Agreement between the methods: Subjective Global Nutritional Assessment and the nutritional assessment of the World Health Organization

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Abstract
Objective: To assess the agreement between the results of the Subjective Global Nutritional Assessment questionnaire, adapted for children and adolescents of the Brazilian population, and the nutritional status assessment method through growth curves and the classification of the World Health Organization in a pediatric hospital service.

Methods: This was an analytical, quantitative, cross-sectional study. During the data collection period, the nutritional status of all patients from 0 to 12 years of age, admitted to the pediatric unit of a university hospital, was concomitantly assessed according to the Subjective Global Nutritional Assessment and World Health Organization curves. To determine the assessment and agreement between these methods, the Kappa and Kendall coefficients were used, respectively, considering a significance level of 5%.

Results: Sixty-one children participated, with a predominance of males. It was observed that the highest frequency of equivalent results occurred among the group classified as well nourished, and that only the height/age variable showed a close agreement between the methods. Additionally, there was a good correlation only for the weight/height variable between the assessment tools used.

Conclusion: Due to the low agreement between the methods, the combination of both may be beneficial for the nutritional assessment of pediatric patients, collaborating with the early diagnosis of nutritional alterations and facilitating the use of adequate dietary therapy.

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Introduction

The integration of nutritional assessment into the complex routine of child hospitalization is essential, regardless of the severity and risks of morbidity and mortality associated with it. This is due to the possibility of identifying the presence of nutritional disorders, such as malnutrition and obesity, which may be associated with diseases and/or other unfavorable social conditions.2,3

Child malnutrition is considered the second most common cause of death among children under 5 years of age in developing countries. At this stage of life, malnutrition results in a loss of physical growth and neuropsychomotor development, and causes greater vulnerability to several comorbidities4 and, consequently, a greater risk of hospital admission.1

Hospitalization, in turn, is a risk factor for the development and/or worsening of malnutrition, as it often causes a loss in the nutritional status of the pediatric patient. This nutritional impairment can significantly affect morbidity and mortality rates, as well as length of hospital stay and hospitalization costs. Thus, there will be a lower hospital bed turnover rate, which consequently hinders the service to the population.1 Therefore, it is essential to perform the early nutritional assessment of all these patients at admission, to diagnose not only malnutrition but also the risk of nutritional status impairment of this group.5

According to Resolution No. 304/2003 of the Federal Council of Nutritionists, the implementation of nutritional assessment and diagnosis through anthropometric, biochemical, clinical, and dietary data favors the creation of an adequate nutritional care plan.6 Ideally, the nutritional assessment should be quick, practical, easy to apply, noninvasive, and capable of being performed at the bedside. Additionally, it is important that it can provide a result as fast as possible.7

Anthropometrics is a widely used science to assess, classify, and monitor nutritional status8 in several age groups, such as in childhood and adolescence, and it allows the perception of growth variations.1 In pediatric patients, the most often used anthropometric data for the analysis of nutritional status are weight, height, weight-to-height ratio, and body mass index (BMI),8 which are assessed according to the curves and reference values created by the World Health Organization (WHO) according to gender and age group; and the use of weight/age, height/age, weight/height, and BMI/age indexes.9,10 In Brazil, the Food and Nutrition Surveillance System (Sistema de Vigilância Alimentar e Nutricional [SISVAN]) suggests that the classification of nutritional status must be based on these curves.11

In addition to anthropometrics, screening methods have been widely used aiming at identifying malnutrition or the risk of developing it.8 In adults, the use of these methods is well established. However, in the case of pediatric patients, there is no consensus on the best technique for nutritional risk screening at the time of hospital admission and during hospitalization.8

There are some tools in the literature used for nutritional screening in pediatric patients. Overall, these tools correlate anthropometric data and patient history information, such as weight history, presence of disease, gastrointestinal symptoms, and food intake data. The best-known pediatric screening tools include the STAMP tool (Screening Tool...
for the Assessment of Malnutrition in Pediatrics), Pedi-
atriac Nutritional Risk Score, Pediatric Yorkhill Malnutrition
Score, Strong Kids, and Subjective Global Nutritional
Assessment (SGNA) for children. However, only the last two
have been translated into Portuguese and validated for the
Brazilian population.

