Pediatric nutritional screening tools: A systematic review of validation studies

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Citation

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Review question

What are the currently available screening tools for detecting malnutrition in hospitalized pediatric patients?
Which are the reference standards used for validation of pediatric nutritional screening tools?
What is the validity of pediatric nutritional screening tools versus used reference standard?

Searches

The systematic review of studies on predictive performance of nutritional screening tools will be conducted using the PubMed, CINAHL and MEDLINE databases. In addition, the studies from reference lists of identified studies will be searched using Google and Google Scholar. Studies in English reporting sensitivity, specificity, positive/negative predictive value in the pediatric (<18 years) population with a sample size of =25 subjects will be eligible for inclusion.

Types of study to be included

Inclusion criteriaTopic: Validation studies of nutritional screening and assessment tools for early identification of malnutrition risk in hospitalized pediatric patientsPopulation: pediatric patientsType of study: quantitative, mixed methods Language English Time frame not limited Exclusion criteria Studies not on the topic and not meeting inclusion criteriaStudies not expressing clinimetric assessment (i.e. validity), but only defining a percentage of malnutrition (no validation study)Studies including less than 25 patientsThe following publication types: editorials, letters, legal cases, interviews, book chapters, commentary pieces, news, review studies, methodological considerationsResearch that is not conducted for humans Duplicates

Condition or domain being studied

Malnutrition in hospitalized children is becoming an increasing problem of public health worldwide. Over the last two decade several studies have shown that the prevalence of malnutrition in hospitalized children varies from 6.1% to 40.9% worldwide. The importance of early detection of malnutrition in hospitalized pediatric patients has led to the development of several nutritional screening tools. Screening tools, which provide early identification of children at risk of nutritional impairment, have the potential to improve health outcomes and reduce healthcare costs. However, currently, there is no consensus on the appropriate screening tool to identify on admission those children who are at risk of developing malnutrition during hospitalization.

Participants/population

Inclusion: Pediatric patients (under 18 years of age)
Exclusion: Adults

Intervention(s), exposure(s)

There are several existing pediatric nutritional screening and assesment tools which have already been validated in different studies. However the reference standard is not uniquely defined.

Comparator(s)/control

The pediatric nutritional screening tools are usualy compared to some reference standard which can be a full diethetic assesment, WHO criteria, anthropomety, another screening tool, etc.

Context

Primary outcome(s)

The list of pediatric nutritional screening and assesment tools that have been properly validated using chosen reference standard.
The list of reference standards used for validation of pediatric nutritional screening and assesment tools.
The analysis of validity results.

Timing and effect measures
The study will be conducted in September and October 2017.
The methodological quality assessment of studies will be performed by Review Manager version 5.3 using a revised tool for the Quality Assessment of Diagnostic Accuracy Studies (QUADAS-2).

Secondary outcome(s)

None

Timing and effect measures
None

Data extraction (selection and coding)

Titles and/or abstracts of studies retrieved using the search strategy and those from additional sources will be screened independently by two review authors to identify studies that potentially meet the inclusion criteria outlined above. The full text of these potentially eligible studies will be retrieved and independently assessed for eligibility by two review team members. Any disagreement between them over the eligibility of particular studies will be resolved through discussion with a third reviewer.
A standardised, pre-piloted form will be used to extract data from the included studies for assessment of study quality and evidence synthesis. Extracted information will include: study setting; study population and participant demographics and baseline characteristics; details of the intervention and control conditions; study methodology; recruitment and study completion rates; outcomes and times of measurement; indicators of acceptability to users; suggested mechanisms of intervention action; information for assessment of the risk of bias. Two review authors will extract data independently, discrepancies will be identified and resolved through discussion (with a third author where necessary).

Risk of bias (quality) assessment

Two review authors will independently assess the risk of bias in included studies using QUADAS-2. Disagreements between the review authors over the risk of bias in particular studies will be resolved by discussion, with involvement of a third review author where necessary.

Strategy for data synthesis

We will provide a narrative synthesis of the findings from the included studies, structured around the type of intervention, target population characteristics, type of outcome and intervention content.

