Journal of Current Research in Food Science 2025; 6(2): 12-17

JOURNAL OF CURRENT RESEARCH IN FOOD SCIENCE

E-ISSN: 2709-9385
P-ISSN: 2709-9377
JCRFS 2025; 6(2): 12-17

www.foodresearchjournal.com
Received: 14-05-2025
Accepted: 16-06-2025

Akanksha Rai
M.Sc. Student, Department of Nutrition and Dietetics, Sharda School of Allied Health Sciences, Sharda University, Greater Noida, Uttar Pradesh, India

Shristi Gupta
Dietician, Nia wellness plate, Faridabad, Haryana, India

Aditi Rikhari
Assistant Professor, Department of Nutrition and Dietetics, Sharda School of Allied Health Sciences, Sharda University, Greater Noida, Uttar Pradesh, India

Akansha
Assistant Professor, Department of Nutrition and Dietetics, Sharda School of Allied Health Sciences, Sharda University, Greater Noida, Uttar Pradesh, India

Neelesh Kumar Mayura
Assistant Professor, Department of Nutrition and Dietetics, Sharda School of Allied Health Sciences, Sharda University, Greater Noida, Uttar Pradesh, India

Correspondence
Aditi Rikhari
Assistant Professor, Department of Nutrition and Dietetics, Sharda School of Allied Health Sciences, Sharda University, Greater Noida, Uttar Pradesh, India

Clinical nutritional assessment: Advances, challenges, and future directions in screening and diagnosis

Akanksha Rai, Shristi Gupta, Aditi Rikhari, Akansha and Neelesh Kumar Mayura

DOI: https://www.doi.org/10.22271/foodsci.2025.v6.i2a.239

Abstract
Clinical nutritional assessment is a cornerstone of patient-centered healthcare, enabling early detection and management of malnutrition across diverse populations. This comprehensive review synthesizes current evidence and best practices associated with the assessment of nutritional status in clinical settings. Using a systematic literature search covering research from January 2000 to March 2024, the review explores the multidimensional "ABCD" framework encompassing anthropometric, biochemical, clinical, and dietary methodologies. Special attention is given to validated screening tools—such as MUST, MNA, NRS-2002, GLIM, and SGA—and their adaptation for specific populations including pediatrics, geriatrics, and the critically ill. The review highlights significant advancements, including the integration of electronic health record systems (EHRS), digital dietary assessment platforms, and emerging biomarker-driven and AI-powered approaches, all of which contribute to enhanced diagnostic accuracy and personalized care. However, implementation challenges persist: variability in tool use, lack of standardization, inadequate clinician training, and limited cultural adaptability constrain widespread adoption. Furthermore, subjective nutrition assessment methods remain vulnerable to recall bias and underreporting, emphasizing the need for objective metrics and technological innovation. The findings underscore the importance of interdisciplinary teamwork and the development of standardized and culturally sensitive protocols to improve patient outcomes. Ultimately, this review advocates for a multimodal, evidence-based approach to nutritional assessment, ongoing research into tool validation, and the strategic integration of novel technologies to advance equity and effectiveness in nutrition care worldwide1.

Keywords: Dietary assessment tools, 24-hour dietary recall, food frequency questionnaires (FFQ), diet histories

Introduction

Clinical nutritional assessment is a foundational process in the delivery of effective, individualized healthcare. It encompasses a multidimensional approach to evaluating an individual's nutritional status by integrating anthropometric, biochemical, clinical, and dietary parameters. This assessment is pivotal for identifying malnutrition, monitoring nutritional risk, and guiding dietary interventions that are essential for improving clinical outcomes. Malnutrition, both undernutrition and overnutrition, remains a critical public health issue globally, contributing to the global burden of disease across all age groups and socioeconomic classes (World Health Organization [WHO], 2021) [11]. In hospitalized patients, malnutrition prevalence ranges from 20% to 50%, depending on the population and criteria used (Cederholm *et al.*, 2019) [3]. Yet, despite its high prevalence and significant consequences, nutritional assessment remains underperformed or inadequately documented in many clinical settings.

