Saudi Journal of Health Research and Practice
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2025January 27;1 (1):1-7

Original Article

Evaluation of Program Learning Outcomes in the Clinical Nutrition Curriculum

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ABSTRACT Assessing program learning outcomes (PLOs) ensures academic curricula align with competencies needed for professional success, particularly in health fields. This study aims to evaluate the PLOs of the Clinical Nutrition (CLN) program at Jazan University. A mixed-method approach was adopted to assess the PLOs' validity, reliability, and achievement. Furthermore, content and construct validity were assessed using the content validity ratio (CVR) and exploratory factor analysis (EFA), respectively. Reliability was assessed using Cronbach's alpha, and aggregates were calculated for 2024 academic cohort examination scores to evaluate PLO achievement. The CVR of the 11 PLOs ranged from 0.5 to 0.9, indicating a strong alignment with educational objectives. EFA yielded a Kaiser–Meyer–Olkin (KMO) value of 0.92, affirming the construct validity. The Cronbach's alpha of 0.799 confirmed internal consistency among the PLOs. Aggregates of the examination scores showed high achievement (more than 85%) in all PLOs except S4 and S5 from the skills domain. In conclusion, this study underscores the significance of robust assessment practices in higher education programs, demonstrating that the PLOs of the CLN program effectively guide student learning and align with accreditation standards. Continuous evaluation and refinement of these outcomes are essential to maintain educational quality and ensure the graduates are well-equipped for professional challenges in the health sector.

Keywords: National Center for Academic Accreditation and Evaluation, Clinical Nutrition Program, Curriculum, Program Learning Outcomes, Validity, Reliability, Factor Analysis.

INTRODUCTION

The assessment of learning outcomes is a fundamental aspect of modern educational systems, particularly in higher education, where the alignment of curricula with expected competencies plays a pivotal role in ensuring the effectiveness of academic programs.[1] Learning outcomes guide not only curriculum development but also teaching practices and assessment strategies, providing a clear roadmap for both teaching staff and students.[2] The measurement of these outcomes is crucial for evaluating the quality of academic programs and ensuring that graduates are equipped with the knowledge and skills necessary for professional success.[3] In this context, program learning outcomes (PLOs) and course learning outcomes (CLOs) have become essential tools for measuring student progress, course effectiveness, and program quality.[4] PLOs refer to the broad competencies that students are expected to achieve by the end of an academic program. These outcomes encapsulate the knowledge, skills, and values that align with the program's overall objectives.[5] PLOs are often aligned with the mission and vision of the academic institution, reflecting the institution's broader educational goals and the needs of stakeholders, including employers, accreditation bodies, and the community.[6] On the other hand, CLOs are the specific knowledge, skills, and abilities that students are expected to develop upon completing an individual course.[7] Each course within a program contributes to the achievement of PLOs by developing certain competencies that are part of the program's overall learning framework.[8] The alignment between CLOs and PLOs is critical as it

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ensures that individual courses collectively contribute to the achievement of the program's overarching goals.[9] Assessing PLOs ensures that academic programs are held accountable to students, employers, and accreditation bodies.[10] It provides tangible evidence that the program is meeting its stated objectives and that the students are acquiring the necessary knowledge and skills to excel in their chosen fields.[11] In health-related programs such as CLN, where the graduates are expected to perform in high-stakes environments, ensuring that learning outcomes are met is crucial for maintaining public trust and ensuring patient safety. In addition, the regular assessment of PLOs supports continuous improvement within academic programs. By evaluating the extent to which students are achieving PLOs, faculty members and administrators can identify areas of the curriculum that may need revision or enhancement.[12] This process helps maintain the relevance of the curriculum to the evolving demands of the profession and ensures that the students are receiving an education that is both current and comprehensive.[13] Moreover, the assessment of PLOs helps in fostering a student-centered approach to education. It provides the students with clear expectations about what they need to achieve and offers a framework for self-assessment and reflection. When the students understand the program's learning outcomes, they can take a more active role in their education, setting personal goals and seeking opportunities for improvement.[14] In terms of accreditation, academic programs must provide clear evidence that the students are achieving the learning outcomes essential for professional practice.[15] The effective assessment of PLOs provides this evidence, supporting the accreditation process and ensuring that the program maintains high standards of quality.[16] Different methods—such as exemplary, formative, and summative assessments, questionnaires, and interviews—can be used to assess the PLOs' achievement. These methods, in general, can be classified into two categories: direct and indirect approaches.[17] Direct assessment involves evaluating student performance based on tangible evidence of learning. Examples include exams, quizzes, practical exams, projects, presentations, and capstone experiences.[18] In the CLN program, direct assessment might take the form of clinical case studies, lab-based evaluations, and competency-based assessments where the students demonstrate their ability to apply theoretical knowledge to practical scenarios. These assessments provide concrete evidence of what students know and can do, making them a reliable method for evaluating PLOs.[19] Indirect assessment gathers information about student learning through perception-based methods such as surveys, self-assessments, exit interviews, and employer feedback.[20] While indirect assessments do not measure student performance directly, they offer valuable insights into the students' perceptions of their own learning and the program's effectiveness.[21] In the CLN program, for instance, surveys of alumni and employers could provide feedback on how well the program prepared the graduates for clinical practice. The effective assessment of PLOs often involves using a combination of direct and indirect techniques (Figure 1). This mixed-method approach ensures that the program can capture a comprehensive view of student learning, balancing objective measures of performance with subjective insights from students and stakeholders.[20,21]

