Reliability And Psychometric Evaluation Of The Nutritional Knowledge Test Among Tribal Students

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ARTICLE INFO	ABSTRACT
	This study examines the internal consistency and item-level reliability of the General Nutritional Knowledge assessment scale, which consists of four sections, using Cronbach's Alpha and other psychometric statistics. With a moderate reliability score (α = 0.63), the scale is deemed suitable for exploratory purposes but requires further refinement for confirmatory or high-stakes use. Item-level analysis highlighted Section 2 as crucial for overall consistency, while Section 3 weakened reliability. The study involved 347 students from the tribal communities of Attappady, who completed the assessment. Data were analyzed using the "psych" package in R, employing metrics such as Cronbach's Alpha, Guttman's lambda-6, and item-total correlations. Based on the findings, the study recommends refining low-contribution items and conducting factor analysis for further validation to improve the scale's psychometric properties. **Keywords**: reliability analysis, GNK sections, Cronbach's Alpha, internal consistency, psychometric validation, tribal students, Attappady.

1. INTRODUCTION

Nutritional knowledge is a cornerstone in promoting healthy eating habits and lifestyle choices, particularly in underserved and marginalized communities. Tribal populations, such as those in Attappady, Kerala, often face unique barriers to nutrition education due to cultural, geographical, and socio-economic factors (Rao & Kulkarni, 2010; Patel & Mehta, 2012). These communities have limited access to resources and health education, making the assessment of their nutritional knowledge vital for designing targeted interventions aimed at improving health outcomes (Kumar & Bhat, 2015).

Among the tools used to evaluate nutritional knowledge, standardized assessments are essential for ensuring that interventions are evidence-based and culturally appropriate. The *GNK (General Nutritional Knowledge)* assessment scale was developed to measure various dimensions of nutritional knowledge among students. However, before it can be widely used, it is crucial to evaluate its psychometric properties, including reliability and internal consistency (Cronbach, 1951; Nunnally & Bernstein, 1994)

This study evaluates the internal consistency and reliability of the *GNK* assessment scale, focusing on its four sections. Using statistical techniques such as Cronbach's Alpha, Guttman's Lambda-6, and item-total correlations, the study aims to assess the scale's effectiveness in capturing nutritional knowledge in the tribal student population of Attappady. The moderate reliability score (α = 0.63) found in this study suggests that the scale is suitable for exploratory purposes, but further refinement is needed for high-stakes or confirmatory assessments (Kline, 2000). Notably, Section 2 was identified as contributing significantly to the scale's overall consistency, while Section 3 showed weaknesses, indicating areas for improvement.

This research includes 347 students from the tribal communities of Attappady and provides valuable insights into the psychometric properties of the *GNK* assessment. These findings highlight the need for further validation and refinement of the scale to ensure that it accurately measures nutritional knowledge in tribal populations, a crucial step for developing effective nutritional interventions (Schmitt, 1996).

2. REVIEW OF RELATED LITERATURE

Internal consistency, typically assessed using Cronbach's Alpha, has been widely used as a foundational metric for scale reliability (Tavakol & Dennick, 2011). A commonly accepted threshold for adequate reliability is 0.70, though exploratory research may tolerate lower levels (DeVellis, 2017). Item-total correlations, signal-to-noise ratios, and average inter-item correlations are also vital in assessing individual item contributions (Field, 2013). Literature emphasizes the importance of refining items with low inter-item coherence or inconsistent contributions to overall alpha (Gliem & Gliem, 2003).

3. METHODOLOGY

The methodology section of the study outlines the design, subject selection, variable selection, data collection, and statistical analyses employed to evaluate the reliability of the GNK assessment scale.

3.1 Selection of Subjects
A total of 347 participants were chosen for the study. These participants were required to complete the GNK assessment, a multi-section instrument designed to measure various constructs. The subjects were selected based on specific inclusion criteria, ensuring a representative sample for the analysis. The selection process aimed at obtaining a diverse group of participants, which would enhance the generalizability of the findings. While the exact demographic characteristics of the participants are not specified, it is assumed that the sample was randomly selected from a population relevant to the use of the GNK assessment, possibly including individuals from educational or psychological research settings.

