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Growth charts in the globalizing world: a new challenge for anthropologists and paediatricians?

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Introduction. Growth references or growth charts are among the most commonly used and most valuable tools for assessing health, development and well-being of individuals, groups of children and adolescents and the communities in which they live. Beside growth charts, reference curves of the weight status or nutritional status were published for many counties and are widely used today in medical practice. The last decades, however, the complex process of globalization and the ongoing phenomenon of transnational and transcontinental migration confronted the users of established growth charts and reference curves with new problems. Is it correct to use reference curves from the originating country if such reference curves are available, or should researchers prefer national standards of the host population?

Materials and methods. Body mass index (kg/m^2) data of 962 children and adolescents of Turkish origin living in Vienna were collected. Four different recommended weight status classifications were compared.

Results. The weight status classification differed significantly among the different reference chars. First of all, the reference charts according to Özer underestimated the amount of overweight and obese children and probands.

Conclusions. In Austria, where immigration of people from all over the world takes place, an adequate evaluation of health and growth of migrant children still represents an unsolved problem.

Key words: growth charts, weight status, migration

INTRODUCTION

At the beginning of the third millennium, a rising prevalence of overweight and obese children and adolescents is seen in developed as well as developing and threshold countries (1–3) According to the WHO, overweight or obesity affects one in ten children or adolescents worldwide (4). In Europe, one in five children can be classified as overweight or obese (5). This tendency is really a dramatic one because childhood obesity is not only an aesthetic problem which may result in social stigmatization of affected children; childhood obesity is also acknowledged to be one of the most important risk factors for hypertension, diabetes mellitus, or abnormal lipid profiles (6, 7), but also for psychic and emotional morbidity during later life (8). Prevention and effective treatment of childhood obesity are therefore very important public health issues today. In order to prevent obesity among children or to treat them effectively, comparable criteria to define obesity have to be used, and that is the problem. According to the WHO, obesity is defined as a condition with excessive fat accumulation (9). Techniques to estimate body fat in a reliable manner, however, are expensive and not practicable in large epidemiological surveys. Therefore, the body mass index (BMI), the simple weight to height^2 (kg/m^2) ratio, is used widely. For an optimal monitoring of a population, up-to-date reference BMI data on representative samples from the population are necessary. During the last two decades, numerous reference curves for different countries or populations have been published (10–12). These national BMI reference curves for children and adolescents, however, are not very practicable for so-called multiethnic societies (13), and we have to be aware that we live in the world of globalization and transnational migration today. The ongoing phenomenon of immigration makes the situation for paediatricians and anthropologists complicated. Should BMI reference curves for a representative sample of the whole (multiethnic) population be used or should separate reference curves for each larger subpopulation be created? An-

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other option is the use of reference curves established for the country or region of origin of each subpopulation. In order to overcome this dilemma, international standard definitions of overweight and obesity, such as those of the WHO (14), CDC (15) or of Cole et al. (16) were established. In the present study, the very specific situation of Vienna, Austria is considered. There is no doubt that Austria today is a country of immigration. Since the 1960s, an increasing number of labour migrants from former Yugoslavia and Turkey migrated to Austria. Today, 17% of the Austrian inhabitants have a background of migration. As reported for several other European countries (13, 17–20), immigrants originating from the Mediterranean region and from the near and middle east show an extremely high prevalence of overweight and obesity (21). This is especially true of children and adolescents (22). But how should the weight status of children and adolescents with a background of migration be classified? In a country of migration, like Austria, the dilemma is that no growth and body mass references for immigrant children exist so far. This lack of growth and body mass data is not only an Austrian problem; it is a problem in several typical countries of immigration, such as the Netherlands (13). Because of a lack of recent BMI curves of the Austrian population, Austrian paediatricians and anthropologists use the percentile curves published by Kromeyer-Hauschild et al. (23). But are these curves appropriate to describe the weight status of children originating from the Near East? In the present study, four different weight status classification curves are compared, based on the data on Viennese children originating from Turkey.

