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Malnutrition in hospitalized children aged 3–18 years

Results by using a new score in comparison with previous described scores.

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ABSTRACTS

Background and aims: A universally accepted screening concept for children is not yet available. It is already standard practice among paediatricians to maintain height and weight charts, allowing calculation of growth velocity which is high sensitive to nutritional status. Our goal was to develop a new score, which reflected the respective weighting of the corresponding coefficients, and to compare with two other scores such as Waterlow and Gomez scores.

Methods: A new score (Vienna score) should identify the subjects with suspicion malnutrition and the specificity with other scores should be evaluated. The score includes total weight loss > 5% relative to pre-illness body weight, weight/height percentile < p10 and lack of appetite and laboratory parameters such as serum albumin, total lymphocyte count and Haemoglobin.

Result: In our study we tested their applicability in paediatric hospital patients and compared the results of the three scores. 100 patients were included in this study. The Vienna score could identify in 43% and 15% of all patients as mild and moderate forms of malnutrition respectively; using the Waterlow score, prevalence of mild, moderate and severe wasting (applying %IBW-H) could be identified in 2%, 2% and 1% respectively and 32%, 8% and 9% of all patients were identified as mild, moderate and severe stunting (applying %BH); by means of the Gomez score (applying %BW), prevalence of mild, moderate and severe forms of malnutrition were appeared in 33%, 13% and 5% of all patients respectively.

Conclusions: The Vienna score can identify children at risk of nutritional depletion better than previously described scores and is able to define the moderate form of malnutrition more than the both forms of Waterlow score and as well as Gomez score approximately. Future clinical trials should be performed in order to get more information about the prevalence of malnutrition in various paediatric populations using this score and to investigate whether clinical relevant forms of malnutrition can be identified in an appropriate way.

Keywords: malnutrition, Vienna score, Gomez Classification, Waterlow score, stunting, wasting

Growth assessment defines the health and nutritional status of children, because disturbances in health and nutrition, regardless of their aetiology, invariably affect child growth and hence provide an indirect measurement of the quality of life of an entire population [1]. Child Malnutrition has been defined or described in many ways. To summarize the common points, child malnutrition may be defined as a pathological state resulting from inadequate nutrition, including undernutrition (protein-energy malnutrition) due to insufficient intake of energy and other nutrients [2].

If the body does not receive the energy it needs in the form of food, weight loss (mostly due to lack of muscle mass) will occur. Children with malnutrition have inadequate fat stores and relatively little muscle mass. Their bones are prominent and they often have disproportionately large abdomens. Brain development can be impaired, and these children have a high incidence of disease because their bodies cannot fight infection [3].

The four major components of assessment of nutritional status in children are: clinical (such as anthropometric), biochemical, dietary and feeding quality development [4].

Growth assessments have therefore been used to monitor the nutritional status. While there are a variety of methods used to measure growth, the most common are known as anthropometric indices, which compare an individual's age, height, and weight, each of which is measured against the others. The values are expressed as percentages, or percentiles, of the normal distribution of these measurements [5].

Through anthropometric studies, researchers have found that particular measurements correlate with specific growth trends, based on how the body normally changes over time. Abnormal height-for-age (stunting) usually measures long-term growth faltering. Low weight-for-height (wasting) correlates with an acute growth disturbance [5].

Children with chronically malnutrition often have delayed growth (height for age). This is in contrast to acute malnutrition, which leads to a deficit in the weight-height-ratio.

Malnutrition	*Albumin Criterion, g/L*	*Totale Lymphocyte Count Criterion, x 10^9/L*	*Hemoglobin Criterion, g/L*	*Score-points*
severe	< 25	< 0,5	< 105	
moderate	25–30	0,5–10	105–110	
mild	30–35	1,0–1,5	110–120	
none	> 35	> 1,5	> 120	

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Additional criteria

a) International or total weight loss of > 5% relative to pre-illness body weight (4 weeks)
b) Weight/height percentile < 10 percentile*
c) Lack of appetite

* K. KROMEYER-HAUSCHILD, M. WABITSCH, D. KUNZE ET AL.: MONATSSCHR. KINDERHEILK. 149 (2001)

Tab. 1: Indications for supplemental nutrition in pediatric cancer patients – Vienna score

Bengoa et al. suggested clinical, biochemical and various anthropometrical methods (head and arm dimensions) to identify malnutrition among children [6]. Nutritional status in children is an indicator of health and well being at both the individual and the population level. Screening for malnutrition should be an integral part of pediatric care universally [7]. Malnutrition is associated with a higher morbidity resulting in an increased need for medical resources and economic expenses [18]. Malnutrition is a well-recognised problem in hospitals, with the prevalence estimated between 28–50% [8].