3.2 Selection of Variables
The primary variable under consideration in this study was the internal consistency of the GNK assessment scale, which consists of four distinct sections. The focus was on evaluating the reliability of each section of the scale. Specific psychometric variables included Cronbach's Alpha (α), Guttman's lambda-6 (G6 smc), average inter-item correlations (Avg. r), item-total correlations, and the signal-to-noise ratio (S/N). These measures helped assess the internal consistency and item-level reliability of each section. The reliability statistics for each section were key in understanding the contributions of individual items to the overall reliability of the scale.

3.3 Collection of Data
The data for the analysis were collected through the completion of the GNK assessment by the participants. Each participant was asked to fill out the assessment, which included four sections, each with a different number of items (18, 36, 13, and 21 points respectively). The responses from the participants were then aggregated for statistical analysis. While the study did not describe any specific instructions or guidelines given to participants, it can be inferred that they were asked to provide honest responses based on their experiences or perceptions related to the GNK assessment. This step was crucial in ensuring the authenticity and validity of the data for the subsequent analyses.

3.4 Statistical Analysis
The primary tool used for the statistical analysis of the data was R, specifically the "psych" package, which offers a comprehensive set of functions for psychometric analysis. The study employed various reliability statistics to evaluate the internal consistency of the GNK sections. These included Cronbach's Alpha (α) for assessing overall scale reliability, Guttman's lambda-6 (G6 smc) for alternative reliability estimation, and the average inter-item correlation (Avg. r) to examine how well items correlated within each section.
In addition to these, the item-total correlations were computed to determine the contribution of each individual item to the overall scale reliability. The Signal-to-Noise ratio (S/N) and variability statistics were also considered to assess the strength and consistency of item relationships across the sections. These metrics helped to identify sections that contributed more strongly to the scale's reliability (such as Sections 3 and 4) and those that weakened it (such as Section 2).

4. ANALYSIS AND INTERPRETATION

The following analysis presents item-level and section-level reliability statistics for the General nutritional knowledge assessment across its four sections. Reliability measures such as Cronbach's alpha, average inter-item correlation, signal-to-noise ratio, and variability statistics are used to evaluate internal consistency and measurement precision. These results help determine the relative consistency and discriminative power of each section in capturing the intended constructs.

Table 1 *Item-Level Reliability Statistics for GNK Sections*

Item	Alpha if Dropped	Avg. r	S/N	r.drop	Mean	SD
GNK.Section.1 (Out of 18)	0.56	0.31	1.35	0.43	8.8	2.6
GNK.Section.2 (Out of 36)	0.47	0.24	0.94	0.55	15.3	4.3
GNK.Section.3 (Out of 13)	0.61	0.34	1.56	0.36	6.2	2.2
GNK.Section.4 (Out of 21)	0.57	0.35	1.59	0.40	8.3	2.8

