Evaluation of the General Growth Parameters of a Group of Children With Severe Early Childhood Caries in Bucharest, Romania

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Abstract

Introduction: Many scientific studies have evaluated the general development of children with early childhood caries (ECC). The results of these studies may vary, between the lack of association of this disease with alterations in the general parameters of growth and the presence of significant modifications of these parameters but none have previously been performed in Romania. ***Aims:*** To compare the anthropometric indices (Ponderal, Statural, and Nutritional) of two groups of preschool children with/without *(severe) early childhood caries*—(S)-ECC and to assess any association between theses variables. ***Methods:*** The study was conducted using two groups of preschool children: a study group of 308 patients (141 girls and 167 boys) with S-ECC and a control group of 200 children (100 girls and 100 boys) without ECC. After obtaining parental consent and ethics approval, all children were examined for caries by one examiner. Their height and weight were measured in order to calculate their Ponderal Index (PI), Statural Index (SI), and Nutritional Index (NI). Changes in these anthropometric indices were evaluated based on age, gender, and severity of ECC. To test for statistical differences between the groups, the chi-square test was used. Odds ratios were also calculated. ***Results:*** In both groups, normal overall development predominated. PI was the most affected, particularly in children with S-ECC. In children with modified growth parameters, underweight predominated (more than half of the children with S-ECC). More than three-quarters of the underweight children with S-ECC showed a ponderal (weight) deficiency of between 10% and 25%. In contrast, among the healthy children in the control group, the predominant growth disorder was overweight. ***Conclusions:*** The growth of 28.6% of the preschool children in the study group (estimated through the NI) appeared to be negatively associated with ECC. There was a directly proportional association between the severity of ECC and the severity of the underdevelopment, expressed by the alteration of the development indices (SI, PI, and NI). The children's age had a statistically relevant influence on the alteration in growth. The greatest differences for all the development indexes were found in children older than five years. Gender had no statistically significant impact on the general growth parameters.

Key Words: Severe Early Childhood Caries, S-ECC, Nutritional Status, Weight Deficiency.

Introduction

Early childhood caries (ECC) presents as one or more decayed or filled tooth surfaces and/or absent teeth in the deciduous (temporary) dentition of a child less than six years old [1]. *Severe early childhood caries* (S-ECC) occurs when there is any sign of caries on smooth surfaces of a tooth or teeth in children less than three years old. The use of the term S-ECC also implies decayed missing filled surface (dmf-s) scores of =4 in three year-olds, =5 in four year olds, and =6 in five year olds [2-5].

There are contradictory reports in the literature with regard to the association between ECC and reduced weight and height. A study of the effect of nursing caries on body weight in a paediatric population from New York showed that the mean age of "low weight" children with nursing caries was significantly greater than for children at, or above,

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their ideal weights, indicating that progression of nursing caries may affect growth adversely [6]. This finding supported the results of an earlier study on the effect of nursing or rampant caries on height and body weight in three- to five-year-old Turkish children, which found that rampant, or nursing, caries may correlate with reduced growth of the body, manifested by reduced weight and height [7].

Initial results from a more recent study, which examined the impact of S-ECC on growth in young Caucasian and African American children living in Ohio and Washington, USA, suggested that children with S-ECC might be growing at a slower rate [8]. However, in 2006, the same authors reported in a similar study that there were no significant differences in height or weight between the study group with S-ECC and a control, caries-free, group [9].

A study of the nutritional status of a population of young children in Toronto, Canada, concluded that 33% of the children in the sample with S-ECC showed evidence of malnutrition. However, others were overweight/obese [10].

A recent study of the nutritional status of young children in Taiwan concluded that children aged between two and five years with S-ECC may encounter some degree of malnutrition problems such as impairment of growth [11].

It has been suggested that S-ECC can have general consequences such as growth failure [12]. A further study emphasised that poor weight or weight loss, sleepless nights, chronic pain, and an inability to eat comprise the profile of a young child with S-ECC [6].

In most small children, S-ECC is associated with reduced growth [8,13] and reduced weight gain [6] due to insufficient food consumption to meet the metabolic and growth needs of children less than two years old [14]. These malnourished children are prone to develop problems, including gastro-intestinal disturbances and speech problems. Later, there may well be an impact on child's education, leading to learning difficulties, lack of concentration, truancy, a lack of self-esteem, and poor integration into the community [4,8,15,16].

In contrast, recent data from studies in the USA indicated that most of the children with gross caries were overweight and the cause might be the consumption of easily chewable food with high caloric value and high sugar content [17,18].

Physical development can be evaluated by periodic measurement of a child's weight and height, which are used to calculate anthropometric indexes for weight, height, and nutrition. In the current study, they are referred to as the Ponderal Index (PI) (for weight), the Statural Index (SI) (for height), and the Nutritional Index (NI) [19]. NI is the most accurate because it appreciates the correlation between a child's weight and height [19].