In 2007, the SGNA questionnaire was adapted for the
pediatric age group by Secker and Jeejeebhoy. It was vali-
dated for this same group in the Brazilian population by
Carniel et al., in 2015. In the field of child and adoles-
cent health, for the purposes of nutritional assessment,
the use of the WHO growth curves and the nutritional
status classification proposed by them are already
well known, and have been recognized regarding their
importance in the nutritional diagnosis of this population.
However, this methodology can identify malnutrition only
after it is installed, i.e., it does not allow the detection of
milder degrees of malnutrition and/or the risk of develop-
ing it. Thus, in the individual assessment, anthropometric
data are more significant for follow-up, since they allow
verifying whether the growth rate considered normal is
maintained.

For this reason, new nutritional assessment tools for
this target population are being developed with the objec-
tive of improving existing resources. However, it is crucial
that these new tools be tested to evaluate their applica-
bility and agreement with other methods already used in
the pediatric age group. Additionally, few studies have
used the SGNA in pediatric patients, or compared their
results with methods currently more widely used in the
evaluation of children and adolescents, such as the WHO
curves.

Thus, the objective of this study was to evaluate the
agreement between the results of the SGNA question-
naire, adapted for children and adolescents of the Brazilian
population, and the nutritional status assessment method
through the WHO growth curves and classification in a pedi-
atriac hospital service.

Methods

Study participants and design

This was an analytical, quantitative, and cross-sectional
study, in which two nutritional assessment tools were
concomitantly applied to patients aged 1 month to 12
years, of both genders, hospitalized for clinical and/or
surgical reasons in the Pediatric Ward of Hospital das Clíni-
cas de Uberlândia of Universidade Federal de Uberlândia
(HCU-UFU), who accepted to participate in the study and
had the informed consent form signed by their parents/
guardians.

All children with a diagnosis of genetic syndromes, cere-
bral palsy, or chronic renal failure were excluded from the
study. The data collection protocol was applied from June to
August 2016, due to higher number of hospitalizations during
the same period in 2015.

The work was approved by the Human Research Ethics
Committee of Universidade Federal de Uberlândia (UFU)
(1,585,335/2016).

Tools

The collection of anthropometric data, weight, and height,
and the application of the SGNA questionnaires adapted
to pediatric patients proposed by Carniel et al. (2015) were
carried out within a maximum period of 72 h after the
patients’ hospitalization in the service, as recommended
by the 2011 Project Guidelines. These measurements
were used for the nutritional assessment proposed by
this SGNA questionnaire, which has different versions
for children younger than 2 and older than 2 years of
age, and for nutritional assessment through the WHO
curves.

Children aged 1 month to 2 years were weighed with-
out clothing and diapers, while those older than 2 were
weighed wearing the pajamas provided by the hospital and
without shoes, both on electronic scales available at the
service.

The height of children younger than 2 years and with a
length of less than 100 cm was measured with the aid of
a graduated anthropometric ruler, with the patient in the
supine position. The other children were measured in the
vertical position, using a manual stadiometer with a mobile
cursor.

The BMI value was obtained using the Quetelet formula,
calculated by the weight (kg)/height$^2$ (m$^2$). Premature
children were assessed at their respective corrected age up to
2 years of age.

To evaluate the agreement between the results obtained,
the nutritional status of all patients was evaluated by the
SGNA and by the WHO growth curves, a method currently
used in the pediatric ward to classify the nutritional status
of hospitalized patients.

When using the SGNA, the individual was classified
according to a global score as: (a) well nourished, when the
child is growing normally, with adequate food consump-
tion and without gastrointestinal symptoms; (b) moderately
malnourished, when the patient shows signs of weight loss or
loss of food consumption, functional capacity, and reduced
muscle mass, demonstrating nutritional status impairment,
when it was previously normal; and (c) severely malnour-
ished, when the child has progressive malnutrition, with
weight loss, reduction of muscle and fat mass, and loss of
food consumption.

