Growth curves in Down syndrome with congenital heart disease

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Summary

Introduction: To assess dietary habits, nutritional status and food frequency in children and adolescents with Down syndrome (DS) and congenital heart disease (CHD). Additionally, we attempted to compare body mass index (BMI) classifications according to the World Health Organization (WHO) curves and curves developed for individuals with DS.
Method: Cross-sectional study including individuals with DS and CHD treated at a referral center for cardiology, aged 2 to 18 years. Weight, height, BMI, total energy and food frequency were measured. Nutritional status was assessed using BMI for age and gender, using curves for evaluation of patients with DS and those set by the WHO.
Results: 68 subjects with DS and CHD were evaluated. Atrioventricular septal defect (AVSD) was the most common heart disease (52.9%). There were differences in BMI classification between the curves proposed for patients with DS and those proposed by the WHO. There was an association between consumption of vitamin E and polyunsaturated fatty acids.
Conclusion: Results showed that individuals with DS are mostly considered normal weight for age, when evaluated using specific curves for DS. Reviews on specific curves for DS would be the recommended practice for health professionals so as to avoid precipitated diagnosis of overweight and/or obesity in this population.

Keywords: Down syndrome, assessment of nutritional status, anthropometry, body mass index.

Study conducted at the Instituto de Cardiologia/Fundação Universitária de Cardiologia (IC/FUC), Porto Alegre, RS, Brazil

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Introduction

Obesity, which in 2012 affected 43,000 worldwide, is an important cardiovascular risk factor.[1] Approximately 30% of the children with Down syndrome (DS) are considered obese according to the World Health Organization (WHO).[2,3] In 2002, growth curves for individuals with DS were proposed by Myrelid et al.[4]

Heart disease occurs in 40 to 50% of patients with DS and contributes significantly to morbidity and mortality in these cases.[5] However, little is known about the prevalence of obesity in young people with DS associated with heart disease/congenital heart disease (CHD).[6,7]

If, on the one hand, heart diseases increase the risk of malnutrition before surgical correction, on the other hand, the overprotection of parents and physical inactivity can aggravate obesity often presented by patients with DS after surgical correction.[5,8]

From the perspective of epidemiology in the course of life, risk factors that occur at different stages of development can have an impact on cardiovascular health throughout life. Malnutrition followed by overweight and obesity may represent an enhancement of risk to cardiovascular health compared to maintaining the same nutritional status over a period of time.[7,9] Children with DS and CHD, due to the characteristics mentioned above, can serve as a model for the study of this phenomenon.

Moreover, the growth and development curves used in studies evaluate patients with DS based on weight and length/height according to age and gender. Despite the indication of these specific distributions, currently the body mass index (BMI) for age is considered as a reference by the WHO for the diagnosis of overweight and obesity in adolescents in the general population.[10]

Therefore, the aim of this study was to evaluate dietary habits, nutritional status and food frequency in children and adolescents with DS and congenital heart disease. Additionally, he sought to compare the BMI classifications according to the curves of the WHO[11] and the curves developed for individuals with DS in this particular group.[4]

Method

Cross-sectional study conducted from May 2011 to December 2012, including children and adolescents aged from 2 to 18 years with Down syndrome and congenital heart disease seen at the Pediatric Cardiology Clinic, Instituto de Cardiologia.

The project was approved by the ethics committee of Instituto de Cardiologia do Rio Grande Sul, under application nº 4458/10. The participants' parents and/or legal guardians signed prior authorization consenting to participate in the research.

A questionnaire with information about family history was applied for analysis of non-communicable diseases, indicating the degree of kinship (father, mother, grandparents and siblings).

Weight and height were measured in a anthropometric scale for adults (with 150 kg capacity and 100 g precision) with coupled stadiometer (maximum length 2 meters and accuracy of 0.5 cm). Nutritional status was analyzed using BMI for age and gender, using the curves for evaluation of individuals with DS recommended by Myrelid et al.[4] and the curves proposed by the WHO.[11] The participants were classified as underweight, normal weight, overweight and obesity.

The eating habits of the participants were assessed using a food frequency questionnaire used in other work with children.[12] For diet assessment, we used a 24-hour record, referring to food intake the day before consultation, and Nutwin software for the analysis of the records. Macro- and micronutrients were evaluated based on the 24-hour record and according to the Dietary Reference Intakes (DRI) recommendations.[13]

Diet composition was analyzed in terms of energy composition, carbohydrates, lipids, proteins, vitamins A, C, D and E, calcium, iron and fatty acids, according to the recommendations of the DRI by gender and age. The percentage distribution of macronutrients was evaluated according to the amounts proposed by the Institute of Medicine.[13]

Considering a proportion of 50% of children with risk factors, with margin of error of 0.8 and a 95% confidence level, we estimated that it would be necessary to study 131 patients. Prevalence was described as percentages with their respective 95% confidence intervals. Continuous variables were described as means and standard deviations. Macronutrient intake was compared between the groups using Student's t-test. The analyses were performed with Statistical Package for the Social Sciences (SPSS) software, version 19.0 for Windows, and a p-value<0.05 was considered significant.

Results

Of the 70 children and adolescents with DS and congenital heart disease potentially eligible during the study period, there were two whose parents did not consent to participate. The final sample thus included 68 participants. The general characteristics of the participants are presented in Table 1.

TABLE 1 Description of the general characteristics and congenital heart diseases in the studied population (n=68).

