OBESITY RISK MANAGEMENT IN CHILDREN AND ADOLESCENTS

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Abstract: Objective*: To develop an obesity risk scoring system for stratifying the children and adolescents into groups with a high, intermediate, or low risk of developing obesity and comorbidities in the near or distant future.*

Design and Methods*: The scoring system was realized by combining criteria which proved to predict well the mentioned morbidities. In conceiving the obesity prevention score for preschoolers we used a sample of 460 people, 156 children and their parents. For the obesity prevention score for scholars we used a sample of 1240 subjects, 416 pupils and their parents. Using simple logistical regression, we studied the presence or absence of obesity as a dependent variable, influenced by a risk factor with 8 levels for preschoolers and 10 levels for pupils (the 8, respectively 10 final scores), as an independent variable.*

Results*: After linearization and exponentiation we got the following results: a R^2 value of 0.93 characterizing the regression on the preschool children and a R^2 value of 0.86 for the data in the school children sample. These high values assert the adequacy of the regression models at the same time with the highly significant p-values sores lower than .0001.*

Conclusions*: The probabilities derived from the scoring systems can be used to determine the need for and the nature of further investigations. This opens the possibility of identifying and monitoring the children at an early stage, and differentiated according to the level of risk, allowing maximum effectiveness in preventing obesity, with minimal effort.*

Keywords: *scores; prevention; obesity; children and adolescents*

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Introduction

Childhood obesity is alarmingly increasing worldwide and it is linked with an increased risk of obesity in adulthood, a wide range of comorbidities, and mortality[1-3]. The present and future costs of childhood obesity are difficult to be assessed, as long as worldwide children are becoming overweight at progressively younger ages and comorbidities that previously were considered adult problems have now become adolescent problems [4-8].

There is now a consensus that prevention would be a very effective way of reversing this trend, and it is recognized that children and adolescents are the priority population for intervention strategies[9]. Targeting the prevention of obesity during the key periods of its development is considered to be of particular relevance in reducing subsequent risks of adult obesity and associated chronic diseases in adulthood. The critical periods that link exposure during growth to later morbidity and mortality associated with obesity were identified as being: the intrauterine period and early infancy, the period of adiposity rebound during mid-childhood, the puberty and post-pubertal period [10-14]. The body mass index (BMI) value at age 7–8 years also proved to be a strong predictor of adult BMI [15]. Previous studies also identified factors that are highly correlated with an increased susceptibility to obesity or its comorbidities at various sensitive and critical life stages of childhood or adulthood**.** Some of these factors are clearly recognized, and refer to following aspects: the period of early adiposity rebound [16], the BMI changes during pubescence and post-pubescence [17], the presence of obesity in children and adolescents [18, 19], the presence of obesity in parents, family history of diabetes and/or cardiovascular disease [20, 22], a high waist circumference value in a given category of BMI for age, since 5 years of age [23], a small birth age[24]. Other factors are insufficiently supported by studies on childhood obesity, like the socio-economic level in early childhood [25] or a high birth weight [17].

In case the most important predictive factors for future obesity development and its comorbidities have been identified as well as the periods in the growth process in which exposure is critical, more efficient primary and secondary prevention strategies and obesity treatment can be developed and implemented. Towards this end, the combination of these elements into easy to use scores for screening and monitoring obesity imposes its utility.

Objective

The aim of the present study was to develop two simple scores, based on easily available and objective variables, to stratify the children and adolescents into groups with a high, intermediate, or low risk of developing obesity and its comorbidities in the near or distant future (table 1). This opens the possibility of identifying and monitoring the children at an early stage and differentiated according to the level of risk allowing maximum effectiveness in preventing obesity, with minimal effort.

Table 1: The objective of the study – Develop two scores for achieving the prevention of obesity

The Obesity Prevention Score for Preschoolers	The Obesity Prevention Score for Scholars
Scope: to quantify the risk for primary prevention of obesity	Scope: to quantify the risk for secondary prevention of obesity
Target: the whole population of children at 6-7 years of age	Target: obese school children and adolescents
Goal: avoid significant overweight to take place in 8 years old children	Goal: early management of obesity and its comorbidities, followed by a decrease in their prevalence in adulthood
Players: school doctors, GPs, pediatricians, other doctors, nurses	Players: school doctors, GPs, pediatricians, other doctors, nurses

Material and methods

During 2006 we have accomplished two pilot studies to check the conception possibilities of the two scores. In designing the obesity prevention score in preschoolers we have used a sample of 460 people, 156 children with the age of eight, and their parents. For the obesity prevention score for school children we have used a sample of 1240 subjects, 416 pupils (7-8 years old, 14-15 years old, 17-18 years old) and their parents. For all the subjects we have accomplished anthropometric measurements (height, weight, waist circumference) and we have calculated the BMI percentiles, establishing the corpulence categories. For preschoolers dynamic measurements were taken, to determine the age of adiposity rebound for each child. Scores were built by combining the elements identified as being strongly correlated with the risk of

future obesity in children and adolescents, elements described in table 2. The two representative samples were built on the cluster sample model (table 3).

