CHAPTER

3

WEIGHT AND HEIGHT IN CHILDREN NEWLY DIAGNOSED WITH CANCER

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ABSTRACT

Background: In children, weight and height represent both nutritional status and growth. We aimed to determine weight and height at diagnosis of cancer in pediatric patients in relation to predicted data from these patients’ growth curves.

Procedure: Actual data of weight and height of 95 children aged 1.5-10 years at diagnosis of cancer were compared with predicted data from growth curves. Age, gender, type of malignancy, extent of disease, and prior weight and height were tested for their potential relation to differences between actual and predicted data.

Results: Based on actual z-scores, 2%, 4%, and 7% of the children were undernourished (weight-for-age (WFA), height-for-age (HFA), and weight-for-height (WFH) <-2 standard deviation score (SDS) respectively). Actual data of weight and height were lower than predicted data. Differences of <-0.5 SDS in WFA, HFA, or WFH were found in 25%, 23%, and 29% of the children respectively. Children with advanced cancer had the highest risk of significant weight loss (<-0.5SDS in WFA) (OR_WFA =3.45 P=.012). Differences were unrelated to type of malignancy, age, gender, and weight and height prior to diagnosis.

Conclusions: At diagnosis, children’s measurements of weight and height were lower than was expected from their growth curve. Even more importantly, according to loss of weight or lack of growth, more children were found to be poorly nourished. Thus, actual measurements of weight and height underestimated the deterioration in nutritional status. Therefore, growth history should be included in the assessment of nutritional status to detect whose nutritional status is at risk.
INTRODUCTION

Weight and height are important parameters to determine a child’s nutritional status and represent the general impression of a child’s growth. Nutritional status is determined by comparing measurements of weight and height with reference values of the population and is expressed in z-scores. A child is considered to be well-nourished when values of weight and height are within -2 and +2 standard deviation score (SDS) and undernourished when these values are below -2 SDS. However, data from one single measurement of weight and height do not adequately reflect the child’s nutritional status. Children who suffer from severe weight loss or lack of linear growth but who nevertheless have what is considered normal weight and height parameters (between -2 and + 2 SDS) can still be undernourished. In fact, even obese children who have insufficient intake due to an illness and who subsequently experience significant weight loss can be undernourished, for weight loss might result in loss of fat mass or fat free mass. As a result of weight loss, children lose muscle strength, suffer from fatigue, have lower tolerance for (chemo) therapy, and are more susceptible to infections. Therefore, when a child is diagnosed with cancer, it is important to assess weight and height prior to the diagnosis, in addition to the assessment of actual values of weight and height. The inclusion of prior weight and height in the assessment of nutritional status will help clinicians to implement appropriate nutrition interventions.

To date, however, weight and height of children newly diagnosed with cancer are seldom compared with previous measurements. Literature reviews on undernutrition in childhood cancer patients revealed that only one study reported weight loss at diagnosis, whereas other studies only included actual values of weight and height to assess nutritional status at diagnosis. In contrast, in adult cancer patients weight loss is seen as an important parameter for the assessment of nutritional status at the time of diagnosis. Moreover, weight loss is included in several nutritional screening tools for adults and is found to have an adequate predictive value for classifying patients as undernourished or well-nourished. Determining weight loss in children is problematic because weight changes as a child grows. During childhood, average growth in weight is 2-3 kg each year. Until the start of puberty children grow 6-7 centimeters taller each year. Hence, when comparing children’s weight and height at diagnosis with prior data, this growth needs to be taken into account. A prolonged period of weight
maintenance or unchanged height should in fact be seen as deterioration in nutritional status. Another problem is that recent measurements of weight and height are usually not available. Moreover, parent-report of weight or height prior to diagnosis is not always reliable because of children’s continuous growth.

In this study we used growth curves from preventive health care centers (PCHC) to predict the child’s weight and height at diagnosis. Healthy children follow their individual growth curve until puberty. In case of normal growth, data from the individual growth curve can be used to predict weight and height. A difference between actual weight and height at diagnosis and predicted values may indicate lack of weight gain, lack of linear growth, or weight loss, all of which indicate deterioration in the child’s nutritional status.