Table 1 indicates the item-level reliability statistics for the GNK sections indicate varying levels of internal consistency. GNK.Section.1 has moderate reliability (α = 0.56) with a higher average inter-item correlation (Avg. r = 0.31). GNK.Section.2 shows the weakest reliability (α = 0.47) and lower average inter-item correlation (Avg. r = 0.24). GNK.Section.3 has the strongest internal consistency (α = 0.61, Avg. r = 0.34), followed by GNK.Section.4 (α = 0.57, Avg. r = 0.35). Sections 3 and 4 are more reliable than Sections 1 and 2.
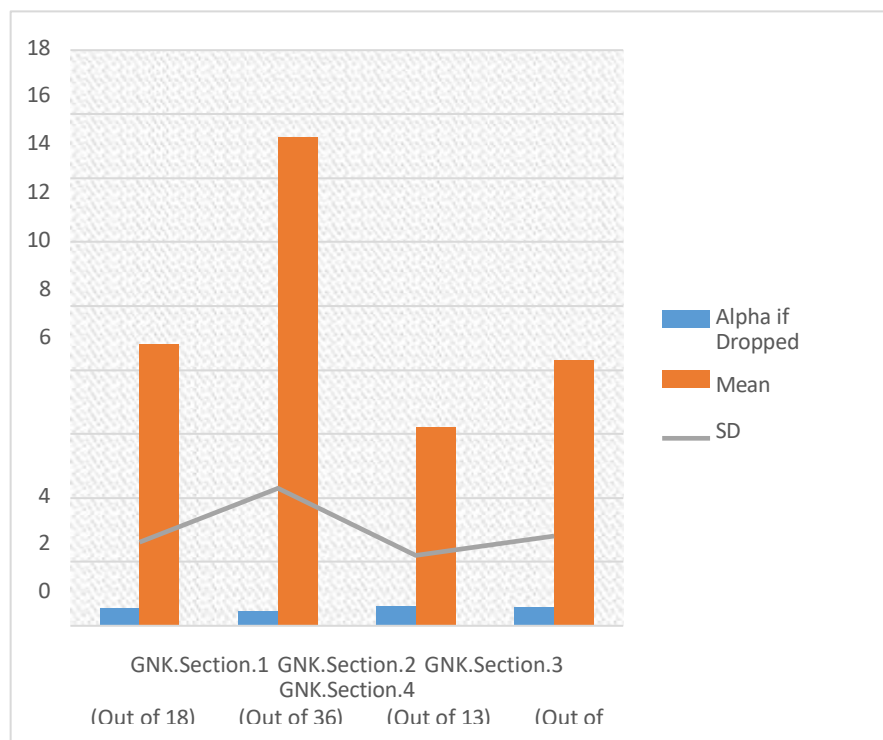
Figure 1 *Item-Level Reliability Statistics for GNK Sections*

Table 2 *Reliability Statistics for GNK Sections*

GNK Section	Raw Alpha	Std. Alpha	G6 (smc)	Avg. r
GNK.Section.1	0.50	0.55	0.62	0.099
GNK.Section.2	0.51	0.56	0.62	0.102
GNK.Section.3	0.51	0.54	0.62	0.096
GNK.Section.4	0.52	0.57	0.63	0.106

Table 2 shows the reliability statistics for the GNK sections show moderate internal consistency across all sections. Section 4 has the highest reliability with a raw alpha of 0.52, while Sections 1, 2, and 3 show slightly lower values. All sections have relatively low average inter-item correlations, indicating moderate but consistent reliability overall.
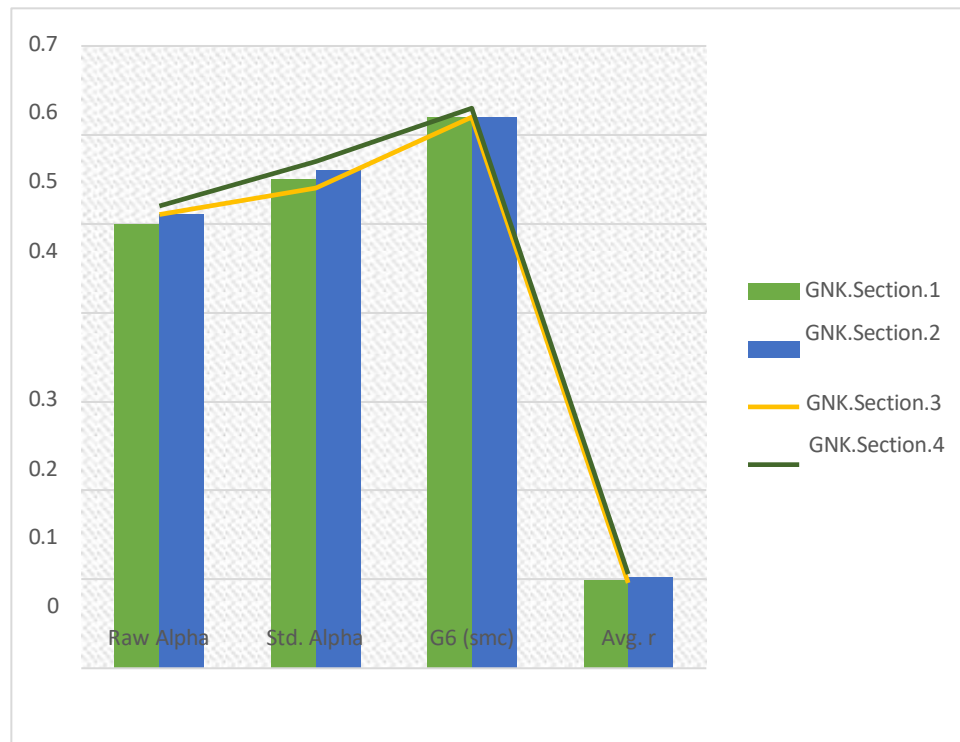
Figure 2 *Reliability Statistics for GNK Sections*