Table 2: The factors that compose the scores:

The Obesity Prevention Score for Preschoolers	The Obesity Prevention Score for Scholars
1-the early adiposity rebound (before age 6 years) on the BMI curves	1-the presence of obesity in children and adolescents;
2- the presence of obesity in one or both parents	2-the presence of obesity in parents;
3-high waist circumference in children from 5-6 years.	3-high waist circumference;
	4-family history of diabetes and / or cardiovascular disease;

Table 3: The samples for the two scores with the distribution by sex of children and adolescents:

The Obesity Prevention Score for Preschoolers			The Obesity Prevention Score for Scholars		
N = 156	Non-obese	Obese	N = 460	Non-obese	Obese
Girls	67	14	Girls	167	42
Boys	56	19	Boys	151	56
Total	123	33	Total	318	98

Tabel 4: The samples for the two scores with the distribution of children and adolescents on scores:

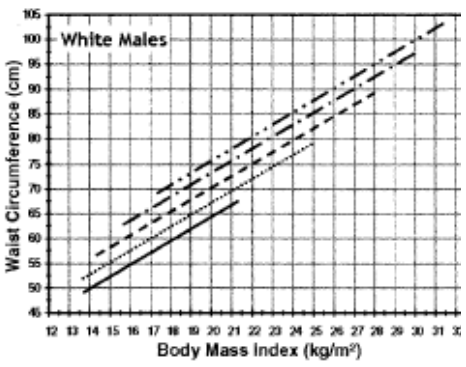
The Score for Preschoolers			The Score for Scholars		
The Score No.	The Sample of Non-obese Preschoolers	The Sample of Obese Preschoolers	The Score No..	The Sample of Non-obese Scholars	The Sample of Obese Preschoolers
1	65	1	1	213	39
2	1	1	2	6	1
3	34	6	3	67	19
4	16	4	4	18	3
5	3	1	5	6	5
6	2	4	6	2	4
7	1	13	7	3	9
8	1	3	8	1	6
			9	1	7
			10	1	5

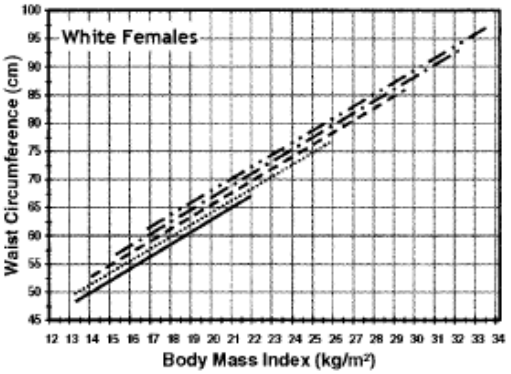
In order to analyze the body mass index for children and adolescents according to their age and sex, we used the 2007 body mass index centiles curve. In view to account for parental obesity we retained the BMI values equal or larger than 30kg/ m^2. To identify children with waist circumference level of risk, until the waist circumference (WC) centiles for Romanian children and adolescents will be developed, we have used the following regression equations built by Janssen, Katzmarzyk et all [23]:

1. for male subjects: WC (cm) = [BMI (kg/m2)* (2.41+/- 0.03)] + [Age (years)* (0.99+/- 0.05)] + [9.8+/- 0.7]; 2. for female subjects: WC (cm) = [BMI (kg/m2)* (2.14+/- 0.03)] + [Age (years) *(0.45+/- 0.05)] + [17.3+/- 0.7];

The graphics of the regression lines, presented lower, were used by the mentioned authors to highlight the ease of identifying children having CT at risk, in clinical medical practice. For a given value of IMC, children falling above the regression line have a CT value at risk, while the subjects falling below the regression line have a CT value without risk.

Graphs of the waist circumference regression lines usable in medical practice (reproduction by Janssen, Katzmarzyk et all[23]:





Using models with the identified risk factors as being strongly correlated with future obesity risk in school children, we have built scores from one to twelve. According to clinical relevance, the score numbers were reduced to 8 for preschoolers and 10 for scholars.

The way the scores were built through a combination of risk factors, as well as their framing into small, medium or high risk, is presented in the diagrams below (green color indicates a low risk, orange a medium risk, red a high risk and brown a very high risk of future obesity and co morbidities).