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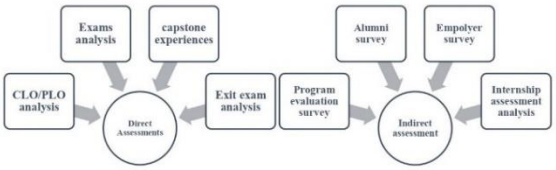

Figure 1: Assessment of Program Learning Outcomes

Outcomes-based assessment is a pedagogical approach that prioritizes the demonstration of specific competencies and skills over traditional forms of assessment.[22] This model shifts the focus from the content delivered to the actual learning outcomes achieved by the students. In the context of the CLN program at Jazan University, outcomes-based assessment aligns seamlessly with the program's objectives, emphasizing the application of knowledge and skills in real-world contexts. This approach necessitates the alignment of curriculum design, teaching strategies, and assessment methods with the PLOs and CLOs.[23] By clearly defining the expected outcomes, educators can create a cohesive learning experience that fosters student engagement and success. Outcomes-based assessment also facilitates the development of rubrics and standardized evaluation tools, providing clarity and consistency in grading practices.[24] The principles of assessment for PLOs are grounded in the concepts of validity, reliability, and fairness. Validity ensures that the assessments accurately measure what they intend to measure, while reliability refers to the consistency of assessment results over time and across different contexts.[25] Fairness entails providing all students with equitable opportunities to demonstrate their learning, regardless of their background or learning style.[26] By adhering to these principles, educators can create a robust assessment framework that not only promotes accountability but also fosters a supportive learning environment. In the CLN program at Jazan University, implementing these principles is crucial for developing a culture of continuous improvement, where the assessment results inform instructional practices and enhance student learning experiences. The primary aim of this study is to assess the learning outcomes of the CLN program at Jazan University, focusing on the effectiveness of PLOs in facilitating student learning and professional preparedness. Through a comprehensive evaluation of assessment practices, this research seeks to identify strengths and areas for

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improvement within the program, ultimately contributing to enhanced educational quality and student success.

MATERIALS AND METHODS

The CLN program, part of the College of Nursing and Health Sciences, collaborates closely with the Deanship of Academic Development to align with the accreditation practices of the National Center for Academic Accreditation and Evaluation (NCAAA). Each program is required to meet five standards, with PLOs being a key component of this assessment. PLOs articulate the knowledge and understanding, skills, values, autonomy, and responsibility that students should possess upon graduation. The bachelor's degree in CLN offered by the Department of Clinical Nutrition at Jazan University encompasses 11 PLOs (Table 1), which are developed in accordance with the Key Learning Outcomes for CLN Programs outlined in the Education & Training Evaluation Commission (ETEC) Manual 2023 as well as the Ministry of Education requirements. This structured approach ensures that the program meets national educational standards while preparing the graduates for professional practice.