Proper nutritional assessment allows for early identification of patients at risk of nutritional deficiencies, optimizes therapeutic responses, and reduces hospital length of stay, morbidity, and mortality (Cederholm *et al.*, 2015) [2]. In both acute and chronic diseases, nutrition plays an integral role in modulating immune function, metabolic regulation, wound healing, and organ function. For instance, in cancer patients, nutritional deterioration can begin even before diagnosis and progress rapidly without early intervention (Arends *et al.*, 2017) [1]. Similarly, in critically ill patients, inflammatory stress exacerbates catabolism, leading to muscle wasting and poor recovery outcomes if not promptly addressed with appropriate nutritional care (Singer *et al.*, 2019) [8]. The consequences of undernutrition are not only clinical but economic—malnourished patients incur higher healthcare costs due to prolonged stays and increased complications (Elia, 2003) [4].

The term "clinical nutritional assessment" encompasses both screening and diagnostic evaluations. Screening tools such as the Malnutrition Universal Screening Tool (MUST), Nutrition Risk Screening (NRS-2002), and Mini Nutritional Assessment (MNA) help identify individuals at nutritional risk (Kondrup *et al*., 2003; Guigoz, 2006) [6, 5]. These are typically used as a first step to decide whether further comprehensive assessment is warranted. Once a patient is identified as being at risk, a full nutritional assessment follows, typically guided by the "ABCD" model—Anthropometric, Biochemical, Clinical, and Dietary assessment components. Each of these dimensions contributes to a more complete and accurate understanding of the individual's nutritional status.

Dietary intake assessments—one of the cornerstones of the ABCD framework—are particularly critical, as they provide insight into food consumption patterns and nutrient adequacy. Tools such as the 24-hour dietary recall, food frequency questionnaire (FFQ), and food diaries allow clinicians and researchers to estimate nutrient intakes and detect potential dietary inadequacies. However, the effectiveness of these tools depends heavily on the interviewer's skill, the respondent's memory, and the cultural relevance of the food items included (Thompson & Subar, 2017) [9]. Furthermore, diet quality assessments are increasingly being integrated into clinical nutrition evaluations to consider not just the quantity but the healthfulness of consumed foods (Willett, 2012) [10].

Clinical nutritional assessment is particularly vital in vulnerable populations such as pediatric, geriatric, and critically ill patients. In children, growth faltering is often the first and most visible sign of malnutrition. In the elderly, age-related physiological changes, comorbidities, and polypharmacy pose challenges in maintaining adequate nutritional status (Guigoz, 2006) [5]. In both groups, failure to assess and address nutritional problems can have irreversible long-term effects. Despite the known benefits of nutritional assessments, implementation barriers persist, including time constraints, lack of training among clinicians, and insufficient institutional policies mandating routine assessments (Kyle *et al*., 2006) [7].

With the growing emphasis on personalized medicine, clinical nutrition is emerging as a vital therapeutic modality rather than just supportive care. Integration of validated nutritional assessment protocols into electronic health records, the use of mobile applications, and tele-nutrition practices are evolving as innovative solutions for broader and more consistent implementation (Zhang *et al*., 2020) [12]. This review provides a detailed exploration of clinical nutritional assessment, its methodologies, and clinical implications, emphasizing the need for standardized, routine practices to improve patient-centered care.

Table 1: Key tools used in Clinical settings for Nutritional Assessment [Gibson, R. S. (2005) [24], WHO. (2006), Maurya, N. K. (2019).] [23]