Diagram 1: The obesity prevention score for preschoolers-the factors that compose each score:

Risk Factors	Score 1		Score 2		Score 3		Score 4	Score 5	Score 6	Score 7	Score 8
Age of Rebound at risk						X	X	X	X	X	X
Parents Obesity	1P		1P	2P	2P			1P	1P	2P	2P
Child's waist circumference at risk		X	X		X		X		X		X

x= the factor is present

Color coding risk level:	green = low risk	orange = medium risk	red = high risk	brown = very high risk

Diagram 2: The obesity prevention score for scholars – the factors that compose each score:

Risk Factors	Score 1	Score 2		Score 3		Score 4	Score 5	Score 6	Score 7	Score 8	Score 9	Score 10
Child/Adolescent Obesity	X	X	X	X	X	X	X	X	X	X	X	X
Parents Obesity		1P	2P			1P	1P		1P	2P	2P	2P
Child's waist circumference at risk				X		X		X	X	X		X
Family history of CVD and DM					X		X	X	X		X	X

The estimation of the risk for each subject was mathematically expressed trough the logistic regression function. Using simple logistical regression, we studied obesity presence or absence, as a dependent variable, influenced by a risk factor with 8 levels for preschoolers and 10 levels for pupils (the 8, respectively 10 final scores), as an independent variable. The results can be easily interpreted with respect to the epidemiologic method, through the use of relative estimated risk (OR). For the statistical model of logistic regression used, the Epi Info soft was used.

Results

After linearization and exponentiation we got the following results: a R^2 value of 0.93 characterizing the regression on the preschool children and a R^2 value of 0.86 for the data in the school children sample. These high values assert the adequacy of the regression models at the same time with the highly significant p-values sores lower than .0001.

Table 5: Logistic regression results - Obesity prevention score for preschoolers

The Score No:	Probabilities Observed	Probabilities Predicted	Odds Observed	Odds Predicted
1	0.015	0.017	0.015	0.02
2	0.50	0.045	1	0.05
3	0.15	0.113	0.17	0.13
4	0.20	0.255	0.25	0.34
5	0.25	0.477	0.33	0.91
6	0.66	0.709	2	2.43
7	0.92	0.867	13	6.51
8	0.75	0.945	3	17.37

Regarding the predicted rate values, for the obesity prevention risk at preschoolers, 2 times greater risk values (2.4364) resulted for a score equal to 6, six times greater (6.5061) for score equal to 7, and seventeen times (17.3738) greater for a score equal to 8. Thus, the scores 1, 2, and 3 predict a low risk, the scores 4, 5, and 6 predict a medium risk and the score 7 a high risk and the score 8 a very high risk of obesity (table 5).

Table 6: Logistic regression results - Obesity prevention scores for pupils

The Score No:	Probabilities Observed	Probabilities Predicted	Odds Observed	Odds Predicted
1	0.1548	0.1399	0.1831	0.1626
2	0.1429	0.1953	0.1667	0.2427
3	0.2209	0.266	0.2836	0.3623
4	0.1429	0.351	0.1667	0.5408
5	0.4545	0.4467	0.8333	0.8072
6	0.6667	0.5464	2	1.2048
7	0.75	0.6426	3	1.7983
8	0.8571	0.7286	6	2.684
9	0.875	0.8002	7	4.0062
10	0.8333	0.8567	5	5.9796

The predicted rate values, for obesity prevention risk for pupils, are close to three times (2.684) greater for a score equal to 8, four times (4.0062) greater for a score equal to 9 and almost six times (5.9796) greater for a score equal to 10. We can say that the scores 1, 2 and 3 predict a low risk, the scores 4 and 5 predict a medium risk, the scores 7, 8 and 9 predict a

high risk, and the score 10 predict a very high risk of obesity and comorbidities in adulthood (table 6).

Discussion

The predictive power of the present resulted scores could be influenced by the small sample used in these pilot studies. Therefore, the analysis will be continued with a bigger, representative sample. The evaluation of the possibility for increasing the scores sensitivity by replacing the waist circumference with the waist to height ratio, which has been reported to be a better predictor of metabolic and cardiovascular risks [26], is underway before the consecutive stages of validation.

Conclusion

Reversing the trend of increasing prevalence of childhood obesity is now one of the priorities of the national programs implemented by health departments in many countries. In this regard it is vital to have simple tools, easy to use, as the scores we proposed in our study, which should allow a more efficient primary and secondary prevention of obesity and its comorbidities. Screening for obesity performed in dynamic, especially during periods that turned out to be "critical" and predictive for its subsequent development, would certainly have an impact on both non-economic and economic costs of obesity.

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