For the purpose of comparison, WHO classifications were
Grouped according to the classification proposed in
the SGNA, as follows: children classified as very thin according
to the WHO were considered to be severely malnourished,
while those classified as thin were considered moderately
malnourished, and finally those with normal weight, at risk
of overweight, overweight, and obese were grouped in the
well-nourished classification.

The WHO Anthro (World Health Organization, Geneva,
Switzerland) and WHO Anthro Plus (World Health Organi-
cation, Geneva, Switzerland) computer programs were used
to determine the Z-score of weight/age (up to 10 years),
height/age, weight/height (up to 5 years), and BMI/age
curves of children of all age groups.

The SGNA questionnaire application and the collec-
tion of anthropometric data, as well as their classification
according to the WHO curves, were performed by the
same observer, who was trained and qualified for this func-
tion. The same research and assessment protocol was used for all patients.

**Statistical analysis**

To estimate the sample size, the G*POWER program was used for power analysis. Aiming to estimate the minimum sample size, considering the two-tailed hypothesis and the parameters of significance level (α = 0.05), test power (1 – β = 0.95), and effect size (Cohen’s d = 0.50), a minimum sample size of 34 individuals was obtained.\(^{23,24}\)

Initially, data normality was verified with the Shapiro–Wilks test. Parametric data are shown as means and standard deviations, and non-parametric data are shown as medians and interquartile range.

To compare the proportions between the variables, the chi-squared test or Fisher’s exact test was used. Cohen’s kappa coefficient was used to evaluate the agreement between the methods. The Kendall coefficient was used to analyze the association between the methods. The level of significance was adjusted to 5% in all analyses.

**Results**

The characterization of the studied sample is described in Table 1, which consisted of 61 hospitalized children, aged between 1 and 155 months. There was a predominance of males (52.4%) and children younger than 2 years (36%) in the sample, with 47.5% females. The median hospital length of stay was ten days.

Most patients who participated in the study were classified as well nourished by the SGNA (70.5%) and as normal weight according to the WHO (67%), while the lowest percentages were found for severely malnourished and very thin children, according to the SGNA (5%) and WHO (1.5%), respectively.

The frequencies of each classification (severely malnourished, moderately malnourished, and well-nourished) were analyzed for each of the assessed methods (Table 2), noting that there was a difference in the frequencies between them (p = 0.001).

When assessing the agreement between the two tools, it was verified that all growth curves showed agreement with the SGNA, except for height/age. However, the degree of this agreement is classified as low (0.20–0.40)\(^{25}\) (Table 3).

In the analysis of the association between the nutritional assessment techniques, it was observed that the variables weight/height, BMI/age, and the final WHO classification were associated with SGNA (p < 0.001) and also with the weight/age (p = 0.002) and height/age (p = 0.028) variables. The Kendall coefficient values showed associations ranging from low (0.20–0.39) to good (0.60–0.79),\(^{26}\) especially the weight/height variable, which showed a considerable (0.624) association with the SGNA (Table 4).

**Discussion**

When concomitantly evaluating the patients according to the SGNA\(^{17}\) and the WHO,\(^{9,10}\) it was verified that most patients were classified as well-nourished and normal