Tool Name	Type	Target Population	Brief Description	Use/Output
MUST (Malnutrition Universal Screening Tool)	Screening	Adults	5-step tool with BMI, weight loss, acute disease effect.	Identifies malnutrition risk.
NRS-2002 (Nutritional Risk Screening)	Screening	Hospitalized adults	Includes BMI, recent weight loss, intake, disease severity.	Early identification for nutritional therapy.
MNA (Mini Nutritional Assessment)	Screening & Assessment	Elderly (≥65 years)	Anthropometry, diet, general and subjective assessment.	Detects malnutrition in elderly.
SGA (Subjective Global Assessment)	Assessment	Hospitalized patients	Medical history and physical exam to classify nutritional status.	Classifies patients into well/moderately/severely malnourished.
PG-SGA (Patient-Generated Subjective Global Assessment)	Assessment	Oncology patients	SGA with patient-completed symptoms, intake, function.	Tracks symptom burden and status.
BMI (Body Mass Index)	Anthropometric	All populations	Weight (kg)/height (m²).	Categorizes underweight to obesity.
Mid Upper Arm Circumference (MUAC)	Anthropometric	Children <5 yrs, adults	Estimates muscle mass reserve.	Indicates undernutrition.
Skinfold Thickness	Anthropometric	All populations	Measures subcutaneous fat using calipers.	Estimates body fat %.
24-Hour Dietary Recall	Dietary	All age groups	Recalls foods/beverages from last 24 hours.	Estimates recent intake.
Food Frequency Questionnaire (FFQ)	Dietary	Population studies	Assesses frequency of intake over time.	Estimates long-term intake patterns.
Diet History	Dietary	Clinical patients	Explores intake, preferences, patterns.	Provides qualitative/quantitative data.
Biochemical Markers	Biochemical	All populations	Blood/urine tests for protein-energy/micronutrients.	Confirms assessment findings.
Nutrition-Focused Physical Exam (NFPE)	Clinical	Hospitalized, chronically ill	Physical signs of deficiency (e.g., muscle wasting).	Evidence of malnutrition.
Handgrip Strength (Dynamometry)	Functional	Adults, elderly	Muscle strength test.	Indicates functional decline.
Dietary Records (Food Diaries)	Dietary	Outpatients, research	Logs all foods for 3-7 days.	Accurate intake estimation.
Bioelectrical Impedance Analysis (BIA)	Body Composition	Clinical/community	Estimates body fat %, lean mass, hydration.	Non-invasive, hydration-dependent.
DEXA (Dual-Energy X-ray Absorptiometry)	Body Composition	Advanced clinical	Measures fat, lean mass, bone density.	Precise but expensive.

The following table summarizes the commonly used tools in clinical settings for nutritional assessment. These tools span across anthropometric, dietary, biochemical, and clinical assessment methods and are tailored to different patient populations.

Nutritional assessment methods

Nutritional assessment is a systematic approach used to evaluate the nutritional status of individuals or populations, with the objective of identifying those at risk of malnutrition, determining appropriate nutritional interventions, and monitoring the efficacy of therapeutic strategies. It forms the cornerstone of clinical nutrition practice, integrating multifaceted methodologies including anthropometric, biochemical, clinical, dietary, and functional assessments—often referred to as the "ABCD" model (Lee & Nieman). A comprehensive nutritional assessment allows healthcare providers to make evidence-based decisions for personalized dietary planning and therapeutic management, particularly for vulnerable populations such as the elderly, patients with chronic illnesses, pediatric patients, and individuals undergoing surgery or cancer treatment (White *et al*., 2012) [20].

Anthropometric assessment involves the measurement of physical dimensions and body composition. Common parameters include weight, height, body mass index (BMI), mid-upper arm circumference (MUAC), triceps skinfold thickness, waist-to-hip ratio, and bioelectrical impedance analysis (BIA). These indicators help determine levels of undernutrition, overnutrition, or specific nutrient deficiencies (Kondrup *et al*., 2003) [6]. For instance, BMI is a standard screening tool used globally for classifying nutritional status in adults; however, it does not account for muscle mass and fat distribution, which may be critical in cases such as sarcopenia or cachexia. Tools such as Dual-Energy X-ray Absorptiometry (DEXA) and computed tomography (CT) scans, though expensive, offer precise body composition analysis and are particularly useful in clinical research or for patients with complex conditions such as cancer or end-stage organ failure (Heymsfield).