Knowledge and Understanding	
K1	Describe the terminologies and principles of clinical nutrition practice, including nutritional instructions to optimize the patient care.
K2	Discuss the nutritional needs of an individual according to the current developments in nutrition & dietary standards.
K3	Demonstrate knowledge and understanding of nutritional education, health promotion, research and inquiry methodologies.
Skills	
S1	Develop critical thinking skills, analytical abilities, problem-solving and evidence-based approach to evaluate the nutritional well-being of individuals or populations.
S2	Demonstrate the ability to perform high-quality scientific research, community and inter- professional activities in the nutritional field by using advanced software's, techniques and tools.
S3	Apply Nutrition Care Process for critically ill patients by using nutritional knowledge and skills.
S4	Use counselling and educational advanced tools to facilitate behaviour change and enhance wellness for individuals and groups at community level.
S5	Communicate effectively, in an oral and written format, to multiple audiences and stakeholders.
Values, autonomy, and responsibility	
V1	Adhere to the code of ethics for healthcare professionals and values of clinical nutrition practice respective to the patient's culture and citizenship.
V2	Develop self-learning skills for nutritional management of chronic diseases.
V3	Ability to active participation in decision making, supervise a team, and performance management (Policies, Guidelines, and Standards in nutrition health care).

Table 1: Program Learning Outcomes of the Clinical Nutrition Program

This study proposed four indices—validity, reliability, sequencing equation model, and aggregates of final scores—to assess the PLOs by both qualitative and quantitative assessment methods. The qualitative assessment focused on the validity and reliability of PLOs, while the quantitative aspect employed two methods: sequencing equation model and aggregates of final scores. These methods provided a comprehensive analysis of the PLOs' alignment with program standards and outcomes.[27]

QUALITY OF PLO MEASUREMENT

Validity Assessment: The validity of the PLOs was evaluated through two sub-indices: content validity and construct validity. To assess content validity, feedback was solicited from program faculty members and other experts (employers, members of the advisory committee) in the clinical nutrition field. A self-designed questionnaire based on a Likert point scale was distributed, with response options ranging from "essential" and "useful but not necessary" to "not necessary." This method aimed to gather qualitative insights regarding the relevance of each PLO. The responses were analyzed using the Lawshe technique,[28] which quantifies content validity by calculating the content validity ratio (CVR) based on expert opinions. For construct validity, exploratory factor analysis (EFA) was conducted.[29, 30] Prior to performing EFA, the Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy and Bartlett's test of sphericity were employed to assess the appropriateness of the data for factor analysis.[31] The KMO value indicates the degree of intercorrelation among the variables, while Bartlett's test checks whether the correlation matrix is significantly different from an identity matrix, suggesting that the data is suitable for factor analysis.

Reliability Assessment: The reliability of the PLOs was measured using Cronbach's alpha, which evaluates internal consistency among the respondents' feedback on the PLOs. A Cronbach's alpha value of 0.70 or higher is generally considered acceptable, indicating that the items in the questionnaire yield consistent results across the sample.

QUANTITY OF PLO MEASUREMENT

Sequencing Equation Model (SEM): Confirmatory factor analysis (CFA) is employed to assess the optimality and alignment of the PLOs,[32] ensuring that they adequately represent the educational objectives of the CLN program. This statistical method allows for the validation of relationships between the observed variables and their underlying latent constructs, thereby reinforcing the quantitative assessment of the PLOs.

Aggregate Method: Students' final examination scores for the academic year 2024 were utilized to evaluate the extent of achievement of the PLOs. This data serves as a quantitative measure of how well students meet the established PLOs.

RESULTS

In total, 24 responses were received during September 2024. Of these, 10 (41.7%) were teaching faculty members, and 14 (58.3%) were experts in the clinical nutrition field. This

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diverse participant pool enriched the validity and reliability of the feedback.

Content Validity: The overall content validity for the 11 PLOs ranged from 0.5 to 0.9. This indicates that the program has successfully formulated the learning outcomes, ensuring they encompass the essential content.

Construct Validity: Exploratory factor analysis, Kaiser-Meyer-Olkin (KMO) test result 0.92 (>0.60) conforms that the sample adequacy and Bartlett's Test of Sphericity (BTS) significant P-value (<0.01) assured that the appropriateness of the factor analysis for the assessment of PLOs. The scree plot with an eigenvalue of more than 2 suggested that the three-factor structure solution (Figure 2) for the program 11 PLOs.

Internal Consistency and Reliability: The Cronbach's alpha index of 0.799 indicates that the 11 PLOs are reliable, with a high level of internal consistency.