MATERIALS AND METHODS

Data set

Data collection took place in strong co-operation with the Viennese school medical authority. Forty-six public schools (so-called Hauptschulen) of Vienna (two from each of the 23 districts of Vienna) were randomly selected to participate in the present project. In Austria, it is obligatory that beside medical data, data regarding stature, height and body weight of all schoolchildren were collected by special educated personal. Stature is measured with an anthropometer to the nearest millimetre. Weight is recorded with a scale precise to ± 100 g. The children and adolescents were measured without shoes and wearing only underwear. For the present study, three age groups of children were analysed. Age group 1 comprised 272 six-year-old children. This first examination took place immediately before school entry. Age group 2 comprised 275 ten-year-old children. This examination took place at the end of primary school. Age group 3 comprised 415 boys and girls. This last examination took place at the age of fifteen years, short before the school attendance ends. The data file including all information concerning stature and body weight are stored by the Viennese school medical officers. We were allowed to use the data of the Viennese school medical office. Altogether we analysed data on 514 boys and 448 girls.

Ethnicity and migrant status

It is very difficult to define migrant status because different definitions to identify a migrant are used (17). In the present study, only children of the first or second generation immigrants were included. Both parents had to be born in their origin country. All subjects started school in Austria, although some of them immigrated to Austria after their birth.

Classification of the weight status

Weight status was determined by using the body mass index (BMI) kg/m^2. Four different classification schemes were compared:

1) the widely used in Austria percentiles of the body mass index, published by Kromeyer-Hauschild et al. (23);

2) the international standard definition for overweight and obesity, published by Cole et al. (16);

3) the reference centiles for Turkish children, published by Özer (24), which are representative for children and adolescents in Turkey;

4) the CDC charts published by Kuczmarski et al. (15) for the American Centre for disease control and prevention.

Statistical analysis

Statistical analysis was carried out by means of the SPSS (program version 11.0). After descriptive statistics (absolute and relative frequencies) Chi-squares were calculated.

RESULTS

Comparison of weight status definitions

As seen in Table 1, the BMI cutoffs defining overweight and obesity differed markedly among the different reference charts. The lowest cutoffs defining overweight and obesity among girls of all three age groups were found in the charts of Cole et al. (16) and Kromeyer-Hauschild et al. The highest cutoffs, in contrast, were nearly exclusively found in the charts of Özer. In the case of boys, the highest cutoffs were also found in the charts of Özer; regarding the lowest cutoffs, however, the result was inhomogeneous and differed among the three age groups. For the age of six years, the lowest cutoffs were found in the CDC charts. For the age groups 10 and 15 years, the lowest cutoffs were found in the charts of Kromeyer-Hauschild et al. (Table 1).

Prevalence of overweight and obesity according to different reference charts

The prevalence of overweight and obesity of the present sample differed significantly depending on the reference charts used ($p < 0.01$). The lowest prevalence of overweight and obesity among girls was always found using the reference charts of Özer, the highest prevalence of obesity being found using the reference charts of Kromeyer-Hauschild et al.

Table 1. **BMI definitions for overweight and obesity**

		Girls		Boys	
		Overweight	Obesity	Overweight	Obesity
		BMI			
6 years	Kromeyer-Hauschild et al. (2001)	17.99–19.67	>19.67	17.86–19.44	>19.44
	Cole et al. (2002)	17.34–19.65	>19.65	17.55–19.78	>19.78
	Özer (2007)	18.93–21.95	>21.95	19.86–21.62	>21.62
	CDC (2000)	17.72–19.75	>19.75	17.52–19.11	>19.11
10 years	Kromeyer-Hauschild et al. (2001)	20.80–23.54	>23.54	20.60–23.35	>23.35
	Cole et al. (2002)	19.86–24.11	>24.11	19.84–24.00	>24.00
	Özer (2007)	22.33–26.47	>26.47	22.63–27.24	>27.24
	CDC (2000)	21.04–24.60	>24.60	20.34–23.73	>23.73
15 years	Kromeyer-Hauschild et al. (2001)	24.59–27.45	>27.45	24.36–27.53	>27.53
	Cole et al. (2002)	23.94–29.11	>29.11	23.29–28.30	>28.30
	Özer (2007)	26.17–29.72	>29.72	27.93–32.54	>32.54
	CDC (2000)	25.46–30.39	>30.39	24.65–28.63	>28.63