Aims

The aims were to compare the anthropometric indexes (Ponderal, Statural, and Nutritional) of two groups of preschool children with/without (severe) early childhood caries—(S)-ECC—and to assess any association between these variables.

Methods

The study was conducted using two samples of children. They were:

1. A Study Group (SG) of 308 patients composed of the 141 girls and 167 boys with S-ECC who, during a one-year period, attended the emergency room in the paedodontics clinic of UMF Carol Davila for a first visit.
2. A Control Group (CG) of 200 children composed of the first 100 girls and 100 boys without ECC, randomly selected from two kindergartens in Bucharest.

The inclusion criteria for the study subjects were all children less than six years of age (71 months old), with no medical or physical problems, who attended the paedodontics clinic emergency room and whose parents gave their written consent for their child to take part in the study.

The study was approved by the ethics committee of the Carol Davila University of Medicine and Pharmacy, Bucharest, Romania.

Data collection

The following data were recorded for each child: name, age, gender, diagnosis (with/without ECC), severity of ECC, height and weight. All examinations were performed by the same person, in standard conditions.

General development assessment method

Weight and height were used to calculate the following anthropometric indexes: Ponderal, Statural, and Nutritional. The PI (for weight) is defined as the ratio between the actual weight and the ideal weight according to the child's age, the SI for height is defined as the ratio between the actual height and the ideal height according to the child's

age, and the NI is defined as the ratio between the actual weight and the ideal weight according to the child's stature. The ideal mean weight and height were obtained from tables and graphs containing the median values established for a certain population. These growth parameters correlate to age and sex [19].

The growth assessment of each child with/without S-ECC was performed by comparing the measured values to the ideal mean values. Depending on these values, every child was allocated to a ponderal, statural, and nutritional category: normal nutrition or poor nutrition (characterised by under- or overweight) [20].

There are three categories for people with a lower than average weight (ponderal deficit). They are: low ponderal deficit—PI=0.89-0.76 (10-25% weight deficit); moderate ponderal deficit—PI=0.75-0.61 (25-40% weight deficit); severe ponderal deficit—PI =0.6 (40% weight deficit). PI<0.90 indicates a high risk of child malnutrition or being underweight. PI values ranging from 0.90 to 1.1 characterise the normal state of nutrition. PI values higher than 1.1 characterise being overweight.

Similarly, for people with a lower than average height (height deficit), there are three categories. These are: low statural deficit (slightly shorter than average)—SI=0.95-0.90; moderate statural deficit —SI=0.89-0.85; severe statural deficit—SI <0.85.

For people with a nutritional deficit, there are also three categories. These are: low nutritional deficit—NI=0.89-0.81; moderate nutritional deficit —NI=0.80-0.71; severe nutritional deficit—NI = 0.70. Values higher than 1.1 indicate overweight [20].

Statistical analysis

Data were analysed using statistical software (SPSS version 15; SPSS Inc, Chicago, USA). The variables used in the statistical analysis were:

- Primary variables: age, gender, weight and height.
- Secondary (derived) variables: SI, PI, NI, age groups, nutritional categories, caries severity (mild, moderate, severe). Although all the patients in the SG presented S-ECC, some were more affected than others. Therefore gravity of the S-ECC in the patients of the SG was classified as follows [21-23]:
  - Very mild: white spot lesions in the cervical region, on smooth labial, palatal or proximal surfaces of the upper incisors. Very mild form was excluded from this study because of the absence of patients presenting with only enamel demineralisation.
  - Mild: carious cavities on incisors, with exposure of yellow-coloured and soft dentine; incipient lesions in the cervical, proximal and occlusal regions of first upper molars.
  - Moderate: extensive lesions into the dentine of the upper incisors, with involvement of the dental pulp; mild form on the upper first molars and very mild form on the upper canines and lower first molars.
  - Severe: coronal fractures in upper incisors—retained carious roots, moderate form on the upper first molars; mild form on the upper canines and lower first molars and very mild form on the upper second molar.

To test for associations/correlations between the variables, the chi-square test was used. The threshold for statistical significance was set at $P>0.05$ (corresponding to a 95% probability). Odds ratios were also calculated in order to compare the probability of developmental alterations between healthy children and children with S-ECC.

Results

The age range, mean age, mean height, and mean weight of all the children in both groups are presented in *Table 1.*

The children's distribution according to the age groups is presented in *Figure 1.* Subjects older than five years (n=102; 33.1%) who presented with S-ECC were predominant in the SG. It is worth noting that just over a fifth (n=62; 20.1%) of the children with ECC were younger than three years.

