.: Subjective Global Assessment in
22 chronic kidney disease: A review: *J Ren Nutr* 2004 **14**(4):191-200.
- 23
24 16. Ash S, Campbell KL, Healy H, et al.: Are we measuring the right outcomes for
25 indicators of improved nutrition status in those receiving renal replacement therapy?: *Nutr*
26 *Diet* 2006 **63**(Suppl 1):A2.
- 27
28 17. Campbell KL, Ash S, Bauer J, et al.: Rating methods of subjective global assessment
29 in chronic kidney disease: *Nutr Diet* 2006 **63**(Suppl 1):A28.
- 30
31 18. Desbrow B, Bauer J, Blum C, et al.: Assessment of nutritional status in hemodialysis
32 patients using patient-generated subjective global assessment: *J Ren Nutr* 2005 **15**(2):211-
33 216.
- 34
35 19. Lawson JA, Lazarus R, Kelly JJ: Prevalence and prognostic significance of
36 malnutrition in chronic renal insufficiency: *J Ren Nutr* 2001 **11**(1):16-22.
- 37
38 20. Cooper BA, Bartlett LH, Aslani A, et al.: Validity of subjective global assessment as a
39 nutritional marker in end-stage renal disease: *Am J Kidney Dis* 2002 **40**(1):126-32.
- 40
41 21. Kalantar-Zadeh K, Kleiner M, Dunne E, et al.: A modified quantitative subjective
42 global assessment of nutrition for dialysis patients: *Nephrol Dial Transplant* 1999 **14**(7):1732-
43 8.
- 44
45 22. Jones JM: The methodology of nutritional screening and assessment tools: *J Hum*
46 *Nutr Diet* 2002 **15**(1):59-71.
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23. Whiting P, Rutjes A, Reitsma J, et al.: The development of QUADAS: a tool for the quality assessment of studies of diagnostic accuracy included in systematic reviews: *BMC Med Res Methodol* 2003 **3**(1):25.
24. Jones JM: Development of a nutritional screening or assessment tool using a multivariate technique: *Nutrition* 2004 **20**(3):298-306.
25. Coleman K, Norris S, Weston A, et al. NHMRC additional levels of evidence and grades for recommendations for developers of guidelines - pilot program 2005-2007. Canberra: National Health and Medical Research Council; (Also available from: http://www.nhmrc.gov.au/publications/files/levels_grades05.pdf accessed 5 November 2005).
26. Enia G, Sicuso C, Alati G, et al.: Subjective global assessment of nutrition in dialysis patients: *Nephrol Dial Transplant* 1993 **8**(10):1094-8.
27. Visser R, Dekker FW, Boeschoten EW, et al.: Reliability of the 7-point subjective global assessment scale in assessing nutritional status of dialysis patients: *Adv Perit Dial* 1999 **15**:222-5.
28. Kalantar-Zadeh K, Kopple JD, Block G, et al.: A malnutrition-inflammation score is correlated with morbidity and mortality in maintenance hemodialysis patients: *Am J Kidney Dis* 2001 **38**(6):1251-63.
29. Heimbürger O, Qureshi AR, Blaner WS, et al.: Hand-grip muscle strength, lean body mass, and plasma proteins as markers of nutritional status in patients with chronic renal failure close to start of dialysis therapy: *Am J Kidney Dis* 2000 **36**(6):1213-25.
30. Stenvinkel P, Heimbürger O, Paultre F, et al.: Strong association between malnutrition, inflammation, and atherosclerosis in chronic renal failure: *Kidney Int* 1999 **55**(5):1899-911.
31. Pifer TB, McCullough KP, Port FK, et al.: Mortality risk in hemodialysis patients and changes in nutritional indicators: DOPPS: *Kidney Int* 2002 **62**(6):2238-2245.
32. Jones CH, Wolfenden RC, Wells LM: Is subjective global assessment a reliable measure of nutritional status in hemodialysis?: *J Ren Nutr* 2004 **14**(1):26-30.