This study has two main objectives. First, we aimed to compare actual weight and height at diagnosis with predicted weight and height based on the child’s growth curve. Second, we aimed to assess whether differences between actual and predicted data are related to age at diagnosis, gender, type of malignancy, extent of disease, and weight and height prior to diagnosis.

**METHODS**

**Participants**

The patients in this study were recruited from two prospective cohort studies (Pecannut study and Clep2 study, data not yet published) conducted at the University Medical Center Groningen (UMCG) in the Netherlands between 2007 and 2013. Children whose data on weight and height were available from PCHC records were included. In addition, only pre-pubertal children (according to Tanner I) aged <11 years were included. This inclusion was based on the fact that during puberty children frequently divert from their growth curves due to growth spurts. This diversion is mostly unrelated to changes in their nutritional status. Exclusion criteria were being non-Dutch speaking or being in a palliative phase of treatment at the time of enrollment. For both studies written informed consent was given by all parents. Both studies received ethical approval from the Medical Ethics Committee of the UMCG.
Measures and procedures

At diagnosis, measurements of actual weight and height were performed.\textsuperscript{20} Details regarding measurements have been published previously.\textsuperscript{18} In addition, data of weight and height were obtained from PCHC records. These data are routinely collected by health care professionals in children between the ages of one month and 4 years. All data were converted into z-scores according to Dutch reference standards for weight-for-age (WFA), height-for-age (HFA), and weight-for-height (WFH).\textsuperscript{14} To determine the children’s own growth curve prior to their diagnosis, the mean value of the z-scores for weight and height of children between 1.5 and 4 years of age was calculated (Fig. 1). This mean z-score represents the child’s nutritional status prior to diagnosis and is called predicted z-score. From the age of 1-1.5 years onwards children have their own growth curve, and studies have demonstrated that they follow

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{figure1.png}
\caption{Example of a weight-for-age growth curve of a boy diagnosed with cancer at the age of 5 years. Difference in z-score $\Delta z$ is: z-score at diagnosis $z_{Dx}$ minus predicted z-score $z_P$ (=mean value of z-scores at age 1.5-4 years).}
\end{figure}
their curve fairly closely until they reach puberty.\textsuperscript{16,21} For patients aged \( \geq 1.5 \) years at diagnosis, all measurements (minimum of 2 measurements) were used to compute the predicted z-score; whereas for children aged 1.5 years at diagnosis the mean values of the last two measurements were used. To determine differences between actual and predicted WFA, HFA, and WFH, change in z-score (\( \Delta z \)-score) was computed as: z-score diagnosis - z-score predicted.

Since weight loss of >5\% during the first 3 months of treatment was found to be clinically relevant in childhood cancer patients on-treatment,\textsuperscript{22} we considered a difference of 5-10\% between predicted and actual data of weight and height to be relevant at diagnosis. This criterion of 5-10\% is also used in adults.\textsuperscript{23} A weight loss of 5-10\% corresponds to a difference of about 0.5 to 1 SDS in weight. These differences were found to be clinically relevant for height as well.\textsuperscript{24} For children aged up to 5.0 years at diagnosis, the period between the last measurement at a PCHC at the age of 4 years and diagnosis did not exceed 12 months. For children >5.0 years at diagnosis, this period varied between 1-7 years. Greater differences are to be expected over a longer period of time; therefore, to control for whether the length of time since the last measurement at a PCHC influenced the magnitude of differences, the \( \Delta z \)-scores were first computed for two age groups: children aged \( \leq 5.0 \) years and children aged >5.0 years at the time of diagnosis. In case the two groups did not differ, further analyses were conducted for the whole group.

Differences in weight and height were evaluated in relation to age, gender, type of malignancy (hematological, solid, and brain), extent of disease, and weight and height prior to diagnosis. Extent of disease was divided into localized or advanced stage (defined as leucocytes >100x10\(^9\)/l in leukemia, metastasis in solid and brain malignancies, stage III and IV in lymphoma).