Table 1. *Age range, mean age, mean height, mean weight of study participants*

	Number	Age ranges in month	Mean age in month	Mean height in centimetres	Mean weight in kilograms
SG	308 (167M, 141F)	16-71	49.6	101.2	15.2
CG	200 (100M, 100F)	27-71	54.7	107.4	17.8

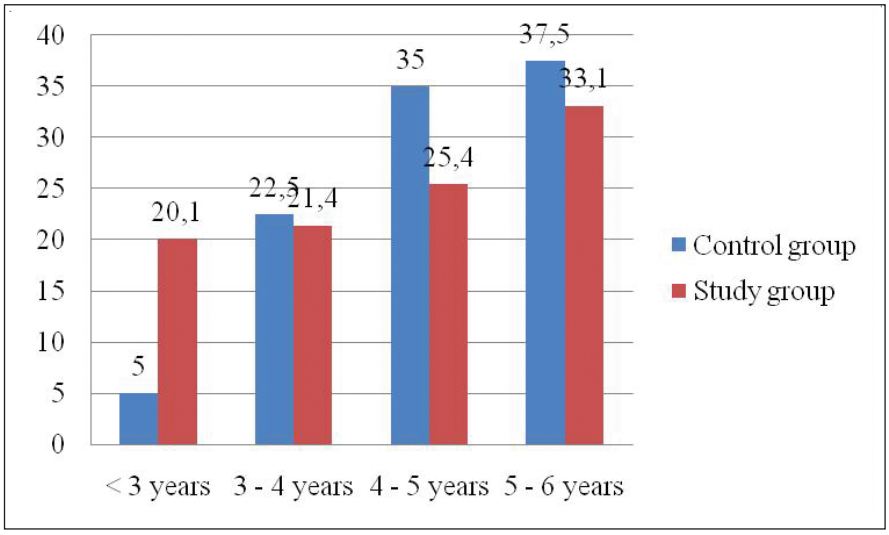

Figure 1. *Distribution (%) of the study samples by age group.*

The SG children's distribution according to the gravity of S-ECC is presented in *Figure 2*. Thus 127 (41.2%) children in the SG had severe forms of S-ECC.

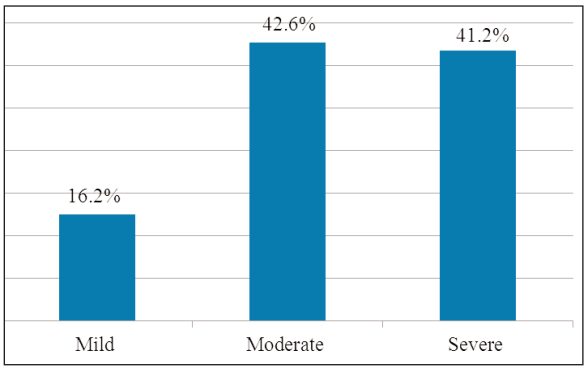

Figure 2. *Distribution (%) of children in the Study Group (SG) according to gravity of S-ECC.*

The distribution of children in both study samples according to PI is presented in *Figure 3*.

- One hundred and forty (45.5%) of the children in SG were either under- or overweight. Ponderal deficit (underweight) predominated em rules n=114 (37%) compared to overweight em rules n=26 (8.5%).
- Within the ponderal deficit, those who were slightly underweight (low ponderal deficit) predominated (n=86; 27.9%) compared to moderately underweight (moderate ponderal deficit) (n=27; 8.8%) or very underweight (severe ponderal deficit) (n=1; 0.3%).
- 94 (47%) of the children in the CG presented as either over- or underweight. More were overweight (n=52; 26%) than underweight (ponderal deficit) (n=42; 21%) *(Figure 3).*

A statistically significant association was noted between the two analysed variables (chi-square test, *P*=0.01) and an association at odds not too high (both Phi and Cramer's V tests=0.27). In