Analysis of subgroups or subsets

None planned

Contact details for further information

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Organisational affiliation of the review

None

Review team members and their organisational affiliations

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Anticipated or actual start date
20 September 2017

Anticipated completion date
20 October 2017

Funding sources/sponsors
None

Conflicts of interest
None known

Language
English

Country
Slovenia

Stage of review
Review_Ongoing

Subject index terms status
Subject indexing assigned by CRD

Subject index terms
Child; Humans; Nutrition Assessment; Nutritional Status

Date of registration in PROSPERO
07 November 2017

Date of publication of this version
20 September 2017

Details of any existing review of the same topic by the same authors

Stage of review at time of this submission

Stage	Started	Completed
Preliminary searches	Yes	No
Piloting of the study selection process	Yes	No
Formal screening of search results against eligibility criteria	No	No
Data extraction	No	No
Risk of bias (quality) assessment	No	No
Data analysis	No	No

Versions
20 September 2017

PROSPERO
This information has been provided by the named contact for this review. CRD has accepted this information in good faith and registered the review in PROSPERO. CRD bears no responsibility or liability for the content of this registration record, any associated files or external websites.

Supplementary File 2

Reporting checklist for systematic review and meta-analysis.

Based on the PRISMA guidelines.

Instructions to authors

Complete this checklist by entering the page numbers from your manuscript where readers will find each of the items listed below.

Your article may not currently address all the items on the checklist. Please modify your text to include the missing information. If you are certain that an item does not apply, please write "n/a" and provide a short explanation.

Upload your completed checklist as an extra file when you submit to a journal.

In your methods section, say that you used the PRISMA reporting guidelines, and cite them as:

Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group. Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement

		Reporting Item	Page Number
	#1	Identify the report as a systematic review, meta-analysis, or both.	1-7
Structured summary	#2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number	2-3
Rationale	#3	Describe the rationale for the review in the context of what is already known.	5-6

Objectives	#4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	7
Protocol and registration	#5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address) and, if available, provide registration information including the registration number.	3, 7
Eligibility criteria	#6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rational	8
Information sources	#7	Describe all information sources in the search (e.g., databases with dates of coverage, contact with study authors to identify additional studies) and date last searched.	7
Search	#8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	See note 1
Study selection	#9	State the process for selecting studies (i.e., for screening, for determining eligibility, for inclusion in the systematic review, and, if applicable, for inclusion in the meta-analysis).	7-8
Data collection process	#10	Describe the method of data extraction from reports (e.g., piloted forms, independently by two reviewers) and any processes for obtaining and confirming data from investigators.	8-9
Data items	#11	List and define all variables for which data were sought (e.g., PICOS, funding sources), and any assumptions and simplifications made.	7-8
Risk of bias in individual studies	#12	Describe methods used for assessing risk of bias in individual studies (including specification of whether this was done at the study or	8

		outcome level, or both), and how this information is to be used in any data synthesis.	
Summary measures	#13	State the principal summary measures (e.g., risk ratio, difference in means).	9
Planned methods of analysis	#14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I2) for each meta-analysis.	9
Risk of bias across studies	#15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	11-12
Additional analyses	#16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	n/a
Study selection	#17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	Figure 1
Study characteristics	#18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citation.	33-37
Risk of bias within studies	#19	Present data on risk of bias of each study and, if available, any outcome-level assessment (see Item 12).	Figure 1
Results of individual studies	#20	For all outcomes considered (benefits and harms), present, for each study: (a) simple summary data for each intervention group and (b) effect estimates and confidence intervals, ideally with a forest plot.	Table 3, 10-11
Synthesis of results	#21	Present the main results of the review. If meta-analyses are done, include for each, confidence intervals and measures of consistency.	9-13

Risk of bias across studies	#22	Present results of any assessment of risk of bias across studies (see Item 15).	See note 2
Additional analysis	#23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	n/a
Summary of Evidence	#24	Summarize the main findings, including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., health care providers, users, and policy makers	13-18
Limitations	#25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review level (e.g., incomplete retrieval of identified research, reporting bias).	18-19
Conclusions	#26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	21
Funding	#27	Describe sources of funding or other support (e.g., supply of data) for the systematic review; role of funders for the systematic review.	22

Author notes

1. 7, Supplementary file 4
2. Supplementary file 7

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Supplementary File 3: Research questions and motivation.

Identifier	Research question	Motivation
RQ1	What are the currently available screening and assessment tools for detecting malnutrition in hospitalized pediatric patients?	To identify the screening and assessment tools for detection of malnutrition in hospitalized pediatric patients that are available in the English language.
RQ2	What is the validity of the screening and assessment tools *versus* the reference standard?	To analyze which reference standards have been used for the validation of screening and assessment tools. To present the validity results based on the reference standard.

Supplementary File 4: Search strategy for PubMed, Cumulative Index of Nursing and Allied Health (CINAHL), and Medline, as carried out on October 20, 2017.