\textit{Statistical analyses}

Since we expected weight and height at diagnosis to be lower than predicted, one-sided dependent t-tests were used to compare actual z-scores for WFA, HFA, and WFH with predicted z-scores for WFA, HFA, and WFH. Two-sided independent t-tests were performed to compare \( \Delta z \)-scores for children aged \( \leq 5.0 \) years and children aged >5.0 years, and Pearson Chi-square was performed to compare percentage children with \( \Delta z < -0.5 \) SDS in both groups. In order to explore the relation between \( \Delta z \) and age, gender, and prior weight and height, Pearson correlation coefficients and independent t-tests
were conducted. Analysis of variance (ANOVA) was used to compare the Δz between the three types of malignancies. Odds ratio were calculated to determine the association between extent of disease and Δz. Significance of OR was tested by Pearson Chi-square. Given that the number of respondents was fixed at 95, statistical power was sufficient for an effect size of 0.25 (β=0.80; α=0.05). P value <0.05 was considered statistically significant.

RESULTS

Respondents
The patient group consisted of 95 children, of which 45 (47%) were girls. The median age was 5.4 years (range 1.7-10.8). Patients were diagnosed with hematological (57%), solid (26%), and brain malignancies (17%) (Table 1).

Actual and predicted weight and height
According to actual z-scores at diagnosis, 2% (2/95) were underweight (zWFA<-2 SDS), 4% (4/95) showed stunting (zHFA< -2SDS), and 7% showed (7/95) wasting (zWFH<-2 SDS) (Fig. 2). The Δz-scores for WFA, HFA, and WFH of the age groups ≤5 years and >5 years did not differ (independent T-test all P values >0.05). Therefore, data of both groups were analyzed together. Actual z-scores for WFA, HFA, and WFH were lower than predicted z-scores (dependent T-test all P values <0.05, Table 2).

Differences in weight and height
Differences of <-0.5 SDS were found in 25% (24/95) of the patients for WFA, 23% (22/95) for HFA, and 29% (28/95) for WFH (Fig. 2). Differences of more than 1 SDS were found in 8% percent (8/95), 9% (9/95), and 16% (15/95) of the patients for WFA, HFA, and WFH respectively. The percentage of children with Δz <-0.5 SDS did not differ between the age groups ≤5.0 years and >5.0 years (Pearson Chi-square all values >0.05).

Factors related to differences from growth curves
Correlation coefficients revealed that differences in WFA, HFA, and WFH were not related to age at diagnosis (Pearson r= -0.024, 0.013, -0.031 respectively, all P values >0.05) or to nutritional status prior to diagnosis.
Table 1. Characteristics of the respondents (n=95).

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Median age (range)</th>
<th>n (%)</th>
<th>Age ≤ 5.0 years</th>
<th>Age &gt; 5.0 years</th>
<th>Gender: female</th>
</tr>
</thead>
<tbody>
<tr>
<td>n (%)</td>
<td>5.4 (1.7-10.8)</td>
<td>44 (46)</td>
<td>51 (54)</td>
<td>45 (47)</td>
<td></td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>Extent of disease n (%)</th>
<th>n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Localized (n=70)</td>
<td></td>
</tr>
<tr>
<td>Hematological</td>
<td>43 (80)</td>
<td>54 (57)</td>
</tr>
<tr>
<td>Leukemia</td>
<td>40</td>
<td>45 (47)</td>
</tr>
<tr>
<td>Lymphoma</td>
<td>3</td>
<td>9 (10)</td>
</tr>
<tr>
<td>Solid tumors</td>
<td>14 (56)</td>
<td>25 (26)</td>
</tr>
<tr>
<td>Neuroblastoma</td>
<td>2</td>
<td>9 (10)</td>
</tr>
<tr>
<td>Wilms tumors</td>
<td>4</td>
<td>6 (6)</td>
</tr>
<tr>
<td>Bone</td>
<td>5</td>
<td>6 (6)</td>
</tr>
<tr>
<td>Solid other</td>
<td>3</td>
<td>4 (4)</td>
</tr>
<tr>
<td>Brain tumors</td>
<td>13 (81)</td>
<td>16 (17)</td>
</tr>
<tr>
<td>Medullo- and ependymoblastoma</td>
<td>2</td>
<td>4 (4)</td>
</tr>
<tr>
<td>Astrocytoma/glioma</td>
<td>6</td>
<td>5 (5)</td>
</tr>
<tr>
<td>Other</td>
<td>1</td>
<td>7 (7)</td>
</tr>
</tbody>
</table>

\[a\] % refers to percentage patients of the diagnosis group  
\[b\] % refers to the total patient group

Figure 2. Percentage of patients (n=95) with \(z< -2\) SDS, \(\Delta z < -0.5\) SDS, and the total percentage of patients with actual low values for weight and height or significant differences. WFA, weight-for-age; HFA, height-for-age; WFH, weight-for-height; \(\Delta z\)-score: z-score diagnosis – predicted z-score; SDS, standard deviation score.
Table 2. Predicted z-score, z-score at diagnosis and difference in z-score: $\Delta z = z_p - z_{dx}$. Mean (SD) are presented.