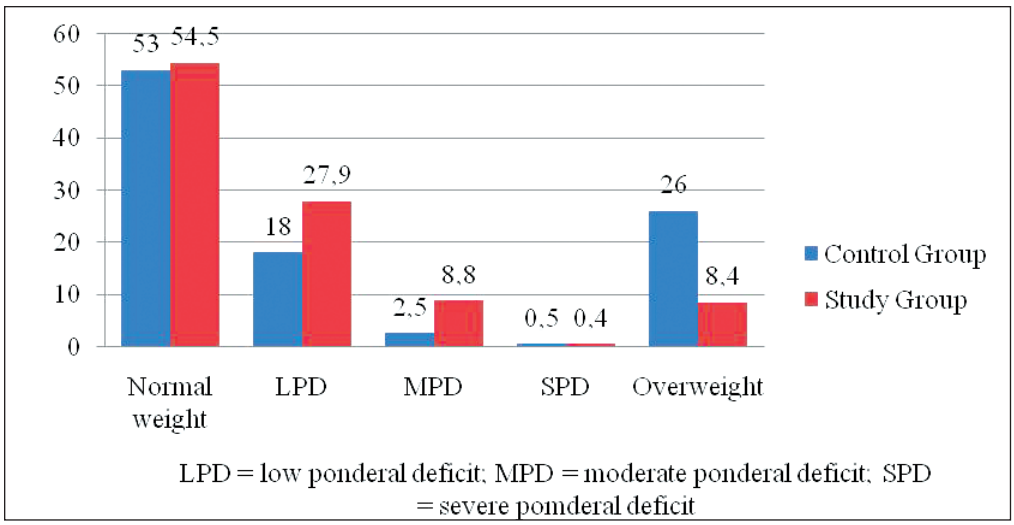

Figure 3. *Distribution (%) of the study samples by Ponderal Index (PI).*

addition to patients within the normal weight category (for which the prevalence was similar in both studied groups), all other variables indicate a difference. These differences indicated that patients with S-ECC were more likely to develop a slight (10-25%) or moderate (25-40%) weight deficit as opposed to healthy patients, for whom the chances of being overweight were greater. The probability in the patients with S-ECC who took part in this study to develop a ponderal deficit was over 2.2 times higher than for healthy patients; the healthy patients were more likely to be overweight (develop a ponderal excess).

The distribution of the SG by the PI and the S-ECC gravity is presented in *Figure 4*.

- Thirty-six (72.1%) of the children with a mild form of S-ECC presented with normal weight, compared to 4 (8.7%) with low ponderal deficit and 10 (19.2%) who were overweight.
- The number of children with a mild form of S-EEC of normal weight was 36 (72.1%) compared to 73 (56%) in the children with moderate form of S-ECC and 55 (43.2%) with severe form S-ECC.

Direct causal relationship between the gravity of the S-ECC and the situation in terms of PI can be seen in *Figure 4*. If about 72% of the patients that presented only a mild form of S-ECC recorded a normal weight, the percentage drops to 43.2% if the young patients were affected by a very severe form of S-ECC. In terms of statistical significance, the differences were *P*=0.01 (chi-square test) and a moderate association (Phi=0.36 and Cramer's V=0.21).

The distribution of the SG by the PI and age groups is presented in *Figure 5*. The number and proportion of the children in the SG with normal weight was 32 (36.5%) aged between five and six years, compared to 54 (59.2%) aged between four and five years, 52 (70.7%) aged between three and four years, and 30 (53.9%) under three years of age *(Figure 5)*.

For the PI, there was a sharp differentiation in the weight of patients over five years of age com-