Biochemical assessment provides objective data on nutrient levels and metabolic functioning through the analysis of blood, urine, or other body tissues. It allows for early detection of nutrient deficiencies before clinical symptoms appear. Key indicators include serum albumin, prealbumin, transferrin, total lymphocyte count, hemoglobin, vitamin and mineral levels (such as vitamin D, B12, folate, iron, and zinc), and electrolyte balance (Gibson, 2005) [24]. For example, hypoalbuminemia may indicate protein-energy malnutrition, although it can also be influenced by inflammation or liver disease. Similarly, low serum ferritin levels often point toward iron deficiency anemia, but this marker may be falsely elevated in the presence of infection or inflammation. Biochemical assessments are especially crucial in critically ill patients and those with chronic kidney disease, where metabolic derangements may be profound and rapid.

Clinical assessment includes a detailed medical and nutritional history along with a physical examination to identify signs of malnutrition or nutrient-related diseases. Healthcare professionals look for symptoms like hair loss, skin dryness, muscle wasting, edema, glossitis, and spoon-shaped nails, which are indicative of specific micronutrient deficiencies. A clinical assessment also evaluates appetite, gastrointestinal symptoms (nausea, vomiting, diarrhea, constipation), swallowing difficulties (dysphagia), and functional capacity, including activities of daily living (Jensen). Moreover, the Subjective Global Assessment (SGA) and Patient-Generated Subjective Global Assessment (PG-SGA) are validated tools that integrate clinical judgment with patient history to stratify malnutrition risk. The SGA, based on weight change, dietary intake, gastrointestinal symptoms, and physical findings, is widely used in hospitals due to its predictive validity in postoperative and cancer patients (Detsky; Bauer).

Dietary assessment focuses on analyzing an individual's food and nutrient intake over a defined period. The most commonly used methods are 24-hour dietary recall, food frequency questionnaires (FFQs), food diaries, and dietary histories. The 24-hour dietary recall involves a structured interview where the patient recounts all foods and beverages consumed in the preceding 24 hours, often with the help of visual aids or food models. This method is relatively quick and cost-effective but may not reflect habitual intake. The Food Frequency Questionnaire (FFQ), on the other hand, assesses the frequency and quantity of food items consumed over a longer duration, typically weeks or months. It is especially useful in large epidemiological studies to identify dietary patterns or nutrient exposures (Willett, 2013) [10]. Food diaries or records, where individuals document all food intake over 3-7 days, offer detailed insight into eating behavior but require high literacy and motivation, potentially leading to underreporting. Dietary assessment tools can be enhanced using technology such as mobile applications, photographic food records, and nutrient analysis software, which reduce error and improve compliance.

Table 2: Comparative overview of commonly used dietary assessment methods in clinical nutrition, highlighting their utility, strengths, and limitations across healthcare settings [Thompson, F. E., & Subar, A. F., 2017) [9].

Methods	Description	Advantages	Limitations	Best Use Cases
24-Hour Dietary Recall	Interview-based recall of all food and beverages consumed in the past 24 hours	Quick, low burden, detailed nutrient intake estimation	Relies on memory, may not reflect typical intake	Outpatient clinics, hospital bedside assessments
Food Frequency Questionnaire (FFQ)	Self- or interviewer-administered tool assessing frequency of consumption of food items over a defined period	Good for long-term dietary patterns, low-cost	May lack portion size precision, depends on food list relevance	Epidemiological research, chronic disease risk assessments
Dietary Record/Diary	Real-time recording of food intake over 3-7 days	Accurate portion estimation, includes contextual meal info	High respondent burden, risk of under-reporting	Research studies, metabolic disorder interventions

Diet History	Detailed review of usual intake, meal patterns, and preferences	Culturally sensitive, captures habitual intake	Requires trained interviewers, time-intensive	Comprehensive outpatient nutrition consultations
Weighed Food Record	Food weighed before consumption and leftovers measured	High accuracy, gold standard in metabolic studies	Impractical in large samples or routine settings	Research labs, inpatient metabolic units
Screening Tools with Diet Components (e.g., MUST, NRS-2002)	Nutritional risk screening with brief intake questions	Rapid, easy to implement, good for triaging	Not detailed for micronutrient intake or meal patterns	Hospitals, ICUs, geriatric and surgical wards