<table>
<thead>
<tr>
<th></th>
<th>Predicted z-score growth curves</th>
<th>Actual z-score at diagnosis</th>
<th>$\Delta$ z-score</th>
<th>P value(^a)</th>
<th>Effect-size(^b)</th>
</tr>
</thead>
<tbody>
<tr>
<td>All patients</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>n=95</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>zWFA (SD)</td>
<td>.09 (.94)</td>
<td>-.14 (1.03)</td>
<td>-.23 (.55)</td>
<td>0.002</td>
<td>.39</td>
</tr>
<tr>
<td>zHFA (SD)</td>
<td>.11 (1.08)</td>
<td>-.10 (1.20)</td>
<td>-.22 (.61)</td>
<td>0.020</td>
<td>.33</td>
</tr>
<tr>
<td>zWFH (SD)</td>
<td>.07 (.84)</td>
<td>-.13 (1.12)</td>
<td>-.20 (.85)</td>
<td>0.047</td>
<td>.23</td>
</tr>
<tr>
<td>Hematological</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>n=54</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>zWFA (SD)</td>
<td>-.00 (.88)</td>
<td>-.17 (.95)</td>
<td>-.17 (.40)</td>
<td>0.002</td>
<td>.39</td>
</tr>
<tr>
<td>zHFA (SD)</td>
<td>.02 (1.02)</td>
<td>-.11 (1.08)</td>
<td>-.13 (.46)</td>
<td>0.020</td>
<td>.28</td>
</tr>
<tr>
<td>zWFH (SD)</td>
<td>-.00 (.81)</td>
<td>-.17 (1.02)</td>
<td>-.17 (.74)</td>
<td>0.047</td>
<td>.23</td>
</tr>
<tr>
<td>Solid</td>
<td></td>
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<tr>
<td>n=25</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>zWFA (SD)</td>
<td>.31 (1.09)</td>
<td>.09 (1.22)</td>
<td>-.40 (.67)</td>
<td>0.003</td>
<td>.52</td>
</tr>
<tr>
<td>zHFA (SD)</td>
<td>.29 (1.26)</td>
<td>.07 (1.39)</td>
<td>-.22 (.60)</td>
<td>0.038</td>
<td>.35</td>
</tr>
<tr>
<td>zWFH (SD)</td>
<td>.24 (.94)</td>
<td>.21 (1.15)</td>
<td>-.45 (.88)</td>
<td>0.008</td>
<td>.47</td>
</tr>
<tr>
<td>Brain</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>n=16</td>
<td></td>
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</tr>
<tr>
<td>zWFA (SD)</td>
<td>.07 (.93)</td>
<td>-.10 (1.06)</td>
<td>-.18 (.74)</td>
<td>0.177</td>
<td>.24</td>
</tr>
<tr>
<td>zHFA (SD)</td>
<td>.14 (1.00)</td>
<td>-.34 (1.34)</td>
<td>-.49 (.99)</td>
<td>0.031</td>
<td>.46</td>
</tr>
<tr>
<td>zWFH (SD)</td>
<td>.03 (.79)</td>
<td>.15 (1.37)</td>
<td>.12 (1.06)</td>
<td>0.327</td>
<td>.12</td>
</tr>
<tr>
<td>Localized stage</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>n=70</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>zWFA (SD)</td>
<td>.03 (.93)</td>
<td>-.11 (.97)</td>
<td>-.14 (.48)(^\dagger)</td>
<td>0.007</td>
<td>.29</td>
</tr>
<tr>
<td>zHFA (SD)</td>
<td>.06 (1.03)</td>
<td>-.12 (1.21)</td>
<td>-.17 (.60)</td>
<td>0.009</td>
<td>.28</td>
</tr>
<tr>
<td>zWFH (SD)</td>
<td>.03 (.83)</td>
<td>-.07 (1.05)</td>
<td>-.09 (.80)(^\‡)</td>
<td>0.119</td>
<td>.12</td>
</tr>
<tr>
<td>Advanced stage</td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>n=25</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>zWFA (SD)</td>
<td>.26 (1.00)</td>
<td>-.21 (1.21)</td>
<td>-.47 (.67)(^\dagger)</td>
<td>0.001</td>
<td>.58</td>
</tr>
<tr>
<td>zHFA (SD)</td>
<td>.26 (1.21)</td>
<td>-.07 (1.22)</td>
<td>-.33 (.66)</td>
<td>0.009</td>
<td>.46</td>
</tr>
<tr>
<td>zWFH (SD)</td>
<td>.18 (.85)</td>
<td>-.31 (1.28)</td>
<td>-.49 (.93)(^\‡)</td>
<td>0.008</td>
<td>.47</td>
</tr>
</tbody>
</table>