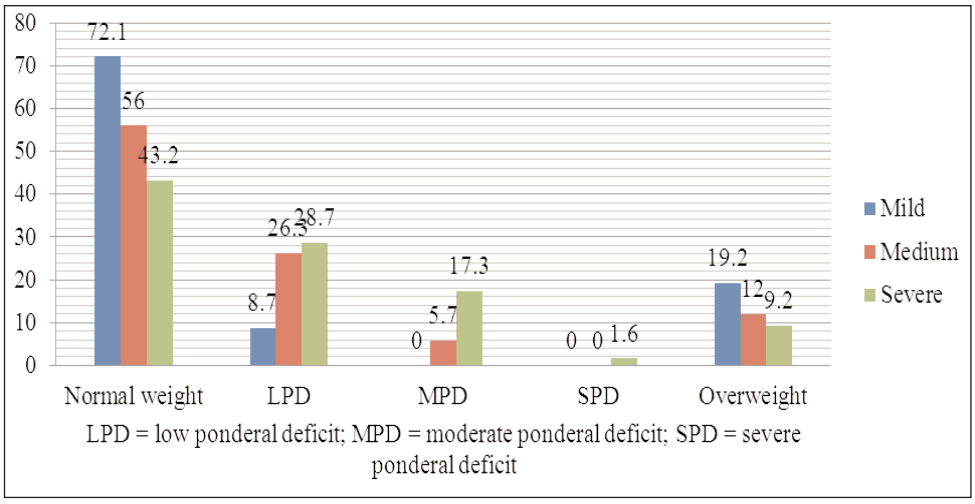

Figure 4. *Distribution (%) of SG by Ponderal Index (PI) and S-ECC gravity*

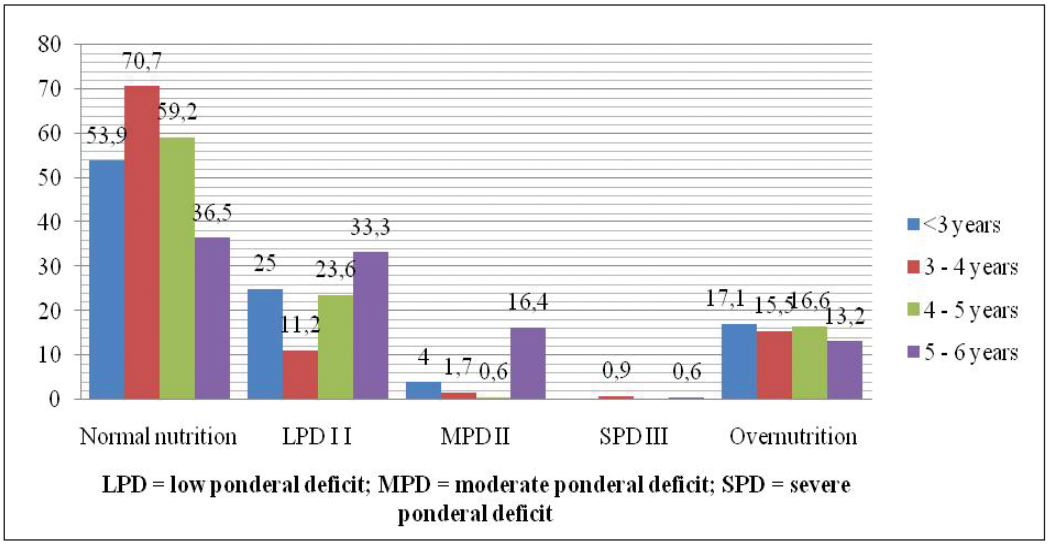

Figure 5. *Distribution (%) of SG by Ponderal Index (PI) and age group.*

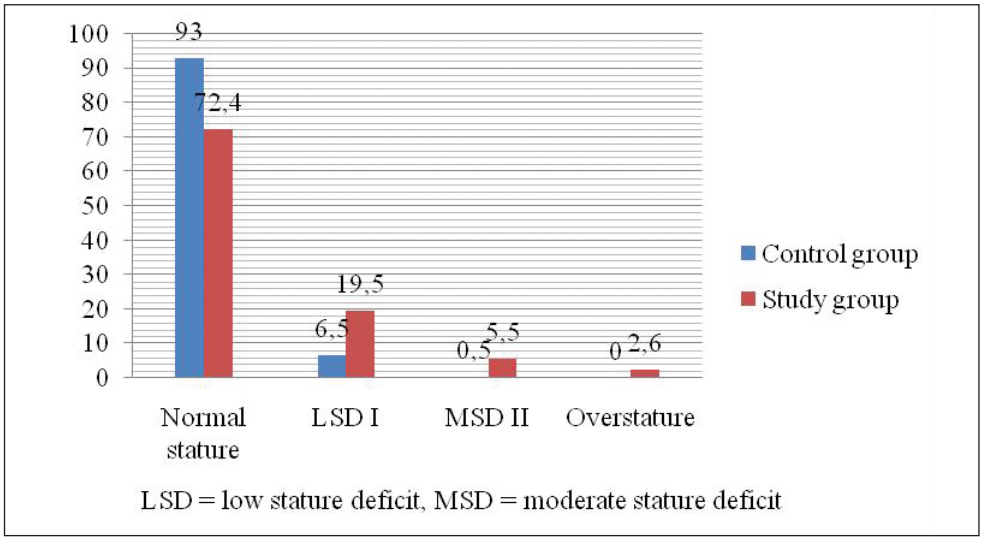

Figure 6. *Distribution (%) of study samples by Statural Index (SI).*

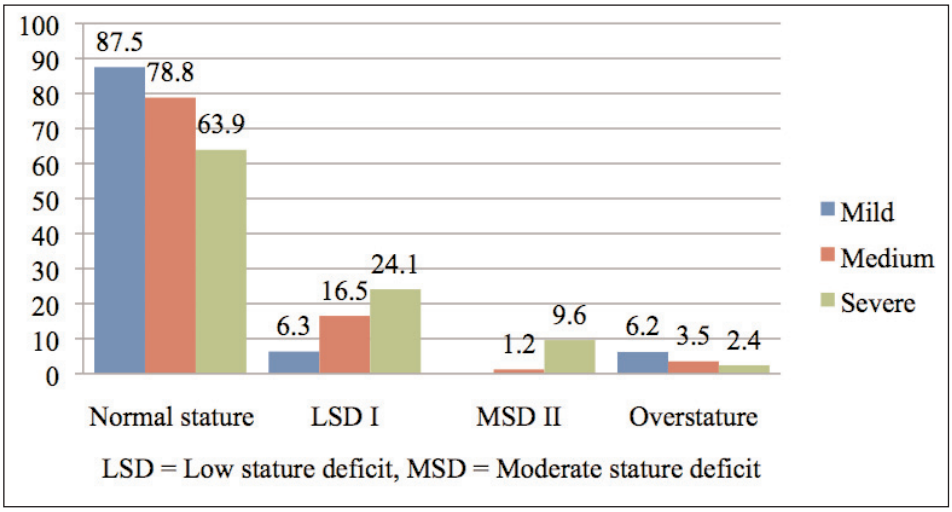

Figure 7. *Distribution (%) of SG by Statural Index (SI) by S-ECC gravity*

pared with other age groups. Thus, at this age, the proportion of patients of normal weight dropped below 40% (at least 17 percentage points lower than at the other ages) and the proportion of patients with a moderate weight deficit (25-40%) increased to over 15% (compared with the other age groups, where negligible levels were recorded). These differences were statistically very significant (chi-square test, *P*=0.01), with a probability of more than 99% and with a moderate association (Phi=0.37 and Cramer's V=0.21). The probability of the patients with S-ECC presenting with normal weight decreased with the increase in the S-ECC's gravity (*P*=0.02), especially in the group of children aged 5-6 years (*P*=0.01).

The distribution of the children in both study samples according to SI is presented in *Figure 6*.

- Eighty-five (27.6%) of the children in the SG presented height modification. Shortness (statural deficit) predominated (n=77; 25%); within the statural deficit, most had a low statural deficit (n=60; 19.5%) and fewer a medium statural deficit (n=17; 5.5%).
- Only 14 (7%) of the children in the CG were short for their age (had a statural deficit). Most were only mildly short (low statural deficit) (n=13; 6.5%) and only one (0.5%) was moderately short (medium statural deficit) (*Figure 6*).

In terms of the analysis of SI, it was noted that the patients without ECC had much higher chances of a normal statural development (93%) or to present a low statural deficit (6.5%). In the SG, the percentage of patients with normal development fell to less than three-quarters (72.4%), whereas the percentage of those who recorded a low statural deficit increased to almost a fifth (19.48%), almost three times higher than in the other group. About 5% of the patients had a moderate statural deficit. The association between SI and S-ECC was statistically significant (chi-square test, *P*=0.01) and the associ-

ation coefficients Phi and Cramer's V had values similar to that recorded for the previous index: 0.26.

The distribution of the SG by SI and the S-ECC gravity is presented in *Figure 7*. The number and proportion of the children with mild forms of S-EEC and of normal height was 44 (87.5%) compared to 103 (78.8%) of children with moderate forms of S-ECC and 81 (63.9%) with severe forms of S-ECC (*Figure 7*).