This was true of all age groups. Regarding the prevalence of overweight among girls of all age groups, the highest prevalence was found using the reference charts of Cole et al. As for the male subsample, it turned out that the lowest prevalence of overweight and obesity was also found using the reference charts of Özer and the highest prevalence of obesity was found using CDC charts. Concerning the prevalence of overweight, the reference charts of Cole et al. yielded the highest percentage. This was true of all three age groups (see Figs. 1–4).

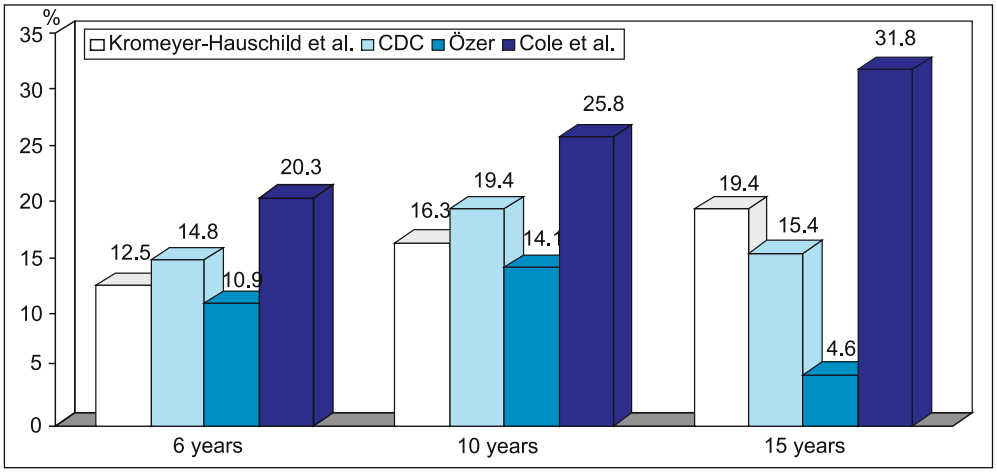

Fig. 1. Percentage of overweight girls classified according to different reference charts

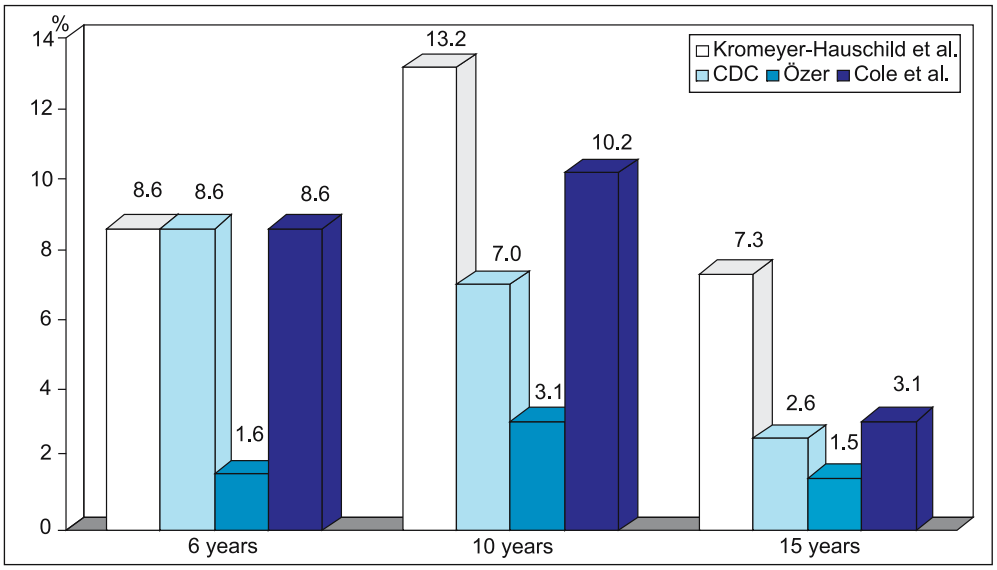

Fig. 2. Percentage of obese girls classified according to different reference charts