\(^a\) P values based on one-sided Paired T-tests. \(^b\) Effect-size based on Cohen’s r; effect sizes are designated as small (0.10), medium (0.30), and large (0.50). \(^\dagger\) These values differ significantly according to independent T-test. \(^\‡\) These values differ significantly according to independent T-test.

y, years; SD, standard deviation; zWFA, z-score weight-for-age; zHFA, z-score height-for-age; zWFH, z-score weight-for-height.
(Pearson r= -0.126, -0.067, -0.124 respectively, all P values >0.05). No differences were found between boys and girls (independent t-test zWFA t= -1.161, zHFA t= -0.269 zWFH t= -0.399, all P values >0.05).

Both patients with hematological and solid malignancies had lower z-scores for WFA, HFA, and WFH at diagnosis than predicted (Table 2). In patients with brain malignancies weight remained stable; whereas height at diagnosis was almost 0.5 SDS lower than the predicted height (Table 2). ANOVA analyses revealed that the three diagnosis groups did not differ with regard to the differences between actual and predicted z-scores (ANOVA (Welch statistic) WFA F=1.299, HFA F=1.121, WFH F=1.777, all P values >0.05.). Differences in Δz-scores for WFA and WFH were greater in patients with advanced stage cancer compared with localized stage (independent T-test values P<0.05, Table 2). Advanced stage was associated with higher risk of significant weight loss (<-0.5SDS) (OR_{WFA}=3.45 P=0.012; OR_{HFA}=1.42 P=.504; OR_{WFH}=2.45 P=0.063). Children with localized or advanced stage did not differ with regard to predicted or actual z-scores (Independent T-test, all P values >0.05).

**DISCUSSION**

This is the first study to use data from growth curves to determine weight loss, lack of weight gain, and lack of linear growth in children newly diagnosed with cancer. Comparison of weight and height at diagnosis with data from growth curves indicated that, on average, children’s weight and height at diagnosis was lower than predicted. At diagnosis for cancer, children were lighter, smaller, and thinner than expected. Based on actual z-scores, 2%, 4%, and 7% were undernourished at diagnosis for WFA, HFA, and WFH respectively. However, compared with their growth curves another 20-24% of the children lost more than 0.5 SDS in WFA, HFA, and WFH. In fact, children’s actual nutritional status at diagnosis was worse than the actual data of weight and height indicated. As such, the actual data of weight and height underestimated the deterioration in nutritional status. Therefore, prior weight and height need to be taken into account when determining the nutritional status of pediatric patients. A child with significant weight loss (for instance, >0.5 SDS in 1 month) might be more at risk of adverse health outcomes than a child who grows along the -2 SDS WFA curve. Moreover, since children with cancer undergo intensive treatment and often experience weight loss,
it is of the utmost importance to detect those children that are already poorly nourished at the time of diagnosis. A comparison of actual values of weight and height with predicted values will not only detect more children at risk of undernutrition, but is also more in line with common practice in pediatrics. However, clinical professionals face the problem of how to determine loss in weight and height at a given time point, for instance, at diagnosis of cancer. The current study offers a potential method to solve this problem.