N°	Keywords	N° of results		
		PubMed	CINAHL	Medline
#1	("premature*" OR "immature*" OR "child*" OR "baby" OR "infant*" OR "newborn*" OR "neonate*" OR "kid*" OR "babies" OR "adolescent*" OR "paediatric*" OR "pediatric*")	3,789,748	561,313	4,822,829
#2	("screen*" OR "assess*")	891,301	570,009	3,164,782
#3	("tool*")	373,730	154,196	553,420
#4	("undernutrition*" OR "undernourish*" OR "malnutrition*" OR "malnourish*")	44,842	7,841	49,600
#5	#1 AND #2 AND #3 AND #4	92	187	496
#6	Limit #5 to (English language)	86	179	459

Supplementary File 5: Inclusion and exclusion criteria.

Inclusion criteria	Exclusion criteria
Topic: Validation studies of nutritional screening or assessment tools for early identification of malnutrition risk in hospitalized pediatric patients	Studies not on topic and not meeting inclusion criteria
Population: Hospitalized pediatric patients	Studies not expressing clinimetric assessment (i.e., validity), but only defining percentages of malnutrition (i.e., no validation study)
Type of study: Quantitative	Studies including <25 patients
Language: English	Publication types: editorials, letters, legal cases, interviews, book chapters, commentary pieces, news, review studies, methodological considerations
Time frame: Not limited	Research not conducted on humans Duplicates

Supplementary File 6: List of excluded papers with reason.

	Studies	Reasons for exclusion
1.	Addo YO, Himes JH, Zemel BS. Reference ranges for midupper arm circumference, upper arm muscle area, and upper arm fat area in US children and adolescents aged 1-20 y. *Am J Clin Nutr* 2017;**105**:111–20.doi:10.3945/ajcn.116.142190	Primary focus is not as paediatric screening toll but midupper arm circumference, upper arm muscle area, and upper arm fat area.
2.	Agudelo S, Gamboa O, Rodriguez F, *et al.* The effect of skin-to-skin contact at birth, early versus immediate, on the duration of exclusive human lactancy in full-term newborns treated at the Clinica Universidad de La Sabana: study protocol for a randomized clinical trial. *Trials* 2016;**17**:521.doi:10.1186/s13063-016-1587-7	Primary focus is not as paediatric screening toll.
3.	Apostolou A, Printza N, Karagiozoglou-Lampoudi T, *et al.* Nutrition assessment of children with advanced stages of chronic kidney disease-a single center study. *Hippokratia 2014;***18**:212–6.	Prevalence of malnutrition in pediatric patients. No validity data.
4.	Aurangzeb B, Whitten KE, Harrison B, *et al*. Prevalence of malnutrition and risk of under-nutrition in hospitalized children. *Clin Nutr* 2012;**31**:35–40.doi:10.1016/j.clnu.2011.08.011	No validity data.
5.	Campbell KL, Ash S, Bauer J, *et al.* Critical review of nutrition assessment tools to measure malnutrition in chronic kidney disease. *Nutrition & Dietetics* 2005;**20:**162–75.doi:10.1111/j.1747-0080.2007.00116.x	Literature review. Primary focus is not as pediatric screening tool.
6.	Cao J, Peng L, Li R, *et al*. Nutritional risk screening and its clinical significance in hospitalized children. *Clin Nutr 2014;***33**:432–6.doi:10.1016/j.clnu.2013.06.009	No validity data.
7.	Day AS, Moeeni V, Walls T. Malnutrition screening tools need to be applied properly before they can be compared--response to Letter to Editors by Gerasimidis et al. *Acta Paediatr* 2014;**103**:e94–5.doi:10.1111/apa.12522	Response to letter to editors.
8.	de Carvalho FC, Lopes CR, Vilela Lda C, *et al*. Translation and cross-cultural adaptation of the Strongkids tool for screening of malnutrition risk in hospitalized children. *Rev Paul Pediatr* 2013;**31**;159–65.doi:10.1590/S0103-05822013000200005	Translation of the screening tool.
9.	Elia M, Stratton RJ. An analytic appraisal of nutrition screening tools supported by original data with particular reference to age. *Nutrition* 2012;**28**:477–94.doi:10.1016/j.nut.2011.11.009	Reviews of the literature to identify the types of screening tools available for different age groups – more for adults.
10.	Gerasimidis K, Macleod I, Maclean A, *et al*. Performance of the novel Paediatric Yorkhill Malnutrition Score (PYMS) in hospital practice. *Clin Nutr* 2011;**30**:430–5.doi:10.1016/j.clnu.2011.01.015	Duplicate.
11.	Girish M, Bhattad S, Ughade S, *et al*. Physical activity as a clinical tool in the assessment of malnutrition. *Indian Pediatr* 2014;**51**:478–80.	Primary focus is not as paediatric screening toll. Physical activity was measured in children with wasting, using Childrens Activity Rating Scale.