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51
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59
60
33. Churchill D, Taylor, WD., Keshaviah, PR.: Adequacy of dialysis and nutrition in continuous peritoneal dialysis: association with clinical outcomes. Canada-USA (CANUSA) Peritoneal Dialysis Study Group.: *J Am Soc Nephrol* 1996 **7**(2):198-207.
34. Kalantar-Zadeh K, Kopple JD, Humphreys MH, et al.: Comparing outcome predictability of markers of malnutrition-inflammation complex syndrome in haemodialysis patients: *Nephrol Dial Transplant* 2004 **19**(6):1507-19.
35. Davies SJ, Phillips L, Griffiths AM, et al.: Analysis of the effects of increasing delivered dialysis treatment to malnourished peritoneal dialysis patients: *Kidney Int* 2000 **57**(4):1743-1754.
36. Isenring E, Bauer J, Capra S: The scored Patient-generated Subjective Global Assessment (PG-SGA) and its association with quality of life in ambulatory patients receiving radiotherapy: *Eur J Clin Nutr* 2003 **57**(2):305-9.
37. Mobley SL, Hogan EK, Gormley SE, et al.: PG-SGA is the best nutrition-related predictor for length of hospital stay in hospitalized patients: *J Am Diet Assoc* 2004 **104**(Supplement 2):15.
37. Chassany O, Sagnier P, Marquis P, et al.: Patient-reported outcomes: The example of health-related quality of life - a European guidance document for the improved integration of health-related quality of life assessment in the drug regulatory process: *Drug Inf J* 2002 **36**:209-238.
38. Fenton SS, Johnston N, Delmore T, et al.: Nutritional assessment of continuous ambulatory peritoneal dialysis patients: *ASAIO J* 1987 **33**(3):650-653.
39. Young GA, Kopple JD, Lindholm B, et al.: Nutritional assessment of continuous ambulatory peritoneal dialysis patients: an international study: *Am J Kidney Dis* 1991 **17**(4):462-471.
40. Jones CH, Newstead CG, Will EJ, Smye SW, Davison AM: Assessment of nutritional status in CAPD patients: serum albumin is not a useful measure: *Nephrol Dial Transplant* 1997 **12**(7):1406-13.
41. Julien JP, Combe C, Lasseur C: Subjective global assessment of nutrition a useful diagnostic tool for nurses?: *Edtna Erca J* 2001 **27**(4):193-6.

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57
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42. Cupisti A, D'alessandro C, Morelli E, *et al.*: Nutritional status and dietary manipulation in predialysis chronic renal failure patients: *J Ren Nutr* 2004 **14**(3):127-133.
43. Qureshi AR, Alvestrand A, Danielsson A, *et al.*: Factors predicting malnutrition in hemodialysis patients: A cross-sectional study: *Kidney Int* 1998 **53**(3):773-782.