The differences between actual and predicted weight and height were the same for boys and girls and independent of the child’s previous weight and height. Thus, children with low values for WFA on their growth curves were not more susceptible to weight loss than children with high values for WFA. Contrary to another study,\textsuperscript{25} which found higher risk of undernutrition in younger children after hospital admission, including children diagnosed for cancer, the current study found no relationship between age and undernutrition.

In patients with hematological and solid malignancies, significant losses in WFA, HFA, and WFH were demonstrated. Despite loss in HFA, loss in WFH was significant as well. This means that, proportionally, loss in weight was more severe than lack of linear growth. According to the literature,\textsuperscript{4,26} children with advanced cancer stage experienced more severe weight loss and their risk of <-0.5 SDS weight loss was more than three times larger than in children with localized cancer. This weight loss prior to diagnosis may be due to diminished energy intake or increased energy requirements. Many patients experience a period of illness and/or nausea prior to diagnosis, resulting in diminished intake. Additionally, tumor mass causes alterations in metabolism which can result in increased energy expenditure.\textsuperscript{27-30} These alterations may particularly concern children with advanced cancer. However, the factor that contributes most to weight loss has not yet been identified.

In contrast to patients with hematological and solid malignancies, WFA and WFH remained stable in patients with brain malignancies; whereas a significant loss of almost 0.5 SDS in HFA was found in this particular patient group. Literature has shown that diminished growth can be one of the early signs of brain tumors. Diminished growth has been found in patients with tumors in the hypothalamic region such as craniopharyngioma\textsuperscript{31} and in patients with brain stem tumors such as astrocytoma and glioma.\textsuperscript{32} Imbalances in growth hormones may play a role here.

A point for discussion is which differences in weight and height are clinically relevant and cause health risks such as infections, and lower survival rates. The most specific criteria define significant weight loss as >2% in 1 week,
>5% in 1 month, >7.5% in 3 months, and >10% in 6 months. Strikingly, in pediatric oncology these criteria have been used only once. A disadvantage of using %weight loss over a prolonged period of time is that the real weight loss is underestimated because normal growth during that period is not taken into account. Since z-scores consider growth, the z-score is a better indicator to detect differences in weight and height over time and should therefore be preferred to %weight loss. To define clinically relevant cut-off values for losses in WFA; HFA; and WFH, differences in z-scores should be related to outcomes such as morbidity; mortality; and quality of life. To date, one study has demonstrated an increased infection rate in childhood cancer patients with >5% weight loss in 3 months compared with their weight at admission. Rapid weight loss seems to make these children more vulnerable to bacterial infections. Thus, >5% or >0.5 SDS weight loss appears to be clinically relevant. Considering these important finding, more studies that address the clinical relevance of weight loss are needed.

An additional finding of this study was lack of linear growth in patients with hematological and solid malignancies. Considering the acute nature of these malignancies weight loss is to be expected. However, the relatively lower height at diagnosis reveals that some of these children may have suffered from poor health for a longer period of time, which suggests that the cancer process was present long before diagnosis.

The results of this study are based on the assumption that children follow their own growth curve until the onset of puberty. The difficulty with this assumption is that the present growth curves have been developed using cross-sectional data, while longitudinal growth curves that determine variation in growth over time are scarce. The question whether children really follow their own growth curve remains unanswered as yet. The few studies on this phenomenon found that in infancy and puberty z-scores regressed to the mean and deviated considerably. However, after infancy until puberty children maintained their growth curve and there was no regression to the mean. Another study found horizontal height tracks in a majority of pre-pubertal children, indicating that those children maintained their growth curve.

This study has demonstrated that data from one single measurement of weight and height are insufficient to obtain a valid impression of a child’s nutritional status at the time of cancer diagnosis. The actual data of weight and height underestimated the deterioration in nutritional status. In contrast, the inclusion of predicted weight and height based on growth curves resulted in the identification of nearly 25% more children with a poor nutritional status.
than a classification based on actual values alone. Children with advanced
cancer had the highest risk of weight loss. Although the onset of cancer is
considered to be acute and is associated with loss in weight, lack of linear
growth was also found in this study. In conclusion, in addition to actual
weight and height at diagnosis, comparison of weight and height at diagnosis
to a child’s growth history, is urgently recommended to detect those children
whose health is at risk and to implement timely intervention measures.

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