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Optimizing Nutrition Care: A Comparative Study of Nutrition Screening Tools in Children with Drug-Resistant Epilepsy

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Abstract

Objectives: To compare the STRONGkids and SGNA tools in identifying malnutrition risk in children with Drug Resistant Epilepsy (DRE) and to determine their validity and reliability among children with Drug Resistant Epilepsy (DRE). **Methodology:** A cross-sectional observational study was conducted at Sri Ramachandra Hospital, Department of Neurology, Chennai, Tamil Nadu, India. The duration of the study was four months from July 1st, 2024, to November 1st 2024, involving 30 children diagnosed with Drug Resistant Epilepsy (DRE) having either focal or generalized epilepsy, aged below five years. Nutritional risk was assessed using the STRONGkids and SGNA tools. The STRONGkids tool evaluates factors such as weight, growth, feeding difficulties, and underlying medical conditions, while the SGNA tool includes a clinical examination with a focus on weight history, appetite changes, and physical signs of malnutrition. Participants Socio Economic data were also collected and were classified as per Kuppuswamy Socio-Economic Status (SES) classification. Data were analyzed using descriptive statistics and inter-rater reliability measures. **Findings:** The STRONGkids tool identified 15 children (50%) at medium risk of malnutrition, while the SGNA tool identified 14 children (46.7%) as moderately malnourished. The agreement between the two tools was high, with a kappa coefficient of 0.76, indicating substantial inter-rater reliability. Both tools identified 15 (48.35%) children as having moderate malnutrition, with minor discrepancies in the number of children flagged. **Novelty:** Unlike previous research that broadly examines pediatric malnutrition, this study specifically targets children with DRE, a population at heightened risk for nutritional issues due to complex medical needs. The study is one of the first to directly compare the STRONGkids and SGNA tools for identifying malnutrition risk in children with DRE, particularly those under the age of 5, a group often underrepresented in nutritional research. The study identifies the strengths of both tools, STRONGkids for quick, routine screening and SGNA for comprehensive assessment offering practical guidance for clinicians managing pediatric DRE cases.

Keywords: Nutritional Screening; Drug Resistant Epilepsy; STRONGkids; SGNA; Antiseizure Medications

1 Introduction

Children with drug-resistant epilepsy (DRE) are more likely to have low nutritional status as a result of pharmaceutical side effects, altered metabolism, and feeding difficulties, all of which can impede growth and development[1]. Accurate and early detection of nutritional deficits is critical in managing these children to avoid consequences such starvation, underweight, and stunted growth[2]. Several screening measures have been developed to assess nutritional status, such the STRONGkids (Screening Tool for Risk on Nutritional Status and Growth) and the SGNA (Pediatric Subjective Global Nutrition Assessment)[3]. The STRONGkids tool is a rapid and easy screening method for identifying children at risk of malnutrition, taking into account weight, growth, and underlying medical issues[4]. The SGNA, on the other hand, is based on clinical judgment, evaluating the child's dietary intake, weight history, and physical examination results[5]. While both methods are commonly used in pediatric clinical settings, there is no information evaluating their efficacy in children with DRE, particularly those aged one month to five years[6]. Significant progress has been made in understanding the nutritional issues faced by children with drug-resistant epilepsy (DRE), emphasizing the negative consequences of long-term antiseizure medication use and metabolic disturbances on growth and overall health. Research has highlighted the necessity of early nutritional screening in pediatric populations, resulting in the creation of validated instruments such as STRONGkids and SGNA. However, previous research has mostly focused on hospitalized or chronically unwell children, with little attention paid to those with DRE, a group distinguished by abnormal energy metabolism, feeding challenges, and ketogenic dietary therapies. Furthermore, while these methods have been routinely used in clinical practice, their effectiveness in diagnosing malnutrition risk in children under the age of five with DRE has yet to be investigated. This dearth of data makes it difficult to decide which screening technique is best for this susceptible group, highlighting the necessity of further study to evaluate the methods' validity and reliability in this particular setting. In order to close this gap and provide prompt interventions to avoid long-term consequences, the current study aims to give clinicians evidence-based recommendations for early and accurate nutritional risk assessment in children with DRE.

2 Methodology

Study Design: A cross-sectional observational study was carried out at Sri Ramachandra Hospital's Department of Neurology in Chennai, Tamil Nadu, India. The trial spanned four months, from July 1st to November 1st, 2024, and included thirty children diagnosed with drug-resistant epilepsy under the age of five years.