Functional assessments, though not part of the traditional ABCD model, are increasingly being integrated into nutritional evaluations. These assessments measure physical performance and strength as indicators of nutritional adequacy, especially protein and calorie intake. Tests like handgrip strength using a dynamometer, gait speed, and the Timed Up and Go test (TUG) provide predictive information about morbidity, disability, and mortality (Cederholm *et al*., 201) [3]. In geriatrics and intensive care units, these markers are invaluable in identifying frailty and functional decline associated with malnutrition.

Several validated screening and assessment tools have been developed to streamline and standardize nutritional assessment in clinical settings. These include the Malnutrition Universal Screening Tool (MUST), Mini Nutritional Assessment (MNA), Nutrition Risk Screening 2002 (NRS-2002), Malnutrition Inflammation Score (MIS), and the Global Leadership Initiative on Malnutrition (GLIM) criteria. The MUST tool is a five-step screening method used in community and hospital settings, considering BMI, unintentional weight loss, and the effect of acute disease. MNA is particularly useful for elderly populations, combining anthropometric, dietary, and subjective assessments. NRS-2002 and GLIM have been validated for use in acute care settings, integrating phenotypic criteria (weight loss, low BMI, reduced muscle mass) with etiologic criteria (reduced intake, inflammation) (Cederholm *et al*., 2019) [3].

Emerging approaches to nutritional assessment increasingly focus on inflammatory markers and metabolic biomarkers, particularly in patients with chronic illnesses, cancer, or sepsis. High-sensitivity C-reactive protein (hs-CRP), interleukin-6 (IL-6), and tumor necrosis factor-alpha (TNF-α) serve as indicators of systemic inflammation and cachexia, guiding nutritional interventions and prognosis. Additionally, nutrigenomic and metabolomic profiling is being explored to personalize nutritional care by identifying gene-diet interactions and metabolic pathways influenced by specific nutrients (Corella & Ordovás). Though still largely in research domains, these tools hold promise for the future of precision nutrition.

Technological advancements also play a pivotal role in modern nutritional assessment. Mobile health (mHealth) platforms, wearable devices, telehealth, and machine learning algorithms are transforming how dietary data is collected and analyzed. Applications like MyFitnessPal, ASA24, and NutriSurvey allow real-time monitoring and dietary tracking. Artificial intelligence (AI) can improve the accuracy of food recognition and nutrient estimation from images, reducing human error and increasing scalability in both clinical and public health settings (Zhu *et al*., 2020).

Despite the availability of robust methods, each assessment technique has limitations. Anthropometric measures may be affected by hydration status and do not reflect acute changes. Biochemical markers can be influenced by non-nutritional factors such as infection or organ dysfunction. Clinical signs may appear late in deficiency states, and dietary methods rely heavily on patient recall and honesty. Therefore, a multimodal approach, combining at least two or more assessment domains, is considered best practice for accurate diagnosis and individualized care planning (Mueller *et al*., 2011) [17].

Methodology

A systematic and structured literature review was performed to encompass the full scope of clinical nutritional assessment as reflected in contemporary research and practice. Literature searches were conducted across leading electronic databases—PubMed, ScienceDirect, Cochrane Library, and Google Scholar—to identify publications from January 2000 to March 2024, thus chronicling more than twenty years of advancement in the field. Sources included peer-reviewed journals, clinical practice guidelines, and documents from health organizations (Maurya, N. K., 2025) [22].

Search strategies utilized combinations of terms such as "nutritional assessment," "clinical nutrition," "malnutrition screening," "food frequency questionnaire," "24-hour dietary recall," "dietary assessment methods," "biochemical markers," "anthropometric measurements," and "nutrition screening tools." Boolean operators (AND, OR) ensured comprehensive retrieval, while specific indexing terms (MeSH) in PubMed enhanced article relevance.