About 30% of all patients in hospital are undernourished. A large part of these patients are undernourished when admitted to hospital and in the majority of these, undernutrition develops further while in hospital. This can be prevented if special attention is paid to their nutritional care. Other features of the patient's primary disease are screened routinely and treated (e.g. dehydration, blood pressure, fever), and it is unacceptable that nutritional problems causing significant clinical risk are not identified [15].

There is good evidence to suggest that improvement to catering services; increased use of artificial nutritional support; and improved pain management and nausea control to improve appetite will increase a patient's nutritional intake and status. There is some evidence to indicate improvements in nutritional status will positively affect length of stay and mortality [8].

It was observed by Hendricks et al that the prevalence of acute protein-energy malnutrition (weight for height) in hospitalized pediatric patients based on the Waterlow criteria was as follows: severe, 1.3%; moderate, 5.8%; mild, 17.4%; and none, 75.5%. The prevalence of chronic protein-energy malnutrition (height for age) was as follows: severe, 5.1%; moderate, 7.7%; mild, 14.5%; and none, 72.8%. The prevalence of acute and chronic protein-energy malnutrition was significantly less in 1992 than in 1976 though [9].

In another study prevalence rates for moderate and/or severe malnutrition (z-score < –2) in hospitalized children on admission were considered as 18.7, 18.2 and 6.9%, for weight/age, stature/age and weight/stature, respectively [10]. In an other study, the prevalence of acute PCM was documented in the hospitalized children and adolescents on the day of admission using Waterlow score (weight for height) in group 0–2 years with 59% (36% mild, 23% moderate), group 2–6 years with 53% (38% mild, 15% moderate), group 6–10 years with 50% (33% mild, 17% moderate) and group 10–18 years with 44% [11].

Malnutrition	*Points (for every parameter)*
severe	3
moderate	2
mild	1
none	0

- INTERNAL OR TOTAL WEIGHT LOSS OF > 5% RELATIVE TO PRE-ILLNESS BODY WEIGHT (4 WEEKS) ..... 2 POINTS
- WEIGHT/HEIGHT PERCENTILE < 10 PERCENTILE ..... 2 POINTS
- LACK OF APPETITE ..... 1 POINT

Points	*Malnutrition*
0–2	none
3–6	mild
7–10	moderate
11–14	severe

Tab. 2: Vienna Score Points

Procedures and calculations

Three nutritional risk scores were utilized at hospital admission to identify patients at risk of malnutrition during hospitalization.

Weight/50th percentile weight for length and length/50th percentile length for age by different percentiles charts for boys and girls [12] were evaluated for Waterlow score [13] and

weight/50th percentile weight for age*100 by different percentiles charts for boys and girls [12] was considered for Gomez classification [14].

Vienna score was developed as a new Score based on Hendricks criteria with additional criteria as weight/height percentile < p10, total weight loss > 5% relative to pre-illness body weight, lack of appetite to assess nutritional risk of malnutrition effectively and quickly. The Vienna score is enclosed.

The following nutritional risk factors such as weight/height percentile < p10 (2 points), total weight loss > 5% relative to pre-illness body weight (2 points), lack of appetite (1 point), laboratory parameters such as albumin, total lymphocyte count, haemoglobin (laboratory parameters were classified such as 3 points for severe, 2 points for moderate and 1 point for mild) were identified on admission. Malnutrition grades by Vienna score were classified as normal (0–2 points), mild (3–6 points), moderate (7–10 points) and severe (11–14 points). Percentiles after Kromeyer-Hauschild [12] were used as weight/height percentiles. Appetite and weight loss > 5% were rated by means of standardized interviews on admission. The laboratory parameters such as albumin, total lymphocyte count and haemoglobin were recorded from laboratory diagnostic.