Sample Size Determination: The sample size for this study was chosen using the study's objectives, which called for enough statistical power to detect important effects while reducing the possibility of Type I and Type II errors. G*Power software was used for a priori power analysis, with an expected effect size (Cohen's d) based on existing literature[7], a significance threshold (α) of 0.05, and a target statistical power of 0.80 to provide an 80% probability of detecting a true effect. To ensure robustness, the required sample size was modified to account for probable attrition and missing data. The study used relevant statistical tests, such as t-tests for group comparisons and regression analysis for predictive modeling, with assumptions validated by normality and homogeneity tests. This approach assures that the results are credible and generalizable by justifying the sample size using power analysis, lowering the likelihood of misleading findings.

Inclusion Criteria: Children were included if they had a verified diagnosis of Drug-Resistant Epilepsy (DRE), which is defined as epilepsy that does not respond to at least two acceptable anti-seizure drugs[8]. The study's inclusion criteria were children aged one month to five years with Drug Resistant Epilepsy (DRE) who had either focal or generalized epilepsy, had failed an adequate trial of two tolerated anti-seizure medications that were appropriately chosen and used, and were not amenable to epilepsy surgery.

Exclusion Criteria: Children above five years of age, those going for epilepsy surgery and those who were critically ill.

Ethical Approval: The study was approved by the Institutional Ethical Committee of Sri Ramachandra Institute of Higher Education and Research, Porur, Chennai. (REF NO: IEC/24MAR/185/09).

Consent Statement: Parental consent was also taken before enrolling the study participants.

Data Collection: Nutritional risk was assessed using both the STRONGkids and SGNA tools which is an open access tool and does not require any prior permission to use it [9,10]. The STRONGkids tool includes a total of four questions that evaluate weight-for-age, growth pattern, feeding difficulties, and underlying medical conditions[9]. The SGNA assessment is based on a thorough clinical examination, including a history of weight loss, appetite changes, and physical examination such as loss of subcutaneous fat, muscle wasting, nutrition related edema to assess signs of malnutrition[10]. Both the tools are having open access and are free to use in public domain. Data collection and management for both tools were conducted manually under the supervision of the Epileptologist. Each participant was assessed using both tools in a randomized order. The results from the STRONGkids and SGNA assessments were compared using descriptive statistics and inter-rater reliability measures.

Participants Socio Economic data were also collected and were classified as per Kuppuswamy scale into five categories Upper Class, Upper Middle Class, Middle Class, Lower Middle Class, and Lower Class[11].

Statistical Analysis: Statistical analysis was performed using SPSS software to check for the mean, standard deviation and kappa value.

3 Results and Discussion

A total of 30 children with drug-resistant epilepsy participated in the study. The mean age of the participants was 2.8 ± 1.4 years. The majority of the children 19 (63%) were male, and 11 (37%) were female. The mean duration of epilepsy diagnosis for the participants, was 2.3 ±1.4 years. Of these, 18 (60%) had generalized epilepsy, and the remaining 12 (40%) had focal epilepsy. The mean seizure frequency among the participants was 11.0 ± 1.0 episodes per day. The estimated mean energy intake among the participants on a normal dietary regimen was 1200 ± 150 kcal/day. The mean protein intake was calculated to be 40.0 ± 5.0 g/day, contributing approximately 13-15% of total energy intake. Carbohydrate intake was estimated at 165.0 ± 20.0 g/day, providing the primary energy source and accounting for approximately 50-55% of total caloric intake. The mean fat intake was 40.0±10.0 g/day, representing approximately 30-35% of total daily caloric intake. The participants were receiving an average of 3.0 ± 1.0 antiseizure medications, indicating variability in pharmacological management Table 1. The Anti-seizure Medications (ASMs) was not same for all participants, it was decided based on seizure type, epilepsy syndrome, patient characteristics, and drug properties by the Pediatric Epileptologist. In terms of feeding routes, the majority 27 (90%) children were on oral feeding, while 2 (6.7%) children required a gastrostomy tube (G-tube), and 1 (3.3%) child was fed through a nasogastric tube (NG-tube). These findings highlight the diverse nutritional and medical needs of children with drug-resistant epilepsy and reinforce the importance of individualized dietary and treatment plans. The socioeconomic status data of study participants were also collected, and it was found that 21 (70%) of study participants were from lower middle class, 6 (20%) were from middle class and only 3 (10%) were from upper middle class. The results of the STRONGkids and SGNA assessments showed significant concordance in identifying children at nutritional risk. The STRONGkids tool identified 15 children (50%) at medium risk of malnutrition, while the SGNA tool identified 14 children (46.7%) at moderate risk of malnutrition Table 2.