Eligibility was restricted to English-language studies involving humans that focused on methods or tools for nutritional assessment in clinical or community health settings. Research on pediatric, adult, and geriatric populations was included to support a lifecycle perspective. Both observational (cross-sectional, cohort, case-control) and interventional (randomized controlled trials, interventions) studies, as well as systematic reviews, meta-analyses, and leading guidelines (from bodies such as ESPEN, AND, and WHO) were eligible.

Exclusions comprised studies limited to animal/*in vitro* models, non-nutrition interventions, reports lacking methodological rigor, or without peer review (Guigoz, 2006) [5].

Of over 500 abstracts screened, approximately 122 full-text articles were evaluated for eligibility, resulting in the selection of 45 articles. Data extraction prioritized tool validity, clinical utility, population specificity, key limitations, and recent advances. This methodology enabled a rigorous, up-to-date synthesis of best evidence and clinical practice in nutritional assessment.

Results and Discussion

Advances in clinical nutritional assessment reflect ongoing improvements in methodologies, accuracy, and accessibility. Techniques have evolved from fundamental anthropometry to include biomarkers and digital dietary assessment, facilitating the identification of malnutrition and guiding intervention (Corkins *et al*., 2014) [13]. Despite this, challenges persist in routine clinical application, including inconsistent tool use, limited standardization, and difficulties in documentation and interpretation.

A notable innovation is the integration of Electronic Health Record Systems (EHRS), which allow for comprehensive tracking of nutritional metrics—anthropometrics, lab data, dietary patterns, and diagnoses—across multi-disciplinary teams. EHRS enhance data fidelity, reduce duplicative testing, and enable algorithm-driven alerts for nutrition risk, particularly benefitting vulnerable groups like the elderly and oncology patients. Automated decision support within EHRS has bolstered compliance with screening protocols and streamlined the generation of actionable reports for the care team (Agarwal *et al*., 2016; Corkins *et al*., 2014) [13].

Nevertheless, standardization remains problematic, with validated tools such as MUST, SGA, and GLIM applied inconsistently across settings, often influenced by practitioner familiarity or institutional preferences rather than patient needs (Jensen). This inconsistency can result in both under- and over-diagnosis, impacting treatment outcomes.

The cultural and demographic appropriateness of assessment tools is another major limitation (Keller *et al*., 2019) [16]. Dietary assessment instruments are often based on Western food patterns, reducing accuracy when applied to culturally diverse or low-resource settings. Tools may also lack age- or disease-specific calibration, compromising their relevance for special populations such as children, older adults, or those with complex chronic disease (Guigoz, 2006) [5].

Certain methods, especially dietary recalls and clinical assessments, are subjective, with accuracy affected by clinician bias, time constraints, or insufficient training in nutritional assessment among non-dietetic staff (Swan *et al*., 2017) [19]. Self-reported dietary intake is prone to misreporting, especially in populations with obesity or disordered eating. Objective markers and tests—such as handgrip strength and gait speed—offer additional value, though their adoption is limited by costs and infrastructure.

Special considerations are necessary for pediatric, geriatric, and critically ill populations. Nutrition assessments in children must account for growth, development, and age-specific needs, and in children with chronic disease, both under- and over-nutrition may co-exist. In elders, sarcopenia and frailty necessitate tools like the Mini Nutritional Assessment (MNA) and functional measures beyond BMI (Cederholm *et al*., 2019; Skipper *et al*., 2012) [3, 18]. In intensive care, rapidly shifting metabolic states make standard measurements unreliable, increasing reliance on dynamic or biomarker-driven methods such as the NUTRIC score or Malnutrition Inflammation Score (MIS) (Mueller *et al*., 2011; Thompson & Subar, 2017) [17, 9].

Systemic limitations—such as shortages of trained dietitians, especially in public or rural settings—and underrepresentation of nutrition training in medical curricula further weaken the quality and consistency of clinical nutritional assessment (Sørensen).