Analysis of the association between SI and the gravity of S-ECC showed that although severity of S-ECC affected statural development, over 60% of the patients with a severe form of S-ECC were of normal stature. The percentage was significantly lower than in patients with mild forms of S-ECC, where the proportion of young patients with normal stature was 87.5%. The probability of patients with S-ECC of being short for their age (develop a low statural deficit) is 4.42 times higher than in healthy patients. In terms of the level of statistical significance, this was *P*=0.01 (chi-square test), with a moderate level of association (Phi=0.32 and Cramer's V=0.19).

The distribution of the SG by SI and age groups is presented in *Figure 8*. The number and proportion of the children in the SG of normal height was 52 (64.8%) for children aged between five and six years, compared to 60 (87.3%) for children aged between four and five years, 60 (90.5%) for children aged between three and four years, and 51 (84.2%) for children aged under three years. (*Figure 8*).

Development in terms of SI in relation to age showed differences between patients. A very different structure from that point of view was recorded, especially for patients who were over five years old. More than a quarter of them (25.8%) had a low statural deficit, whereas almost one-tenth (9.4%) had a moderate statural deficit. These differences were statistically significant (chi-square test, *P*=0.001) and there was a moderate association between age and SI (Phi=0.36 and Cramer's V=0.21).

The distribution of the children in both study samples according to NI is presented in *Figure 9*. Eighty-eight (28.6%) children in the SG presented with evidence of deficient nutrition. Underweight (nutritional deficit) predominated (75; 24.4%), compared with overweight (13; 4.2%). Of those with a nutritional deficit, more had a low nutritional deficit (44; 14.3%) than those with a medium nutritional deficit (31; 10.1%). Forty-eight (24%) of the children in the CG presented with nutritional modifications. Most had only a low nutritional deficit (37; 18.5%), 10 (5%) had a moderate nutritional deficit, and only one (0.5%) a severe nutritional deficit (*Figure 9*).

The probability of the patients with S-ECC of developing a moderate nutritional deficit was 1.02 times higher than in healthy patients. Although greater differences occurred only among the categories of patients who presented a nutritional deficit, a low level association was observed in terms of association coefficients (Phi=0.24, Cramer's V=0.24), although it was still statistically significant (chi-square test, *P*=0.001).