Table 3 *Signal-to-Noise Ratio and Variability Statistics*

GNK Section	S/N	α SE	Var(r)	Median r
GNK.Section.1	1.2	0.034	0.024	0.069
GNK.Section.2	1.3	0.033	0.022	0.086
GNK.Section.3	1.2	0.034	0.024	0.071
GNK.Section.4	1.3	0.033	0.023	0.089

Table 3 indicates that GNK.Section.4 has the highest consistency and reliability, with the best Signal-to-Noise Ratio (S/N) of 1.3 and the highest median inter-item correlation (0.089). GNK.Section.2 also shows a higher S/N of 1.3 and a median r of 0.086, suggesting better consistency than Sections 1 and 3, which have slightly lower median correlations (0.069 and 0.071, respectively). Sections 2 and 4 also exhibit lower variability in inter-item correlations compared to Sections 1 and 3, reinforcing their higher reliability.
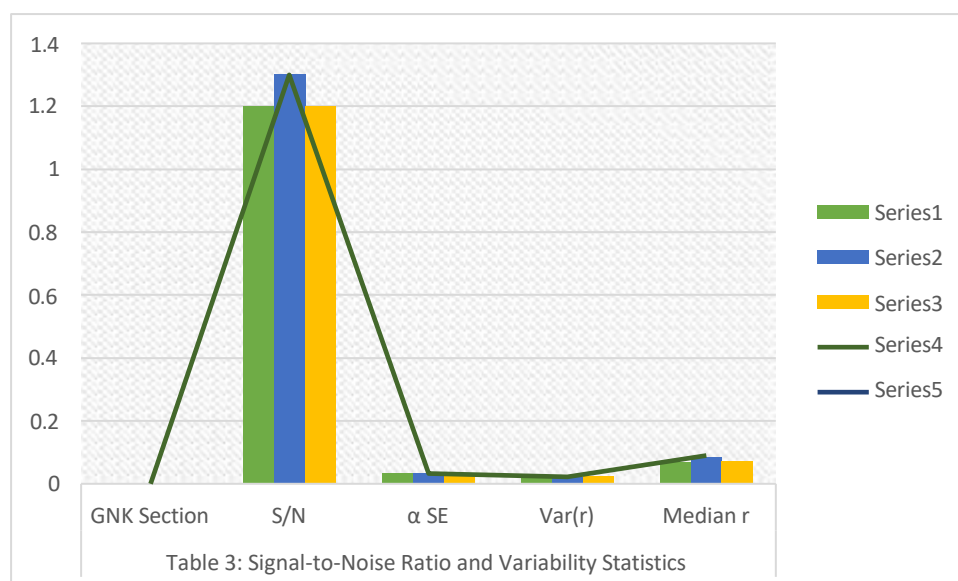

Table 3: Signal-to-Noise Ratio and Variability Statistics

Figure 3 *Signal*-to-Noise Ratio and Variability Statistics

Table 4 *Item Statistics for GNK Sections*

GNK Section	N	Raw r	Std. r	r.cor	Mean	SD
GNK.Section.1	347	0.386	0.50	0.411	8.9	2.7
GNK.Section.2	347	0.373	0.46	0.386	14.9	4.4
GNK.Section.3	347	0.400	0.53	0.456	6.0	2.0
GNK.Section.4	347	0.255	0.42	0.328	8.4	2.6