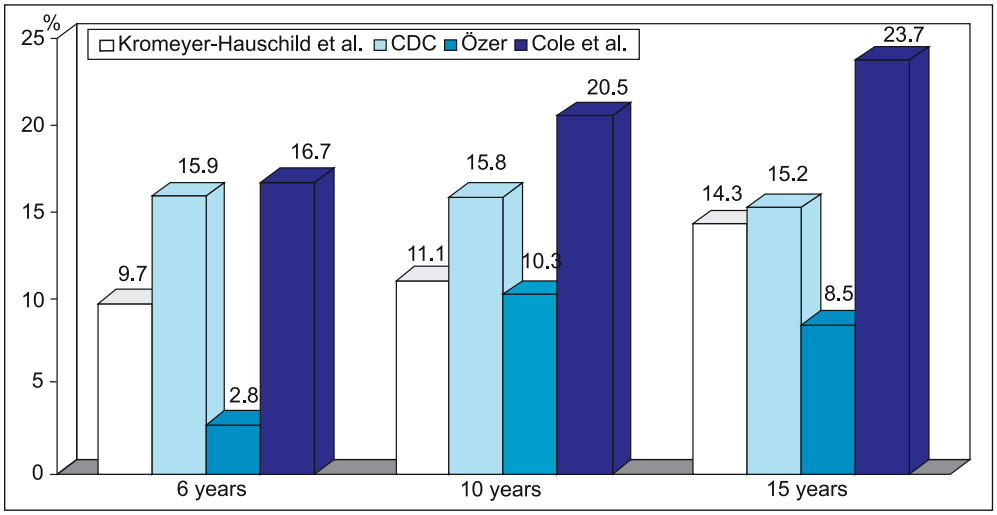

Fig. 3. Percentage of overweight boys classified according to different reference charts

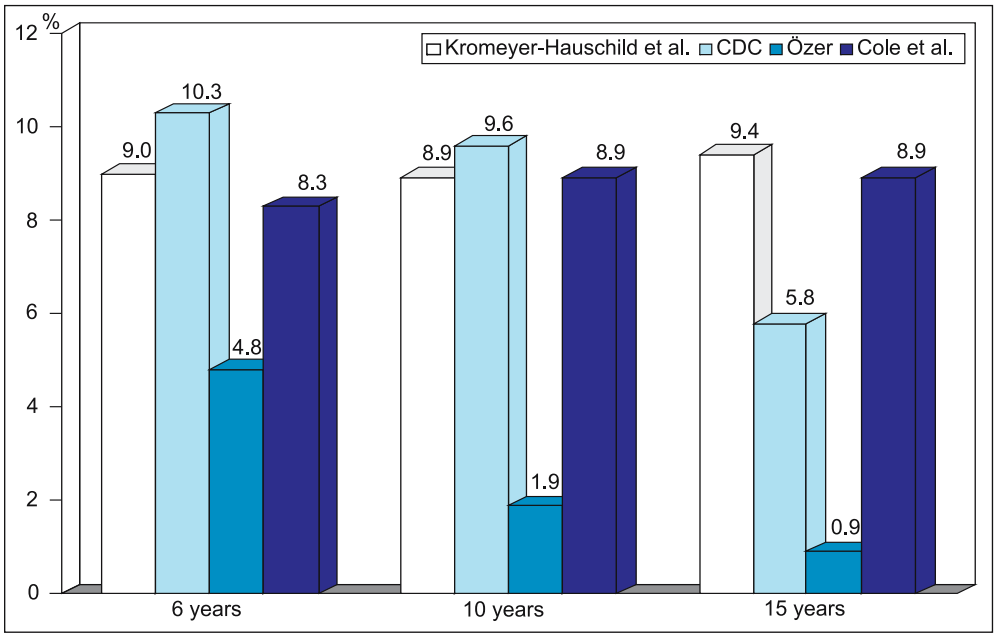

Fig. 4. Percentage of obese boys classified according to different reference charts