Table 1. Descriptive Data

Variable	Category	Number
Age Range (Years)	Less than 1 year	2 (8%)
	1 year to 3 years	14 (47%)
	4 to 5 years	14 (45%)
Sex	Male	19 (63%)
	Female	11 (37%)
Duration of Epilepsy Diagnosis	Mean ±SD	2.3 ± 1.4 years
Epilepsy Type	Generalized Epilepsy	18 (60%)
	Focal Epilepsy	12 (40%)
Seizure Frequency	Mean ±SD	11.0 ± 1.0 per day
Nutritional Intake	Energy Intake (kcal/day)	1200 ± 150
	Protein Intake (g/day)	40.0 ± 5.0
	Carbohydrate Intake (g/day)	165.0 ± 20.0
	Fat Intake (g/day)	40.0 ± 10.0
Antiseizure Medications (appropriately chosen ASMs based on seizure type, epilepsy syndrome)	Mean ±SD	3.0 ± 1.0

The STRONGkids assessment results revealed that 40% $(n = 12)$ of the children exhibited deviations in weight-for-age, while 47% $(n = 14)$ demonstrated abnormal growth patterns. Feeding difficulties were reported in 33% $(n = 10)$ of the children, and 60% $(n = 18)$ had underlying medical conditions that could impact their nutritional status. Similarly, the Subjective Global Nutritional Assessment (SGNA) indicated that 43% $(n = 13)$ of the children had a history of weight loss, and 50% $(n = 15)$ experienced appetite changes. Additionally, 37% $(n = 11)$ showed signs of subcutaneous fat loss, while 40% $(n = 12)$ exhibited muscle wasting. Furthermore, 30% $(n = 9)$ of the children presented with nutrition-related edema, highlighting the presence of malnutrition-related complications within the study population.

Table 2. Contingency Table for STRONGkids and SGNA

Screening Tool	Test Tool	At Risk (Yes) (TP)	Not at Risk (No) (FP)	At Risk (No) (FN)	Not at Risk (Yes) (TN)	Total
STRONGkids	SGNA	14	1	1	14	30
SGNA	STRONGkids	14	1	1	14	30

***TP – True Positive, FP – False Positive, FN – False Negative, TN – True Negative**

To check inter-rater reliability for assessing two tools, statistical methods such as Kappa was used, which measured the level of agreement between raters while accounting for chance. The formula used to calculate Observed Agreement (Po) was $Po = (a+d)/N$ and the Expected Agreement (Pe) was calculated using formula $Pe = [(a+b)(a+c)/N^2] + [(c+d)(b+d)/N^2]$. Followed by which Kappa Statistic (κ) was calculated by using the formula $\kappa = (Po - Pe)/(1 - Pe)$. The agreement between the two tools was high, with a kappa coefficient of 0.76, indicating substantial inter-rater reliability Table 3. According to the Landis and Koch Interpretation Scale, the kappa value (0.76) indicates substantial agreement between the STRONGkids and SGNA tools in identifying malnutrition risk[12]. Of the 15 children (50%) identified at medium risk of malnutrition by STRONGkids, 14 (47%) were also flagged by SGNA at moderately malnourished, while 2 (7%) were only identified by STRONGkids. Conversely, 1 child (3%) flagged by SGNA was not identified by STRONGkids. In terms of severity, both tools demonstrated similar findings, with 12 (40%) of the children classified as having moderate to severe malnutrition.

Table 3. Cohen's Kappa (κ) Statistic

Step	Result
Observed Agreement (Po)	0.9333
Expected Agreement (Pe)	0.50
Kappa Statistic (κ)	0.766

To address the concern regarding the lack of statistical comparison between STRONGkids and SGNA, additional validation metrics such as sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) were analyzed. The sensitivity of STRONGkids in identifying children at nutritional risk, using SGNA as a reference, was found to be 93.3%, while its specificity was 90%. The PPV and NPV for STRONGkids were 93.3% and 90.0%, respectively, demonstrating a high capacity to correctly classify children at risk. Similarly, SGNA demonstrated equivalent predictive values. These data indicate that both techniques are highly accurate in screening for malnutrition, which supports their therapeutic value. However, a larger sample size and longitudinal follow-up would be beneficial for reinforcing these findings.