The table 4 indicates that GNK.Section.3 has the strongest item relationships, with the highest raw (0.400), standardized (0.53), and corrected (0.456) correlations, along with a low mean (6.0) and SD (2.0), reflecting consistency and a narrow score distribution. In contrast, GNK.Section.4 shows the weakest item relationships with the lowest correlations and moderate score variability. Sections 1 and 2 show moderate item relationships, with Section 1 slightly stronger than Section 2.
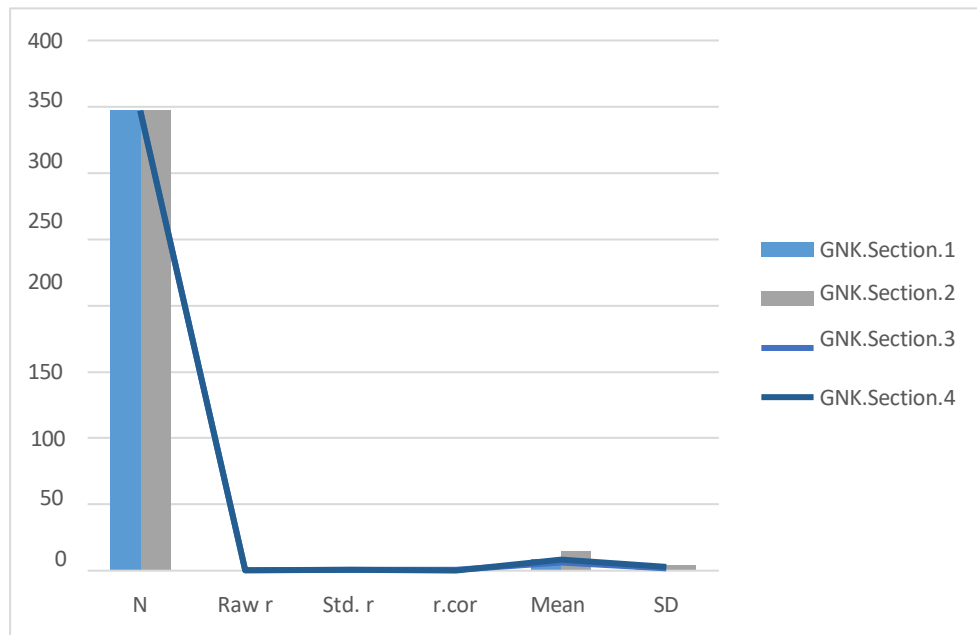
Figure 4 *Item Statistics for GNK Sections*

5. DISCUSSION ON FINDINGS

5.1 Item-Level Reliability Analysis
The reliability statistics presented in Table 1 offer insight into how each section of the GNK assessment contributes to internal consistency and overall scale robustness. GNK Section 1, which includes 18 items, demonstrates moderate reliability with an alpha of 0.56 and an average inter-item correlation of 0.31. These values suggest that while the items are moderately related, there is room for refinement. In contrast, GNK Section 2, the largest with 36 items, shows weaker reliability (alpha = 0.47, Avg. r = 0.24), indicating that the items in this section may not be cohesively measuring a single construct. Interestingly, Section 3, although smaller (13 items), shows stronger internal consistency with an alpha of 0.61 and Avg. r = 0.34, suggesting that the items are more tightly aligned. Section 4, comprising 21 items, has an alpha of 0.57 and the highest average inter-item correlation (Avg. r = 0.35), further pointing to relatively better internal consistency. Collectively, these results suggest that Sections 3 and 4 contribute more positively to the reliability of the GNK assessment, while Section 2 appears to dilute scale coherence.

5.2 Section-Wise Reliability Statistics
In Table 2, a broader psychometric overview is provided using multiple reliability coefficients. All four sections demonstrate raw alpha values ranging narrowly between 0.50 and 0.52, with standardized alpha and Guttman's lambda-6 (G6 smc) values clustering around 0.54–0.57 and 0.62, respectively. These figures reinforce the notion of moderate reliability across sections. Section 4 edges slightly ahead in reliability performance with a raw alpha of 0.52 and the highest average inter-item correlation (Avg. r = 0.106), suggesting more cohesive item behavior. Though the differences between sections are not drastic, this consistency in moderate alpha values implies that while the overall scale is stable enough for exploratory studies, refinement is needed for applications demanding high precision.