Anthropometric measurements were taken on admission. The patient's Body Weight (BW, kg) was measured with a digital scale and Body Height (BH, cm) was assessed using an Ulmer-Stadiometer. Body Mass Index (BMI) was calculated using the formula: BMI (kg/m^2) = BW (kg)/BH2 (m^2).

Subjects

Nutritional risk was assessed prospectively in 100 paediatric patients aged 3–18 years who are hospitalized from march 2006 to October 2006 in the department of Paediatrics in the University Hospital of Vienna using Vienna score and was compared with two other scores such as Waterlow and Gomez scores.

Results

The Vienna score as a new score, the Gomez classification and the Waterlow score are screening and assessment tools aimed at detecting malnourished individuals and those at risk for malnutrition. In our study we tested their applicability in paediatric hospital patients and compared the results of the three tools. 100 patients were included in the study.

According to Tab. 3, the Vienna score (as index of nutritional status) could be completed in 43% and 15% of all patients as mild and moderate forms of malnutrition respectively ($p < 0{,}001$), prevalence of mild, moderate and severe wasting (applying %IBW-H) was in 2%, 2% and 1% respectively and 32%, 8% and 9% (applying %BH) of all patients were identified as mild, moderate and severe stunting ($p > 0{,}05$). Also 33%, 13% and 5% (applying %BW) were appeared as mild, moderate and severe underweight respectively ($p > 0{,}05$).

Data collected from 100 hospitalized children released that 43 subjects identify as mild form of malnutrition applying Vienna score. Data conducted on 43 patients belonging to the mild form of malnutrition using Vienna score revealed that 23 patients of this group have lack of appetite, total weight loss of 5% relative to pre-illness body weight appears in 5 participants, weight/height percentile < p10 reports in 18 children and albumin, total lymphocyte count and haemoglobin define below the reference values in 17, 12 and 31 subjects respectively.

In a relevant percentage of those tested, Vienna score, Gomez classification, and Waterlow score identify different results as being nutritionally at risk. Although the categories of the results were not completely identical for the three tools, there were more patients at risk malnutrition according to the Vienna score (43%) than according to the Gomez classification (33%) or the Waterlow score in stunting and wasting forms (32% and 2%).

The direct comparison of the Vienna score with the Gomez and Waterlow scores demonstrated among 43 patients classified as being nutritionally at risk using Vienna score, 15, 39 and 20 patients of this group could have not been detected any forms of malnutrition using Gomez score, wasting and stunting form of malnutrition applying Waterlow score respectively and also, the Vienna score could identified 9 patients as being nutritionally at risk who could have not been even detected as malnutrition using any other described scores.

Prevalence of moderate form of malnutrition using Vienna score among 100 hospitalized children was seen in 15 subjects. According to the data of 15 moderate malnourished patients using Vienna score, lack of appetite appears in 10 children, total weight loss > 5% relative to pre-illness body weight reports in 10 participants, weight/height percentile < p10 defines in 9 children and Albumin, total lymphocyte count and haemoglobin identify below the reference values in 13, 8 and 15 participants of this group respectively. These findings were the best predictor of whether patients were at risk of nutritional depletion.

According to the categories of the results in moderate form of malnutrition for the three tools, there were more patients in moderate form of malnutrition according to the Vienna score (15%) than according to the Gomez classification (13%) or the Waterlow score in stunting and wasting forms (8% and 2%). Data collected from direct comparison of described

N = 100	*No*	*Mild*	*Moderate*	*Severe*
Vienna score	42	43	15	0
Waterlow score (wasting)	95	2	2	1
Waterlow Score (stunting)	51	32	8	9
Gomez score	49	33	13	5

Table 3: **The prevalence of malnutrition in paediatric patients using different scores.**

scores demonstrated among 15 patients who classified as moderate form of malnutrition using Vienna score, has been detected no forms of malnutrition using Gomez score, wasting and stunting form of malnutrition applying Waterlow score in 3, 15 and 7 patients respectively and also, the Vienna score has been detected moderate form of malnutrition in 3 subjects who were not even detected as malnutrition using any other described scores.