For Peer Review

Table 1: Prevalence of malnutrition by SGA tool and administrator in CKD

| Author Year | Rating scale | Country | Population | Administrator | Definition of Malnutrition | Prevalence of malnutrition |
|-------------------------------|--------------|---------------|-------------------------|--------------------------------|----------------------------|----------------------------|
| Fenton 1987 ³⁸ | A,B,C | Canada | 118 PD | Physician or nurse | SGA B or C | 23% |
| Young 1991 ³⁹ | A,B,C & obj | Europe, US | 224 PD | Physician | SGA B or C | 41% |
| Enia 1993 ²⁴ | A,B,C | Italy | 36 HD; 23PD | Physician | SGA B or C | 31% |
| Jones 1997 ⁴⁰ | A,B,C | England | 76 PD | Not stated | SGA B or C | 47% |
| Julien 2001 ⁴¹ | A,B,C | France | 32 HD | Nurses | SGA B or C | 76% |
| Lawson 2001 ¹⁵ | A,B,C | Australia | 50 HD | Dietitian | SGA B or C | 28% |
| Cooper 2002 ¹⁶ | A,B,C | Australia | 52 HD; 24 PD | 1) Physician & 2) Dietitian | SGA B or C | 48% 42% |
| Cupisti 2004 ⁴² | A,B,C | Italy | 70 pre-dialysis | Physician | SGA B; no C | 29% |
| Desbrow 2005 ¹⁴ | A,B,C | Australia | 60 HD | Dietitian | SGA B; no C | 20% |
| Pifer 2002 ²⁹ | mSGA A,B,C | USA | 7719 HD | Retrospective | SGA B or C | 19% |
| Churchill 1996 ³¹ | 1-7 | Canada and US | 680 commencing PD | Not stated | SGA 1or2=C 3,4or5 = B | 55% |
| Visser 1999 ²⁵ | 1-7 | Netherlands | 13 HD, 9PD | Nurses | SGA 1or2=C 3,4or5 = B | 36% |
| Jones 2004 ³⁰ | 1-7 & A,B,C | England | 72 HD | Dietitian | SGA B; no C | 31% |
| Qureshi 1998 ⁴³ | 1-4 | Sweden | 128 HD | Physician | Rating 2 – 4 | 64% |
| Stenvinkel 1999 ²⁸ | 1-4 | Sweden | 119 commencing dialysis | Physician | Rating 2 – 4 | 44% |
| Stenvinkel 2002 ³² | 1-4 | Sweden | 206 commencing dialysis | Not stated | Rating 2 – 4 | 39% |

Table 2: Description, advantages and disadvantages of SGA-based nutrition assessment tools utilised in CKD.

| Tool | Method | Modification from SGA | Advantages | Disadvantages |
|---|--------------------------|---|---|--|
| Retrospective mSGA | Rating A,B,C | Retrospective 'self rating' on A, B, C scale | Conducted as a survey (self-report) | Relys on self-report and carer's physical assessment |
| 4-point SGA | Rating 1 to 4 | Expands the "B" category to two. Ratings >2 represent malnutrition. | May delineate poor nutrition status | Similar issues to original, difficult to note changes over time |
| 7-point SGA | Rating 7 to 1 | Expands the 3 categories of the original SGA, to 7 on a Likert-type scale. | May delineate levels of nutrition status | May increase inter-observer variation |
| Dialysis Malnutrition Score (DMS) | Scored 7 to 35 | Scores 7 components of the SGA as 1 (normal) to 5 (very severe). | Scored so less subjectivity | Allocation of scores not based on evidence |
| Malnutrition Inflammation Score (MIS) | Scored 0 to 30 | 10 components, the DMS with BMI, serum albumin and total-iron binding capacity, scored according to severity 0 (normal) to 3 (very severe). | Includes objective categories - less reliance on subjectivity | Requires biochemistry (albumin and iron studies), and weight/height measures for BMI |
| Patient-Generate Subjective Global Assessment (PG-SGA) | Scored 0 to 35 and A,B,C | Provides a numerical score, dependant on the impact of each SGA component on nutrition status. | Patient completes medical history, scored so less subjective | May require more patient input |

Table 3: Definition and study design for validity and reliability testing corresponding draft NHMRC level of evidence in reference to nutrition assessment tools in CKD

| | Definition³⁷ | Study design and NHMRC level of evidence²³ |
|--------------------------------|---|---|
| Clinical validity | Explores the relationship that exists in known parameters associated with nutrition status, but not used in the tool. Validity is then only established against the parameter within that investigation | Cross-sectional comparison with reference that is not a gold standard, and/or is not blinded (Level III-2, Diagnosis) |
| Predictive Validity | Explores the correlation with another measure assessed in the future (e.g. morbidity and mortality) | Prospective, cohort (Level II, Prognosis, applies only to studies of diagnostic accuracy) |
| Criterion Validity | Evaluates agreement and performance (sensitivity/specificity) of the tool, against a valid, gold-standard reference measure. | Cross-sectional blinded comparison in consecutive or non-consecutive patients (Level II or III-1, Diagnosis) |
| Inter-rater Reliability | Tool can provide good agreement between users | Cross-sectional |
| Intra-rater Reliability | Tool is reproducible after test-retest assessment | Test-Retest |
| Internal Reliability | An assessment of the correlation across items within the assessment tool | Cross-sectional |