Table 2. **Comparison of weight status classifications of girls**

	Kromeyer-Hauschild et al. (2001)					
	6 years		10 years		15 years	
	Overweight	Obese	Overweight	Obese	Overweight	Obese
Cole et al. (2001)						
Normal weight	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Overweight	100%	0.0%	100%	18.8%	100%	57.1%
Obese	0.0%	100.0%	0.0%	81.3%	0.0%	42.9%
Significance	n. s.		P < 0.01		P < 0.01	
Özer (2007)						
Normal weight	68.8%	0.0%	71.4%	0.0%	100%	14.3%
Overweight	31.3%	81.8%	28.6%	75.0%	0.0%	64.3%
Obese	0.0%	18.2%	0.0%	25.0%	0.0%	21.4%
Significance	P < 0.001		P < 0.001		P < 0.001	
CDC (2000)						
Normal weight	0.0%	0.0%	19.0%	0.0%	43.2%	0.0%
Overweight	100%	0.0%	81.0%	47.1%	56.8%	64.3%
Obese	0.0%	100.%	0.0%	52.9%	0.0%	35.7%
Significance	n. s.		P < 0.01		P< 0.01	

Table 3. **Comparison of weight status classifications of boys**

	Kromeyer-Hauschild et al. (2001)					
	6 years		10 years		15 years	
	Overweight	Obese	Overweight	Obese	Overweight	Obese
Cole et al. (2001)						
Normal weight	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Overweight	100.0%	0.0%	100.0%	0.0%	100%	4.8%
Obese	0.0%	100%	0.0%	100%	0.0%	95.2%
Significance	n. s.		n. s.		n. s.	
Özer (2007)						
Normal weight	100%	15.4%	46.7%	0.0%	100%	0.0%
Overweight	0.0%	30.8%	53.3%	76.9%	0.0%	90.5%
Obese	0.0%	53.8%	0.0%	23.1%	0.0%	9.5%
Significance	P < 0.001		P < 0.001		P < 0.001	
CDC (2000)						
Normal weight	0.0%	0.0%	0.0%	0.0%	18.8%	0.0%
Overweight	85.7%	0.0%	93.3%	0.0%	81.2%	38.1%
Obese	14.3%	100%	6.7%	100%	0.0%	61.9%
Significance	P < 0.001		P < 0.001		P < 0.001	

Comparison of classifications

As shown in Tables 2 and 3, the highest correspondence in the classification of obesity and overweight was found between the charts of Kromeyer-Hauschild et al. and Cole et al. This was especially true of the male subsample. The lowest correspondence was found between the charts of Kromeyer-Hauschild et al. and the charts of Özer. The classifications differed statistically significantly for all age groups and both sexes.