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Demographic characteristics and nutritional status by the Subjective Global Nutritional Assessment (SGNA) method and growth curves (weight/age, height/age, weight/height, and BMI/age) in children and adolescents.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Overall characteristics</strong></td>
<td><strong>Sample (n=61)</strong></td>
</tr>
<tr>
<td><strong>Age group – n (%)</strong></td>
<td></td>
</tr>
<tr>
<td>&lt;2 years</td>
<td>22 (36)</td>
</tr>
<tr>
<td>≥2 years &lt;5 years</td>
<td>9 (15)</td>
</tr>
<tr>
<td>≥5 years &lt;10 years</td>
<td>19 (31)</td>
</tr>
<tr>
<td>≥10 years</td>
<td>11 (18)</td>
</tr>
<tr>
<td><strong>Gender – n (%)</strong></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>29 (47.5)</td>
</tr>
<tr>
<td>Male</td>
<td>32 (52.4)</td>
</tr>
<tr>
<td><strong>Hospital length of stay (days) – median [interquartile range]</strong></td>
<td>10 (6.0–22.0)</td>
</tr>
<tr>
<td><strong>SGNA classification – n (%)</strong></td>
<td></td>
</tr>
<tr>
<td>Well nourished</td>
<td>43 (70.5)</td>
</tr>
<tr>
<td>Moderately malnourished</td>
<td>15 (24.5)</td>
</tr>
<tr>
<td>Severely malnourished</td>
<td>3 (5.0)</td>
</tr>
<tr>
<td><strong>WHO classification – n (%)</strong></td>
<td></td>
</tr>
<tr>
<td>Very thin</td>
<td>1 (1.5)</td>
</tr>
<tr>
<td>Thin</td>
<td>7 (11.5)</td>
</tr>
<tr>
<td>Normal weight</td>
<td>41 (67.0)</td>
</tr>
<tr>
<td>Overweight</td>
<td>7 (11.5)</td>
</tr>
<tr>
<td>Obesity</td>
<td>3 (5.0)</td>
</tr>
<tr>
<td>Severe obesity</td>
<td>2 (3.5)</td>
</tr>
<tr>
<td><strong>Z-score growth curves – mean ± SD</strong></td>
<td></td>
</tr>
<tr>
<td>W/A</td>
<td>−0.016 ± 1.48</td>
</tr>
<tr>
<td>H/A</td>
<td>0.023 ± 1.32</td>
</tr>
<tr>
<td>W/H</td>
<td>−0.018 ± 1.24</td>
</tr>
<tr>
<td>BMI/A</td>
<td>−0.065 ± 1.67</td>
</tr>
</tbody>
</table>

| WHO, World Health Organization; W, weight; A, age; H, height; BMI, body mass index. |

<table>
<thead>
<tr>
<th>Table 2</th>
<th>Frequency of severely malnourished, moderately malnourished, and well-nourished individuals by the Subjective Global Nutrition Assessment (SGNA) method and WHO growth curves in children and adolescents (n = 61).</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SGNA n (%)</strong></td>
<td><strong>WHO n (%)</strong></td>
</tr>
<tr>
<td></td>
<td>Severe malnourished</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Severe malnourished</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Moderately malnourished</td>
<td>1 (1.6)</td>
</tr>
<tr>
<td>Well nourished</td>
<td>0 (0.0)</td>
</tr>
</tbody>
</table>

| WHO, World Health Organization. |
Table 3 Agreement between the Subjective Global Nutritional Assessment (SGNA) method and WHO growth curves in children and adolescents (weight/age, height/age, weight/height, BMI/age).

<table>
<thead>
<tr>
<th>Variables</th>
<th>% Agreement well nourished</th>
<th>% Agreement moderately malnourished</th>
<th>% Agreement severely malnourished</th>
<th>Cohen’s kappa</th>
<th>p-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>W/A – Z-score</td>
<td>74.0</td>
<td>6.0</td>
<td>0.0</td>
<td>0.35</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>H/A – Z-score</td>
<td>70.5</td>
<td>21.3</td>
<td>1.6</td>
<td>0.14</td>
<td>0.088</td>
</tr>
<tr>
<td>W/H – Z-score</td>
<td>80.6</td>
<td>3.2</td>
<td>0.0</td>
<td>0.39</td>
<td>0.001</td>
</tr>
<tr>
<td>BMI/A – Z-score</td>
<td>68.9</td>
<td>3.3</td>
<td>0.0</td>
<td>0.21</td>
<td>0.020</td>
</tr>
<tr>
<td>WHO final classification</td>
<td>68.9</td>
<td>6.6</td>
<td>0.0</td>
<td>0.31</td>
<td>0.002</td>
</tr>
</tbody>
</table>

Table 4 Association between the Subjective Global Nutritional Assessment (SGNA) method and WHO growth curves in children and adolescents (weight/age, height/age, weight/height, BMI/age).