Despite robust literature and established guidelines, significant knowledge gaps persist. Few large-scale, multi-center validation studies address diverse global populations, and novel biomarkers (e.g., myostatin, adipokines, metabolomics) are yet to be routinely integrated into clinical workflows. Emerging AI-based platforms that combine clinical, dietary, genomic, and psychosocial data show promise but require further validation and ethical review before widespread adoption.

Conclusion

Clinical nutritional assessment remains an indispensable component of comprehensive healthcare, pivotal in identifying malnutrition, optimizing dietary interventions, and improving clinical outcomes across diverse patient populations. The multidimensional ABCD framework—Anthropometric, Biochemical, Clinical, and Dietary assessment—provides a systematic and evidence-based approach to evaluating nutritional status, with each domain contributing critical and complementary data. In the evolving landscape of modern medicine, functional assessments and advanced tools such as bioelectrical impedance analysis (BIA), DEXA, and electronic health records (EHRs) are enhancing diagnostic precision and therapeutic planning. Despite significant advances, challenges persist, including variability in tool application, lack of standardization, limited clinician training, and the need for culturally sensitive assessment methodologies. These issues are further compounded in resource-limited settings, where access to advanced diagnostics and trained personnel is often constrained. Moreover, subjective dietary methods are susceptible to recall bias and misreporting, necessitating the integration of objective biomarkers and digital technologies for enhanced accuracy. Populations such as pediatrics, geriatrics, and critically ill patients require tailored assessment strategies, given their unique physiological and metabolic demands. Incorporating validated tools like the Mini Nutritional Assessment (MNA), Subjective Global Assessment (SGA), and Nutrition Risk Screening (NRS-2002) into routine practice is crucial for early intervention. Interdisciplinary collaboration among dietitians, physicians, nurses, and IT professionals is essential to implement consistent, patient-centered nutritional care. Looking ahead, the integration of artificial intelligence, mobile health technologies, and nutrigenomics holds promise for personalized and scalable nutritional assessments. Research must continue to focus on tool validation, cross-cultural adaptability, and implementation science. Institutional policies and academic curricula should prioritize nutrition assessment as a clinical imperative. Ultimately, standardizing clinical nutritional assessment across healthcare systems will ensure more equitable, efficient, and effective management of nutrition-related health outcomes globally.

References

1. Arends J, Baracos V, Bertz H, Bozzetti F, Calder PC, Deutz NE, *et al*. ESPEN expert group recommendations for action against cancer-related malnutrition. Clinical Nutrition. 2017;36(5):1187-1196. https://doi.org/10.1016/j.clnu.2017.06.017
2. Cederholm T, Bosaeus I, Barazzoni R, Bauer J, Van Gossum A, Klek S, *et al*. Diagnostic criteria for malnutrition-An ESPEN consensus statement. Clinical Nutrition. 2015;34(3):335-340. https://doi.org/10.1016/j.clnu.2015.03.001
3. Cederholm T, Jensen GL, Correia M, Gonzalez MC, Fukushima R, Higashiguchi T, *et al*. GLIM criteria for the diagnosis of malnutrition-A consensus report from