DISCUSSION

The body mass index calculated from body height and body weight is used widely as a simple measurement for evaluating nutritional and health status and for screening for overweight and obesity. In order to identify overweight and obese individuals, it is necessary to have objective screening and evaluation criteria. In adults, a BMI above 25.00 usually indicates overweight and above 30.00 obesity (9). This weight status classification is widely accepted. For children and adolescents, in contrast, there is still a lack of consensus. During the last decades, reference curves for different populations were published, which define overweight and obesity by 90th and 97th centiles of population standards (25). Overweight and obesity were therefore differently defined depending on the reference curves used. These different standards make a comparison of between different populations difficult. Therefore Cole et al. (16) published internationally based cutoffs. However, this international standard was also criticised and some of its limitations were discussed (25, 26). But problems arise not only from international comparisons. A special problem was pointed out by Frederiks et al. (13): the dilemma of countries with a high proportion of children with a background of migration. These authors described the situation of Turkish children in the Netherlands. In such multicultural and multiethnic societies it is not clear which kind of reference charts should be used to evaluate the weight status of children and adolescents: reference charts from a representative sample of the whole multiethnic society or separate charts for each subpopulation. Frederiks et al. (13) suggested to evelop separate charts for each subpopulation. In contrast, the study of Stellinga-Boelen et al. (27) used Dutch reference charts for children of asylum seekers of different origin and reported no problems by using Dutch national reference curves. Another possibility to overcome this problem is the use of international standards; however, the validity of international standard references was also discussed critically (28, 29). In the present paper, four different reference charts were compared based on the BMI data of Turkish children in Austria. The Turkish minority is the second largest group of immigrants in Austria. The prevalence of overweight and obesity among its children and adolescents is high (22). The widely used in Austria reference curve of German children and adolescents, published by Kromeyer-Hauschild et al. (23), was compared with the international standards published by Cole et al. (16) and the CDC charts (15). Additionally, the reference curves for Turkish children in Anatolia, published by Özer (24), were applied. These Özer charts had higher cutoffs for overweight and obesity than all other reference charts. Therefore, the Özer charts yielded the lowest prevalence of obesity and overweight for both girls and boys of the present sample. The highest prevalence of overweight and obesity was found using the charts of Kromeyer-Hauschild et al. (23) and Cole et al. (16). The national reference curve of Kromeyer-Hauschild et al. (23) for German children and adolescents showed also a correspondence with the international standards published by Cole et al. (16). But what

does this mean in practice? Using international standards for German children and national standards for Austrian children with a background of migration from Turkey differ significantly from those published for Turkish children in Turkey. The problems of anthropologists as well as paediatricians monitoring weight status during childhood and adolescence still remain unsolved. Further research and the development of adequate reference curves for children with a background of migration – as discussed by Frederiks et al. (13) for the Netherlands – seems to be an option for Austria, too.

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AUGIMO LENTELĖS PASAULYJE: NAUJAS IŠŠŪKIS ANTROPOLOGAMS IR PEDIATRAMS?

S a n t r a u k a

Įvadas. Augimo rekomendacijos ir lentelės yra vertingiausios ir dažniausiai naudojamos nustatant vaikų ir paauglių grupių, taip pat bendruomenių, kuriose jie gyvena, vystymąsi ir sveikatos būklę. Greta augimo lentelių daugelyje šalių paskelbtos rekomenduojamo svorio ar mitybos kreivės, plačiai taikomos medicinoje. Pastaruoju metu sudėtingas globalizacijos procesas, transnacionalinė bei transkontinentinė migracija iškelia šių lentelių ir rekomendacinių kreivių vartotojams naujas problemas. Ar teisinga naudoti rekomendacines kreives jų kilmės šalyje, ar tyrėjas turėtų teikti pirmenybę nacionaliniams populiacijos standartams?

Medžiaga ir metodai. Tyrimui buvo panaudoti 962 turkų vaikų ir paauglių, gyvenančių Vienoje, kūno masės indekso (kg/m^2) duomenys. Palygintos keturios skirtingos rekomenduojamos svorio klasifikacijos.

Rezultatai. Tarp skirtingų rekomendacinių kreivių išsiskyrė svorio klasifikacija. Rekomendacinės kreivės pagal Özer nepakankamai įvertino per didelio svorio, nutukusių vaikų ir probandų kiekį.

Išvados. Austrijoje, į kurią atvyksta žmonės iš viso pasaulio, emigrantų vaikų sveikatos ir augimo įvertinimas tebėra neišspręsta problema.

Raktažodžiai: augimo lentelės, svorio kreivės, migracija