The study's findings provide vital insights into the nutritional and medical issues experienced by children with drug-resistant epilepsy (DRE), emphasizing the significance of appropriate nutritional risk assessment in this vulnerable population. Our findings are consistent with previous literature, which highlights the high frequency of nutritional risk among children with chronic neurological disorders. Our study's mean age (2.8 ± 1.4 years) is comparable to other studies analyzing juvenile epilepsy populations, such as Berg *et al.*[13], who reported a similar mean age of 3.1 ± 1.2 years in a cohort of children with refractory epilepsy. Furthermore, our findings that 60% of the children had generalized epilepsy and 40% had focal epilepsy are comparable with the distribution seen in recent research[14], which showed that generalized epilepsy is more common in younger children with DRE. Our study found a mean seizure frequency of 11.0 ± 1.0 occurrences per day, indicating severe epilepsy in this sample. This conclusion is consistent with prior research, such as that conducted by Wirrell *et al.*[15], which found increased seizure loads in children with refractory epilepsy. Participants used an average of 3.0 ± 1.0 antiseizure drugs (ASMs), indicating pharmacoresistance. This aligns with Perucca *et al.'s*[16] findings, emphasizing the importance of multimodal therapy approaches in DRE control. Our study's estimated mean energy intake (1200 ± 150 kcal/day) and macronutrient distribution align with earlier findings on dietary habits in children with epilepsy. For example, Kossoff *et al.*[17] found that children on standard diets had identical calorie intake levels prior to starting ketogenic therapy. Furthermore, the proportion of children requiring enteral feeding (10%) is consistent with the findings of Löscher *et al.*[18], who discovered that children with severe epilepsy frequently require enteral nutrition support due to feeding difficulties caused by pharmaceutical side effects and neurological impairment. Our study found that 70% of participants were from the lower-middle socioeconomic class, highlighting the importance of financial constraints in getting appropriate epilepsy care and nutrition. This pattern is comparable with the findings of Sharma *et al.*[19], who identified socioeconomic differences as a significant predictor of health outcomes in children with chronic neurological disorders. The STRONGkids and SGNA assessments in our study showed significant agreement in identifying children at risk of malnutrition, with 50% identified as medium risk by STRONGkids and 46.7% as moderate risk by SGNA.

White *et al.* [20] reported similar results, finding significant agreement between these measures in determining malnutrition risk in pediatric neurology patients. However, our study contributes new data by focusing on young children with DRE, for whom these screening techniques have received limited prior validation. These findings emphasize the importance of tailored dietary management and nutritional evaluation in children with DRE. Given the scarcity of data on the efficacy of STRONGkids and SGNA in this specific group, our study adds to the expanding body of literature advocating for their use in pediatric neurology settings. Future research should look into longitudinal outcomes to see how early nutritional risk identification affects growth, seizure control, and general quality of life in children with DRE.

4 Conclusion

This study sheds new light on the nutritional issues faced by children with drug-resistant epilepsy, particularly those from lower socioeconomic origins. Our data show that STRONGkids and SGNA identify nutritional risk, similarly, justifying their usage in pediatric neurology settings. This cohort had a substantial epileptic burden and nutritional issues, as evidenced by quantitative data, including an average seizure frequency of 11.0 ± 1.0 episodes per day and an average calorie intake of 1200 ± 150 kcal. Unlike prior studies, which have primarily focused on general pediatric epilepsy populations, this study particularly looks at children with DRE ages one month to five years, filling a key knowledge gap.

Our study's primary merit is its targeted assessment of proven nutritional screening techniques in a high-risk juvenile epilepsy group, which adds to the little literature in this field. However, drawbacks include a small sample size and a cross-sectional design, which limits findings about long-term nutritional outcomes. Future research should include longitudinal follow-up and larger cohorts to improve the generalizability of the findings. Furthermore, the impact of dietary interventions, such as the ketogenic diet, on nutritional risk assessment outcomes is an unanswered subject that requires additional research. Our findings highlight the need of including nutritional evaluation in standard epilepsy care. We urge that pediatric neurologists and dietitians collaborate to create targeted nutritional therapies for children with DRE. Further studies should look into personalized dietary changes to promote growth and overall health outcomes in this susceptible population.

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