12.	Groleau V, Thibault M, Doyon M, *et al*. Malnutrition in Hospitalized Children: Prevalence, impact, and management. *Can J Diet Pract Res* 2014;**75**:29–34.doi:10.3148/75.1.2014.29	Not validation of the screening tool. Prevalence of malnutrition in pediatric patients.
13.	Hartman C, Shamir R, Hecht C, *et al*. Malnutrition screening tools for hospitalized children. *Curr Opin Clin Nutr Metab Care* 2012;**15**:303–9.doi:10.1097/MCO.0b013e328352dcd4	Literature review.
14.	Hasegawa J, Ito YM, Yamauchi T. Development of a screening tool to predict malnutrition among children under two years old in Zambia. *Glob Health Action* 2017;**10**:1339981.doi:10.1080/16549716.2017.1339981	Development of the screening tool.
15.	Huysentruyt K, Devreker T, Dejonckheere J, *et al*. Accuracy of nutritional screening tools in assessing the risk of undernutrition in hospitalized children. *J Pediatr Gastroenterol Nutr* 2015;**61**:159–66.doi:10.1097/MPG.0000000000000810	Literature review.
16.	Huysentruyt K, Vandenplas Y, De Schepper J. Screening and assessment tools for pediatric malnutrition. *Curr Opin Clin Nutr Metab Care* 2016;**19**:336–40.doi:10.1097/MCO.0000000000000297	Literature review.
17.	Joosten KF, Hulst JM. Nutritional screening tools for hospitalized children: methodological considerations. *Clin Nutr* 2014;**33**:1–5.doi:10.1016/j.clnu.2013.08.002	Methodological considerations.
18.	Karagiozoglou-Lampoudi T, Daskalou E, Lampoudis D, *et al*. Computer-based malnutrition risk calculation may enhance the ability to identify pediatric patients at malnutrition-related risk for unfavorable outcome. *JPEN* 2015;**39**:418–25.doi:10.1177/0148607114529161	No validation to reference standard.
19.	Gerasimidis K, Macleod I, Finlayson L, *et al*. Introduction of Paediatric Yorkhill Malnutrition Score - challenges and impact on nursing practice. *J Clin Nurs* 2012;**21**:3583–86.doi:10.1111/j.1365-2702.2012.04164.x	Description of the screening tool. Examine the feedback of hospital nursing staff on aspects of PYMS use in clinical practice. Not validation of the screening tool.
20.	Moeeni V, Walls T, Day AS. Nutritional status and nutrition risk screening in hospitalized children in New Zealand. *Acta Paediatr* 2013;**102**:e419–e423.doi:10.1111/apa.12299	Determine the prevalence of malnutrition. No validation of the screening tool.
21.	Moeeni V, Walls T, Day AS. PP145-SUN Assessment of a nutritional risk screening tool (Strongkids) in hospitalized children when applied by different health care providers. *Clin Nutr* 2013;**32**:S77.doi:10.1016/S0261-5614(13)60190-9	Poster presentations.
22.	Norman K, Schütz T, Kemps M, *et al*. The Subjective Global Assessment reliably identifies malnutrition-related muscle dysfunction. *Clin Nutr* 2005;**24**:143–50.doi:10.1016/j.clnu.2004.08.007	Identifying malnutrition-related muscle dysfunction malnutrition with Subjective Global Assessment (SGA) tool in adult patient, not children.
23.	Pan P, Tao G, Sun X. Subjective global assessment and prealbumin levels of esophageal cancer patients undergoing concurrent chemoradiotherapy. *Nutr Hosp* 2015;**31**:167–73.doi:10.3305/nh.2015.31.5.8596	To evaluate the nutritional status of adult (not children) patients undergoing chemoradiotherapy for esophageal cancer using Subjective Global Assessment (SGA)