5.3 Signal-to-Noise Ratio and Item Variability
The data in Table 3 shed light on the internal consistency and predictability of item performance through

signal-to-noise ratio (S/N), standard error of alpha (α SE), variance in correlations (Var(r)), and median inter-item correlation (Median r). GNK Sections 2 and 4 both recorded the highest S/N ratios of 1.3, indicating better clarity and reduced measurement error compared to Sections 1 and 3 (S/N = 1.2). Median inter-item correlations further support this trend, with Section 4 achieving the highest value at 0.089. Variance in inter-item correlations is also lowest in Section 2 (Var(r) = 0.022), suggesting consistent item relationships. Overall, these indicators favor Section 4 as the most statistically sound in terms of item behavior, with Section 2 showing improved consistency despite its previously noted lower alpha, possibly due to the greater number of items diluting the overall reliability score.

5.4 Descriptive Item Statistics

Table 4 presents key descriptive and correlation-based metrics for each section, offering further insight into individual item behavior. GNK Section 3 continues to display robust item relationships with a raw correlation (Raw r = 0.400), standardized correlation (Std. r = 0.53), and a corrected item-total correlation (r.cor = 0.456). These values indicate that Section 3 items align well with the overall scale. Section 1 also performs moderately with Raw r = 0.386 and r.cor = 0.411, though slightly below Section 3. While Section 2 exhibits a lower corrected correlation (r.cor = 0.386), it is not significantly behind. However, Section 4's lower raw and corrected correlations (0.255 and 0.328 respectively) contrast with its strong average inter-item correlation and S/N ratio, suggesting that while the section is internally consistent, its items may not align as strongly with the total scale. These patterns underscore the complexity of reliability assessment, where consistency and contribution to total scale may not always align perfectly.

Across all statistical indicators, the GNK assessment demonstrates moderate internal consistency, with Sections 3 and 4 generally outperforming Sections 1 and 2 in terms of reliability. Section 2, despite having the most items, may benefit from item reduction or rewording to enhance coherence. Section 4, with strong S/N and inter-item correlation metrics, appears the most promising for future scale development. The findings suggest that while the GNK scale is suitable for exploratory research, refinements and confirmatory factor analysis are needed to elevate it to a high-stakes or diagnostic level tool.

6. CONCLUSIONS

This study examines the reliability and internal consistency of the GNK assessment scale, which consists of four sections. Key findings include:

1. Section 3 demonstrated the highest reliability, with consistent measurement across its questions. Section 4 also performed well, while Section 1 exhibited moderate reliability. Section 2, however, showed the weakest reliability, indicating that its items might be too broad or varied.
2. All sections achieved moderate overall reliability, making the scale acceptable for research purposes. Section 4 slightly outperformed the others in terms of inter- item consistency. However, some improvements in item clarity could further enhance the scale's reliability.
3. Sections 2 and 4 displayed stable response patterns, suggesting that participants answered consistently. Despite Section 2's lower internal consistency, it holds potential for improvement. Sections with stable responses are generally more reliable for data collection.
4. Section 3 had the strongest alignment between individual items and the overall theme, followed by Section 1. Section 2's items, though individually strong, lacked collective focus, while Section 4's items, although relevant, were slightly weaker.
5. In terms of overall reliability, the Cronbach's alpha for the GNK scale was 0.63, which falls below the ideal threshold of 0.70. This suggests that while the scale is acceptable for exploratory use, it requires refinement. Specifically, Section 2 needs substantial revision to improve its contribution to the overall reliability of the scale. Sections 3 and 4 should be retained or further developed for future use.
6. The study emphasizes the importance of item-level reliability analysis to understand how individual sections contribute to the scale's overall consistency. Psychometric techniques such as Cronbach's alpha, Guttman's lambda-6, and average inter-item correlation provide valuable insights into the scale's structure, laying the groundwork for future refinement and validation.
7. GNK assessment scale shows promise, its current version requires revision, particularly in Section 2. Future research should focus on refining the scale through factor analysis to ensure stronger coherence between items and enhance its psychometric validity for broader use.

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