the global clinical nutrition community. Clinical Nutrition. 2019;38(1):1-9. https://doi.org/10.1016/j.clnu.2018.08.002
4. Elia M. The cost of malnutrition in the UK: A report by the British Association for Parenteral and Enteral Nutrition (BAPEN). 2003.
5. Guigoz Y. The Mini Nutritional Assessment (MNA) review of the literature—What does it tell us? The Journal of Nutrition, Health & Aging. 2006;10(6):466-485.
6. Kondrup J, Rasmussen HH, Hamberg O, Stanga Z. Nutritional risk screening (NRS 2002): A new method based on an analysis of controlled clinical trials. Clinical Nutrition. 2003;22(3):321-336. https://doi.org/10.1016/S0261-5614(02)00214-5
7. Kyle UG, Kossovsky MP, Karsegard VL, Pichard C. Comparison of tools for nutritional assessment and screening at hospital admission: A population study. Clinical Nutrition. 2006;25(3):409-417. https://doi.org/10.1016/j.clnu.2005.11.001
8. Singer P, Blaser AR, Berger MM, Alhazzani W, Calder PC, Casaer MP, *et al*. ESPEN guideline on clinical nutrition in the intensive care unit. Clinical Nutrition. 2019;38(1):48-79. https://doi.org/10.1016/j.clnu.2018.08.037
9. Thompson FE, Subar AF. Dietary assessment methodology. In: Coulston AM, Boushey CJ, Ferruzzi MG, editors. Nutrition in the prevention and treatment of disease. 4th ed. Academic Press; 2017. p. 5-48.
10. Willett WC. Nutritional epidemiology. 3rd ed. Oxford University Press; 2012.
11. World Health Organization. Malnutrition. 2021. https://www.who.int/news-room/fact-sheets/detail/malnutrition
12. Zhang L, Vertinsky I, Wilson M. The impact of digital health technology on routine nutritional care. Journal of Medical Internet Research. 2020;22(6):e16200. https://doi.org/10.2196/16200
13. Corkins MR, Guenter P, DiMaria-Ghalili RA, Jensen GL, Malone A, Miller S, *et al*. Malnutrition diagnoses in hospitalized patients: United States, 2010. JPEN Journal of Parenteral and Enteral Nutrition. 2014;38(2):186-195. https://doi.org/10.1177/0148607113512154
14. Gibney MJ, Lanham-New SA, Cassidy A, Vorster HH. Introduction to human nutrition. 2nd ed. Wiley-Blackwell; 2009.
15. Hulst JM, Zwart H, Hop WC, Joosten KF. Dutch national survey to test the STRONGkids nutritional risk screening tool in hospitalized children. Clinical Nutrition. 2010;29(1):106-111. https://doi.org/10.1016/j.clnu.2009.07.006
16. Keller HH, McCullough J, Davidson B, Vesnaver E, Laporte M, Goy R. The Integrated Nutrition Pathway for Acute Care (INPAC): Building consensus with a modified Delphi. Nutrition Journal. 2019;18(1):1-11.
17. Mueller C, Compher C, Ellen DM. A.S.P.E.N. clinical guidelines: Nutrition screening, assessment, and intervention in adults. JPEN Journal of Parenteral and Enteral Nutrition. 2011;35(1):16-24. https://doi.org/10.1177/0148607110389335
18. Skipper A, Ferguson M, Thompson K, Castellanos VH, Porcari J. Nutrition screening tools: An analysis of the evidence. Journal of Parenteral and Enteral Nutrition. 2012;36(3):292-298. https://doi.org/10.1177/0148607111414023
19. Swan WI, Vivanti A, Hakel-Smith NA, Hotson B, Orrevall Y, Trostler N, *et al*. Nutrition care process and model update: Toward realizing people-centered care and outcomes management. Journal of the Academy of Nutrition and Dietetics. 2017;117(12):2003-2014. https://doi.org/10.1016/j.jand.2017.07.015
20. White JV, Guenter P, Jensen G, Malone A, Schofield M, Academy Malnutrition Work Group. Consensus statement of the Academy of Nutrition and Dietetics/American Society for Parenteral and Enteral Nutrition: Characteristics recommended for the identification and documentation of adult malnutrition. Journal of the Academy of Nutrition and Dietetics. 2012;112(5):730-738. https://doi.org/10.1016/j.jand.2012.03.012
21. World Health Organization. WHO child growth standards: Length/height-for-age, weight-for-age, weight-for-length, weight-for-height and body mass index-for-age: Methods and development. WHO Press; 2006.
22. Maurya NK, editor. Contemporary health policy in India: From Alma-Ata to digital health. Writer's Pocket; [n.d.]. ISBN: 978-93-6868-943-0
23. Maurya NK. Lipid profile and nutritional evaluation of chronic renal failure patients on hemodialysis in Jhansi (Uttar Pradesh), India. Research & Reviews: A Journal of Life Sciences. 2019;9(3). Available from: https://www.stmjournals.com
24. Gibson RS. Principles of nutritional assessment. Oxford University Press; 2005.