		and association of prealbumin levels to nutritional status.
24.	Rinninella E, Ruggiero A, Maurizi P, *et al.* Clinical tools to assess nutritional risk and malnutrition in hospitalized children and adolescents. *Eur Rev Med Pharmacol Sci* 2017;**21**:2690–701.	Literature review.
25.	Rojratsirikul C, Sangkhathat S, Patrapinyokul S. Application of subjective global assessment as a screening tool for malnutrition in pediatric surgical patients. *J Med Assoc Thai* 2004;**87**:939–46.	No validity data.
26.	Roller RE, Eglseer D, Eisenberger A, *et al*. The Graz Malnutrition Screening (GMS): a new hospital screening tool for malnutrition. *Br J Nutr* 2016;**115**:650–7.doi:10.1017/S0007114515004924	Validation of the screening tool for the detection of malnutrition in adult patients in acute-care hospitals.
27.	Rowell A, Long C, Chance L, *et al*. Identification of nutritional risk by nursing staff in secure psychiatric settings: reliability and validity of St Andrew's Nutrition Screening Instrument. *J Psychiatr Ment Health Nurs* 2012;**19**:722–8.doi:10.1111/j.1365-2850.2011.01848.x	Description of the screening tool. No validity data. Not only for pediatric patients.
28.	Secker DJ, Jeejeebhoy KN. Subjective global nutritional assessment for children. *J Acad Nutr Diet* 2007;**85**:1083–9.	Description of the screening tool. Determining the prevalence of malnutrition.
29.	Secker DJ, Jeejeebhoy KN. How to perform Subjective Global Nutritional assessment in children. *J Acad Nutr Diet* 2012;**112**:424–31.e6.doi:10.1016/j.jada.2011.08.039	Describe perform of screening tool. No validity data.
30.	Sermet-Gaudelus I, Poisson-Salomon A, Colomb V, *et al*. Simple pediatric nutritional risk score to identify children at risk of malnutrition. *Am J Clin Nutr* 2000;**72**:64–70.	Only description of display for the selection of noninvasive indicators. No validity data.
31.	St Pierre A, Khattra P, Johnson M, *et al*. Content validation of the infant malnutrition and feeding checklist for congenital heart disease: a tool to identify risk of malnutrition and feeding difficulties in infants with congenital heart disease. *J Pediatr Nurs* 2010;**25**:367–74.doi:10.1016/j.pedn.2009.04.009	Only checklist developed using Delphi method. Not a tool.
32.	Veloza AL, Rodníguez PA, Henao AM, *et al*. MON-P120: Screening Tool for the Assessment of Malnutrition in Paediatrics (STAMP) on admission to atertiary hospital in Bogotá, Colombia. *Clin Nutr* 2016;**35**:S197.doi:10.1016/S0261-5614(16)30754-3	Poster presentations.
33.	Wong S, Graham A, Harini SP, *et al*. Profile and prevalence of malnutrition in children with spinal cord injuries-assessment of the Screening Tool for Assessment of Malnutrition in Paediatrics (STAMP). *Spinal Cord* 2012;**50**:67–71.doi:10.1038/sc.2011.139	Describe the profile (medication, BMI, appetite, C-reactive protein, prescribed medications, experienced previous intensive care, mechanical ventilation, artificial nutritional support, new admissions) of children admitted to the Spinal cord injury (SCI) centre and not validation.
34.	Carniel MP, Santetti D, Andrade JS, *et al*. Validation of a subjective global assessment questionnaire. *J Pediatr (Rio J)* 2015;**91**:596–602.doi:10.1016/j.jped.2015.03.005	No validity data.

35.	Gilliam J, Laney SO. Nutrition Screening for Infants and Young Children with Special Health Care Needs: Spoken Country, Washington. 2008. https://www.doh.wa.gov/Portals/1/Documents/Pubs/970-116_NutritionScreeningForInfantsAndYoungCSHCN.pdf (Accessed 20 Oct 2017).	No validity data.
36.	Metcoff J. Clinical assessment of nutritional status at birth: fetal malnutrition and SGA are not synonymous. *Pediatr Clin North Am* 1994;**41**:875–91.	No validity data.
37.	Mezoff A, Gamm L, Konek S, *et al*. Validation of a nutritional screen in children with respiratory syncytial virus admitted to an intensive care complex. *Pediatrics* 1996;**97**:543–6.	Description of the screening tool. Determining the prevalence of malnutrition. No validity data.
38.	Reilly HM, Martineau JK, Moran A, *et al*. Nutritional screening-evaluation and implementation of a simple nutrition risk score. *Clin Nutr* 1995;**14**:269–73.doi:10.1016/S0261-5614(95)80063-8	Description of the screening tool. Development of the screening tool. Determining the prevalence of malnutrition. Not only on paediatric patients.