Table 4: Validation studies for SGA-derived tools in CKD

| Tool | Studies included Author, year, study type (sample) | Clinical Validity | Predictive Validity | Criterion Validity | Reliability | Design comments |
|---|--|--|---------------------------------|---|--|--|
| SGA | Enia 1993 Clinical validity (36HD; 23PD) Lawson 2001 Clinical and predictive validity 50 CKD (Pre-dialysis) Cooper 2002 Criterion validity and reliability (24PD; 52HD) | Albumin, BIA, (p<0.001) MAMC, % BF, nPCR (p<0.05); Fat-free mass | Mortality/Morbidity (12 months) | Not established (Nitrogen Index <85%= malnutrition) | Inter-observer reliability Moderate (weighted k=0.60) | Clinical and criterion validity: blinded to objective results Criterion validity: Question Choice of gold-standard cut-off |
| Retrospective mSGA | Pifer 2002 Predictive (7719 HD) | | Mortality (6 months) | | | Question face validity ↓ death risk for B |
| 7-point SGA scale | Chruchill 1996 Clinical and Predictive validity (680 starting PD) Visser 1999 Clinical validity and Reliability 22 Dx (13HD; 9PD) Jones 2004 Criterion validity (72 HD) | Rating <5: Albumin 1-7 BMI, MAMC, %BF | Mortality/Morbidity (2-3 years) | Composite nutrition score (incl SGA, BMI, TSF, MAMC, Alb) | Inter-observer ICC=0.72 Intra-observer ICC=0.88 | Interpreted 7-point SGA as interval Reliability on small sample (n=16) Criterion Validity: Large overlap scores between groups indicate lack of linearity. |
| Dialysis Malnutrition Score | Kalantar-Zadah 1999 Clinical validity and Reliability (41 HD) | MIS Alb, Cr, BUN, Iron, Chol, MAMC (p<0.001) | | | Inter-observer K=0.83 | No report on "risk" score or malnutrition cut-off, or number that refused study. Reliability on small sample (n=13) |
| Malnutrition Inflammation Score | Kalantar-Zadah 2001 Clinical and Predictive validity (83 HD) Kalantar-Zadah 2004 Clinical and Predictive validity (378 HD) | Albumin, CRP, Cr, Hct IL-6 | Morbidity/Mortality (12 months) | | | MIS appears to be a "risk assessment/ outcome predictor" MIS >8 = high risk Advantageous to predict outcome over SGA and DMS |
| Patient-Generated Subjective Global Assessment | Desbrow 2005 Clinical and Criterion validity and Reliability (60 HD) | Albumin | | >9 SGA PG score ≥9 good reliability to SGAB: 83% sens, 92% spec; | Internal Reliability α-coefficient 0.73 | NHMRC III-I Nature of the gold-standard did not allow 'blinding' of the SGA to PG-SGA |

SGA Subjective Global Assessment ; PG-SGA Patient-Generated Subjective Global Assessment ; DMS Dialysis Malnutrition Score ; MIS Malnutrition Inflammation Score
 HD Haemodialysis, PD Peritoneal Dialysis, Pre-Dx Pre-Dialysis,
 Alb Albumin, nPCR normalised Protein Catabolic Rate, BIA Bio-impedance Phase angle
 MAMC Mid-arm muscle circumference, BF Body Fat, TSF Tricep Skin-fold, FFM Fat Free Mass
 Cox PHM Cox Proportional Hazards Model, MW Mann-Whitney, MV Multivariate, ICC Interclass correlation