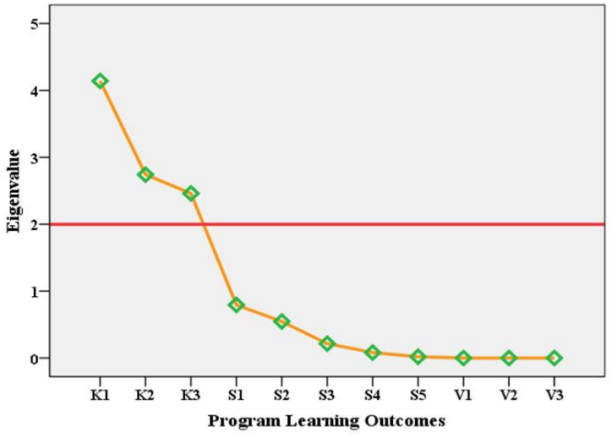

Figure 2: Scree Plot of Program 11 PLOs with Three-factor Solution

Sequence Equation Modal: The comparative fit index (CFI) of 0.912, with a non-significant chi-square value and a root mean square error of approximation (RMSEA) value of 0.050 (95% CI: 0.045–0.055, P < 0.01), indicates that the model has an excellent fit with the program 11 PLOs, with acceptable factor loading boundaries between 0.47 and 1.00. The PLOs K1, K2, and K3 had significant factor loadings (path coefficients) with knowledge and understanding domain (K1 = 1.00, K2 = 1.00; P < 0.01, and K3 = 0.47; P < 0.01), followed by S1, S2, S3, S4, and S5 with the skills domain (S1 = 0.97, S2 = 0.90; P < 0.01, S3 = 0.91; P < 0.01, S4 = 0.77; P < 0.01, and S5 = 0.70; P < 0.01). V1, V2, and V3 had significant factor loadings (path coefficients) with the values, autonomy, and responsibility domain (V1 = 1.00, V2 = 1.00; P < 0.01 and V3 = 0.67; P < 0.01). In summary, the skills and values, autonomy, and responsibility domains contributed more than the knowledge domain (knowledge = 0.09, skills = 0.28, and values = 0.61) in the overall student achievement of the educational objectives of the program, and there was no evidence of collinearity in the model (Figure 3). The factor structures remain intact, and all the PLOs had significant paths as well as correlations with the respective factor domains.

Aggregate Method: The students' cohort 2024 final examination scores were used for measuring the quantity of PLO achievement (Table 2). The target performance achievement of each PLO is set as 100% of the students getting 85% or above.

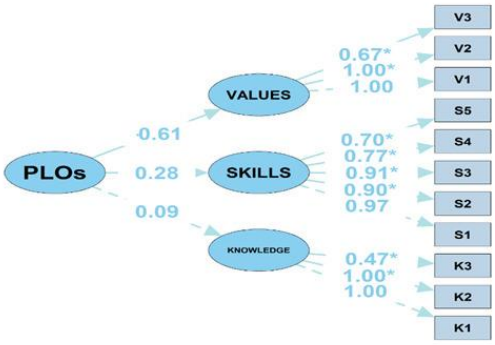

Figure 3: PLOs Structure by Structural Equation Modeling
PLOs: Program learning outcomes, KNOWLEDGE: Knowledge and understanding domain, SKILLS: Skills domain, VALUES: Values, autonomy, and responsibility domain and *Highly significant (P < 0.01).

Direct Assessment Method			
PLOs	Male	Female	Average
Knowledge and Understanding			
K1	80	90	85
K2	91	80	86
K3	89	89	89
Skills			
S1	85	85	85
S2	91	90	91
S3	90	90	90
S4	80	79	80
S5	80	80	80
Values, Autonomy, and Responsibility			
V1	87	84	86
V2	90	91	91
V3	87	84	86

Table 2: Aggregates of PLOs Attainment Results (%)

Figure 4 displays the overall performance of students across various assessments in 2024, indicating the percentage of students meeting the target benchmark of 85% or above for each PLO. The data reveals that, with the exception of PLOs S4 and S5, the students demonstrated strong proficiency, achieving the desired performance levels in their examinations.

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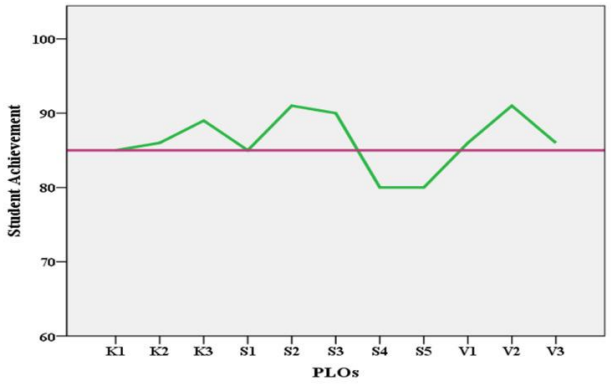

Figure 4: Students Achievement in all examinations for the academic year 2024.