<table>
<thead>
<tr>
<th>Variables</th>
<th>n</th>
<th>Kendall’s r</th>
<th>p-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>W/A – Z-score</td>
<td>50</td>
<td>0.440</td>
<td>0.002</td>
</tr>
<tr>
<td>H/A – Z-score</td>
<td>61</td>
<td>0.278</td>
<td>0.028</td>
</tr>
<tr>
<td>W/H – Z-score</td>
<td>31</td>
<td>0.624</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>BMI/A – Z-score</td>
<td>61</td>
<td>0.454</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>WHO final classification</td>
<td>61</td>
<td>0.500</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

In the present study, it was observed that the nutritional statuses generated by the SGNA and the WHO have a low agreement. In 2014, Carniel et al. similarly observed a low agreement (0.38, p = 0.001) between the weight/height variable and the SGNA, whereas for the other variables, agreement levels were different from those found in this study.

Possibly, the combination of objective and subjective data proposed in the SGNA contributes to the fact that the final classifications of the methodologies disagree, which shows the importance of using both tools in clinical practice as complementary techniques for an adequate nutritional diagnosis.

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Possibly, the combination of objective and subjective data proposed in the SGNA contributes to the fact that the final classifications of the methodologies disagree, which shows the importance of using both tools in clinical practice as complementary techniques for an adequate nutritional diagnosis.

These results demonstrate the importance of performing the nutritional assessment through objective and subjective methods at hospital admission, aiming to identify malnourished patients and/or those at nutritional risk. The early diagnosis of these conditions allows the establishment of an adequate diet therapy, which contributes to the treatment and improvement of the prognosis and hospital discharge of the individual. As demonstrated by Baccaro et al. in 2007, who evaluated the nutritional status of patients in a hospital in Argentina, malnourished patients were hospitalized for a period longer than seven days (on average) than patients with normal weight. Moreover, among the patients who died, 62.5% belonged to the group classified as severely malnourished.

Furthermore, the SGNA allows the concise and rapid collection of a large part of the patient’s history, and also identifies those at greater nutritional risk who need a more careful investigation of their clinical history, indicating which individuals require a more intense follow-up, preventing the worsening of the nutritional picture. The same was observed by Rocha, Rocha, and Martins in 2006, who evaluated the nutritional status of children younger than 5 years evaluated at admission and at hospital discharge. They found that 51.6% of the patients had weight loss during hospitalization, and 9.17% of the children with normal weight...
prior to hospital admission had their nutritional condition worsen during hospitalization.

However, the SGNA also has limitations, namely the need for training and experience of the observer, which is an important factor for the test accuracy, since the assessment accuracy depends on the ability to recognize nutritional variations. In addition, because it is a qualitative method, it has low sensitivity to identify small nutritional status alterations, and therefore it is not a good tool to follow the patient’s evolution, with objective methods being more adequate in this case.\(^{18}\)

At the same time, another negative point observed in the present study was the non-differentiation between children with normal weight from those with overweight and/or obesity, as proposed by the WHO classification.\(^9,^{16}\) Therefore, all of these patients, although showing very different nutritional diagnoses and requiring diverse dietary therapies, are classified as well-nourished, which may induce errors. As well as the malnourished patients, those who are overweight also need special care, since this condition also characterizes a nutritional status imbalance and increases the risk of developing chronic diseases and, consequently, morbidity and mortality.

The fact that the assessments were made by only one observer is also a limitation of the present study, which could lead to a referral bias. However, every precaution was taken to minimize possible errors. Furthermore, the authors emphasize the need for further studies that address this issue.

Low agreement was found among the assessed methods. Thus, in the absence of a gold standard method, it is concluded that the combination of objective and subjective methods, such as anthropometric assessment through the WHO curves and the SGNA, may be beneficial for pediatric patients, since it allows the early diagnosis of nutritional alterations and/or nutritional risk. Consequently, this indication can help in the creation of an adequate dietary therapy to minimize the risks of compromising the growth and development of the pediatric patient.

Conflicts of interest

The authors declare no conflicts of interest.

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