The distribution of the SG by the NI and the S-ECC gravity is presented in *Figure 10*. The number and proportion of children in the SG with normal nutrition and a mild form of S-ECC was 37 (75%) compared to 86 (65.9%) in children with a moderate form of S-ECC and 26 (20.5%) with a severe form of S-ECC (*Figure 10*).

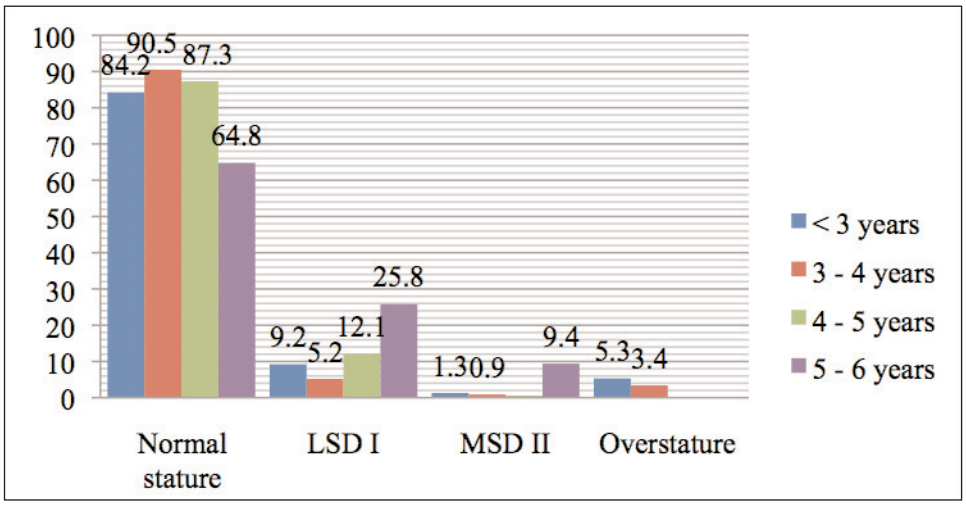

Figure 8. *Distribution (%) of SG by Statural Index (SI) by age group.*

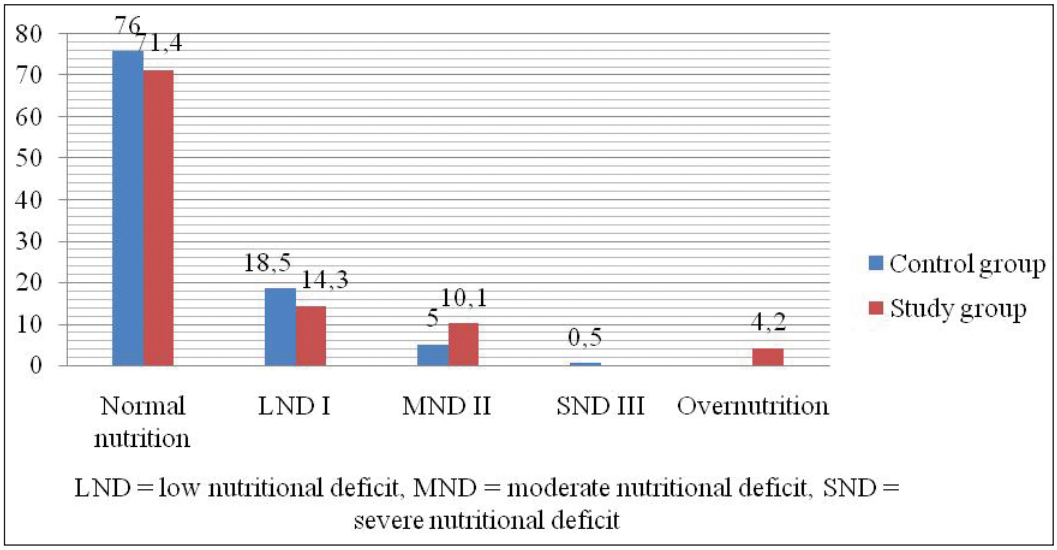

Figure 9. *Distribution (%) of study samples by Nutritional Index (NI).*

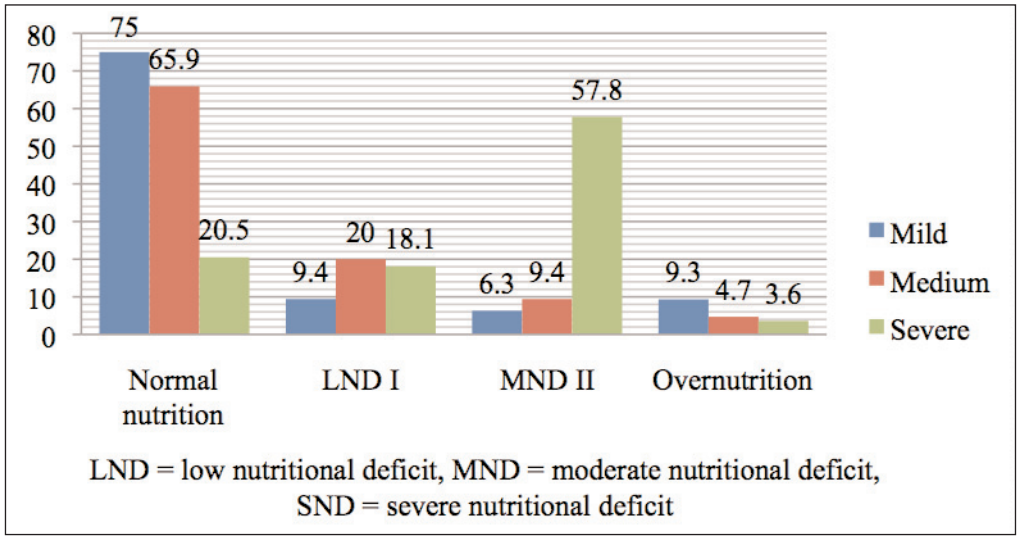

Figure 10. *Statural Index (%) of SG by Nutritional Index (NI) and gravity of S-ECC.*

Figure 10 shows the association between the gravity of S-ECC and NI. There was a directly proportional relation between the severity of S-ECC and the situation in terms of NI. If three-quarters of those who had a mild form of S-ECC recorded normal NI values, when the S-ECC was severe the proportion of patients with normal NI values dropped to a value of 20.5%. These descriptive connections were not statistically significant (chi-square test) at the established level (95%), the probability being situated in this case at a level of 91%. The intensity of the association between the two variables was low (Phi=0.28 and Cramer's V=0.16). There were no statistically significant differences with regard to the NI and the children's age group or between boys and girls.

Discussion

The study employed anthropometric measurements—PI, SI, and NI—to evaluate the nutritional status of preschool children with S-EEC in comparison with a healthy control group. Although many other studies use another method of assessing body growth, the Body Mass Index (BMI), defined as the individual's body weight divided by the square of his or her height, the results are similar in most cases.

The findings from the current study concerning the growth patterns of the children with S-ECC are in agreement with results obtained in several other studies, which show that S-ECC is associated with a low weight [6,8,13,24].

Growth impairment (represented by underweight and overweight) was present in S-ECC children in both the current study and in a study performed in 2009 in Taiwan [11]. However, the proportion of underweight children in the current study was about 9% higher whereas the proportion of overweight children was 3.6% lower. This may reflect the relative standards of living in Romania

and Taiwan or differences in the diet in the two countries.

The results of the current study also confirm those obtained in a study performed in the USA (Hayes *et al.* 2005), regarding the fact that children with S-ECC were shorter than their caries-free counterparts [9].