DISCUSSION

This study aimed to analyze PLOs within the CLN program at Jazan University. The findings from this study provide important insights into the validation of PLOs for this program. The diverse group of participants, including teaching faculty members and other clinical nutrition experts, ensures a broad representation of perspectives, enhancing the reliability of the results. The analysis of the content and construct validity, internal consistency, and assessment of PLO achievement presents a robust evaluation of the educational outcomes associated with the program.[33, 34] Along similar lines, the studies that emphasize the importance of continuous refinement of learning outcomes to ensure they remain relevant and comprehensive.[35, 36] This study employed EFA to assess the construct validity of the PLOs at the clinical nutrition department. This is consistent with the studies of Naglaa et al. (2022) and Chee-Peng (2024), which also employed similar statistical methods to validate educational constructs.[38, 39] The three-factor structure derived from the scree plot analysis aligns well with theoretical frameworks in educational assessment that suggest categorizing learning outcomes into knowledge and understanding, skills, values, autonomy, and responsibility.[40] The Cronbach's alpha index for the internal consistency of the PLOs signified a good level of reliability. This suggests that the PLOs are measuring a coherent construct, which is crucial for ensuring that the students are developing the intended competencies throughout their educational experience. A comparable study has reported similar findings, where high internal consistency was linked to effective learning outcomes and program quality.[41] In assessing the quantity of PLOs achievement, the results of this study indicate that the students performed well and achieved the target benchmarks of the PLOs except for S4 and S5 in the skills domain. This performance can be interpreted as a positive reflection of the teaching methodologies and curriculum implemented within the program. Notably, the high performance in values and autonomy outcomes reinforces the importance of instilling ethical and professional values in clinical practice, as outlined in the existing literature.[42]

The strengths of this study lie in its rigorous methodology, including a well-defined participant selection process and the use of established statistical techniques for validating PLOs. However, it is important to acknowledge the study's limitations. The sample size of 24, while adequate for preliminary analysis, may not be representative of the entire population of faculty members and experts in clinical nutrition. A larger, more diverse sample could provide more generalizable results. Additionally, the study relied on self-reported measures, which may introduce bias as the participants might have overestimated their competence or the program's effectiveness. Another limitation is the time frame of the data collection as it was conducted over only a month. This brief period may have influenced participant response rates and could limit the depth of insight obtained regarding the program's outcomes. Furthermore, while the assessment metrics for PLOs provide valuable quantitative data, qualitative insights from open-ended feedback could enhance the understanding of the participants' perspectives on the program's strengths and weaknesses. Lastly, while the study successfully demonstrated strong content and construct validity, it did not explore the longitudinal impact of PLOs on student performance over time. Incorporating a longitudinal approach could provide deeper insights into how well the PLOs prepare students for their professional roles post-graduation.

CONCLUSIONS

In conclusion, this study provides valuable insights into the validation of PLOs for the CLN program at Jazan University. The findings demonstrate that the program is effectively achieving its learning outcomes, particularly in knowledge and values, while highlighting areas for improvement in skills application. The analysis emphasizes the need for continuous evaluation and refinement of educational strategies to ensure that graduates are well-equipped to meet the demands of the clinical nutrition field. Future research should focus on expanding the sample size, incorporating qualitative assessments, and employing longitudinal studies to track the long-term effectiveness of the program. By addressing these areas, the CLN program can further enhance its educational outcomes and better prepare students for their professional roles.

AUTHOR CONTRIBUTIONS:

Z.H.H. was responsible for conceptualization, methodology, project administration, data curation, validation, formal analysis, writing the original draft, and review and editing of the manuscript. R.M.C assisted in data analysis. A.A.A contributed to the manuscript review. The authors have read and agreed to the published version of the manuscript.

FUNDING

This research received no specific grants from any funding agency in the public, commercial, or none-profit sector.

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INFORMED CONSENT STATEMENT:

Not Applicable

DATA AVAILABILITY STATEMENT

The datasets generated and/or analyzed during the current study are not publicly available. However, they can be obtained from the corresponding author upon request.

ACKOWLEDGMENTS

The authors sincerely acknowledge all of the participants and clinical nutrition experts for their invaluable support and guidance in completing this research.

CONFLICTS OF INTEREST

Authors declare that they have no conflicts of interest.

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