In contrast, it was found 19 patients from 100 children who could not been identified being affected malnutrition using Vienna score, but the same patients were defined as malnutrition using other described scores. According to the same group of 19 subjects, 1 and 7 patients were identified as wasting and stunting form of malnutrition using Waterlow score and the remaining 11 subjects defined as malnutrition using Gomez score.

The following Table 4 reflects the observed diseases among the patients conducted on 43 and 15 patients who belong to mild and moderate form of malnutrition using Vienna score respectively. According to table below, these diseases such as shunt dysfunction, allergic asthma, migraine, Glycogenosis Ib, high fever infection, postoperative infection (PEG-Sonden implantation), epidural haematoma, scarlet fever, sepsis and rotavirus were classified as others diseases.

Discussion

A universally accepted screening tool for children is not yet available. It is already standard practice among paediatricians to maintain height and weight charts, allowing calculation of growth velocity, which is high sensitive to nutritional status [15].

Waterlow score (WHC) was not an adequate screen for malnutrition, for several reasons. First, WHC is a better indicator of acute malnutrition than chronic. Second, there was a high prevalence of extreme short stature. The NCHS derived the WHC from cross-sectional measures on children without disabilities and with normally distributed stature. These normative values may not be of use in evaluating children with extremely short stature. Waterlow reviewed the literature and concluded that expected weight for height is relatively independent of age. Third, WHC may perform poorly as artificially added weight may elevate WHC, thus reducing its ability to reflect fat stores [16].

The Gomez criteria relied exclusively on weight-for-age and hence could not discriminate between short-term and long-term forms of malnutrition. Thus, patients classified on the basis of weight-for-age criteria are a mixed group in terms of their clinical nutritional status [14]. It has been demonstrated that critically ill children are at risk for fat or protein depletion and development of malnutrition, which is associated with increased morbidity and mortality [17].

Therefore we tried to develop a score to define malnutrition in paediatric patients, based upon laboratory parameters suggested by Hendricks et al. [9] and added total weight loss $>5\%$ relative to pre-illness body weight, weight/height percentile $<$p10 and lack of appetite. In our study has been considered a new score (Vienna score) which reflected the respective weighting of the corresponding coefficients and some other anthropometric indexes (%BW, %BH and %IBW-H) as criteria for the assessment of nutritional status, our results demonstrated the existence of nutritional status impairment.

Based on the collected data among patients as mild form of malnutrition applying Vienna score revealed correlation between malnutrition in this group and mild, moderate and severe form of malnutrition using Gomez classification in 16, 9 and 3 subjects respectively and association among described group and mild, moderate and severe form of wasting and stunting applying Waterlow score were seen in 1, 2, 1 and 11, 6, 6 subjects respectively.

The collected data among patients as moderate form of malnutrition using Vienna score released that moderate form of this group associates with mild, moderate and severe form of malnutrition using Gomez classification in 8, 2 and 2 subjects and reports in this group

4, 1 and 2 of the subjects as mild, moderate and severe stunted respectively and appears only 1 subject as mild form of wasting using Waterlow score.

Mild form of malnutrition using Vienna score has been revealed as well as Gomez and stunting form of Waterlow scores and moderate form of the malnutrition applying this score has been correlated with Gomez score better than stunting form of Waterlow score, but association among Vienna score and wasting form of Waterlow score in both forms of malnutrition were low. It was not found any subjects with severe form of malnutrition using Vienna score.

Prevalent diseases in the subjects who were identified as malnutrition using Vienna score were kidney, M. Crohn, pneumonia, rheumatism, liver transplantation and celiac diseases respectively.

We conclude that this paediatric nutritional risk score can identify children at risk of nutritional depletion better than described scores and define the moderate form of malnutrition more than the both forms of Waterlow score and as well

Form of malnutrition using Vienna score	*n*	*M. Crohn*	*Celiac disease*	*Liver transplantation*	*Other form of gastroenteritis diseases*	*Kidney problem*	*Pneumonia*	*Rheumatism*	*others*
mild	43	7	2	1	6	10	2	2	13
moderate	15	4	–	2	–	5	2	2	–

Table 4: **The observed diseases among mild and moderate malnourished children using the Vienna score**

as Gomez score approximately. Future observations should be performed in order to get more information about the prevalence of malnutrition in various paediatric populations using this score and to investigate whether clinical relevant forms of malnutrition can be identified in an appropriate way.

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