The present study is in disagreement with results obtained by the same authors (Hayes *et al.* 2006), which found that there were no significant differences in baseline height or weight between children with S-ECC and caries-free children [10]. These differences may well have been because in the present study there was a larger proportion of patients with severe forms of ECC, due to a more cariogenic diet, late requests for treatment, poor oral hygiene and understanding of the need to control sugar intake, poor education and poor economic status. It was also noticeable that in the American study more children were overweight. In Romania, in the control group very few were overweight. This finding may reflect the differences between the diets of poor children in the USA and Romania.

In order to generalise these findings to the whole country, additional studies are needed, on a larger number of children, conducted in different geographical regions. This research should also be performed in rural areas, where there is often poor access to a dentist, especially one who is a specialist in paediatric dentistry, as well as poor health education. These factors could alter the results.

In summary, it can be said that if the sample in the current study is representative of the entire city, in Bucharest, Romania, the growing prevalence of ECC, together with its negative consequences, is an important general and oral health problem, because this problem can be linked to alterations in growth and development. In the children studied, there was an association between the severity of ECC and the severity of the underdevelopment.

Conclusions

In the populations investigated in this study:

- The growth of 28.6% of the preschool children in the study group (estimated through the NI) appeared to be negatively affected by the existence of severe early childhood caries (S-ECC).
- There was a directly proportional association between the gravity of S-ECC and the severity of the underdevelopment, expressed by the alteration of the development indexes (SI, PI, and NI).
- The children's age had an influence on the alteration of growth.
- The greatest differences for all the development indexes were found in children older than five years.
- Gender had no statistically significant impact on the general growth parameters.

Contribution of each author

AMR coordinated the study, drafted the article, collected data from the study group, and collected bibliographic data.

RSV collected data from the control group.

IVF drafted the article, collected data from the study group, compiled the database for the statistic study, provided the graphic illustrations and was responsible for the English translation.

MC calculated the anthropometric indices.

CH performed the statistical calculations.

IC collected data from the study group and completed the database.

Statement of conflict of interests

As far as is known, there was no conflict of interest for any of the authors.

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