Variable	Overall n (%)
Age (years – mean±SD)	9.29±4.88
Gender	
Female	36 (52.9)
Male	32 (47.1)
Heart diseases	
Atrioventricular septal defect	36 (52.9)
Interventricular communication	25 (36.8)
Interatrial communication	23 (33.8)
Persistent arterial duct	14 (20.6)
Tetralogy of Fallot	10 (14.7)
Tricuspid insufficiency	7 (10.3)
Pulmonary stenosis	6 (8.8)
Mitral insufficiency	5 (7.4)
Patent foramen ovale	3 (4.4)
Other	9 (13.3)

SD: standard deviation.

Atrioventricular septal defect (AVSD) was the most common heart disease (52.9%), and 47.1% were male. There were differences in BMI classification (underweight, normal weight, overweight and obesity) between the curves proposed for people with DS and the curves proposed by the WHO (Table 2).

Adequate intake of carbohydrates, proteins and lipids was achieved by 66.2, 94.1 and 41.2% of participants, respectively. As for the intake of micro- and macronutrients, there was an association between vitamin E and polyunsaturated fatty acids (Table 3).

TABLE 2 Comparison of anthropometric assessment using BMI curves for normal individuals and for individuals with Down syndrome.

		BMI for normal individuals				
		Low weight N=1 n (%)	**Normal weight N=34 n (%)**	**Overweight N=17 n (%)**	**Obese N=16 n (%)**	**p<0.01**
BMI for individuals with Down syndrome	**Low weight N=6 n (%)**	1 (100)	5 (14.7)	0 (-)	0 (-)	
	Normal weight N=44 n (%)	0 (-)	29 (85.3)	14 (82.4)	1 (6.3)	
	Overweight N=8 n (%)	0 (-)	0 (-)	3 (17.6)	5 (31.3)	
	Obese N=10 n (%)	0 (-)	0 (-)	0 (-)	10 (62.5)	

BMI: body mass index.

TABLE 3 Intake of macro- and micronutrients in 24 hours record.

Nutrient	Overall Mean±SD	Low weight (n=6) Mean±SD	Normal weight (n=44) Mean±SD	Overweight (n=8) Mean±SD	Obesity (n=10) Mean±SD	p-value
Macronutrients						
TEV (kcal)	1882.82±495.16	1664.67±347.76	1878.43±443.82	2218.25±806.70	1764.10±407.13	0.143
Carbohydrates (%)	54.45±11.35	58.51±10.04	52.91±12.33	59.13±9.01	55.01±8.49	0.406
Protein (%)	17.50±4.48	16.92±2.86	17.13±4.36	19.39±4.26	17.92±5.99	0.600
Lipids (%)	27.17±8.93	24.56±9.14	28.58±8.60	21.47±9.50	27.05±8.99	0.182
Micronutrients						
Fiber (g)	19.89±9.65	14.34±2.71	20.30±8.98	24.76±13.59	17.52±10.56	0.196
Calcium (mg)	1126.06±963.72	1101.40±628.86	1081.47±880.43	1672.80±1645.49	899.63±743.03	0.364
Iron (mg)	14.81±6.58	13.40±8.72	13.90±5.00	19.20±6.35	16.13±10.24	0.166
Sodium (mg)	1626.72±940.93	869.36±445.24	1651.08±917.06	1916.69±1024.22	1741.98±1082.61	0.185
Zinc (mg)	10.37±4.08	7.79±3.70	10.22±4.19	11.96±3.41	11.27±3.97	0.248
Vitamin A (RE)	749.90±1037.9	752.22±745.53	681.07±801.83	701.17±1008.49	1090.33±1921.80	0.741
Vitamin E (aTE)	5.12±2.38	3.51±1.98	5.44±2.02	3.50±1.97	5.97±3.49	0.034
Vitamin C (mg)	168.71±121.30	197.25±203.97	111.27±146.83	183.99±288.26	69.74±101.82	0.338
Vitamin B12 (mcg)	6.47±3.98	2.16±0.80	3.94±6.85	7.66±9.26	2.35±1.91	0.302
Saturated FA (g)	22.45±15.33	17.57±9.70	23.48±13.99	24.78±25.91	18.99±14.14	0.691
Monounsaturated FA (g)	17.94±10.77	11.38±5.78	19.02±10.42	18.16±15.01	16.93±10.77	0.438
Polyunsaturated FA (g)	9.03±4.53	4.45±2.56	9.68±4.11	7.31±4.40	10.25±5.78	0.031

TEV: total energy value; FA: fatty acids; SD: standard deviation; RE: retinol equivalents; aTE: alpha tocopherol equivalents.

Food frequency is described in Figure 1, where it was observed that 48.5% (n=33) never consume snacks, 77.9% (n=53) never consume fried egg, 51.5% (n=35) never consume French fries, 64.75 (n=44) never consume other fried foods, 77.9% (n=53) never consume sandwich cookies, 45.6% (n=31) never consume sweets, and 60.3% (n=41) never consume desserts. We also observed daily consumption of milk by 70.6% (n=48), of fruit by 52.9% (n=36), vegetables by 54.4% (n=37), and of meat by 76.5% (n=52).

Figure 2 shows the nutritional status of the population studied according to the classifications by age, so that normal weight was more frequent in all age groups.

Discussion

In this cross-sectional study, we observed that children and adolescents with DS have, in most cases, BMI suitable for age, when evaluated by specific curves for DS. With regard to eating habits, there was an adequate intake of nutrients according to the recommendations and association between BMI classification and intake of polyunsaturated fatty acids and vitamin E.

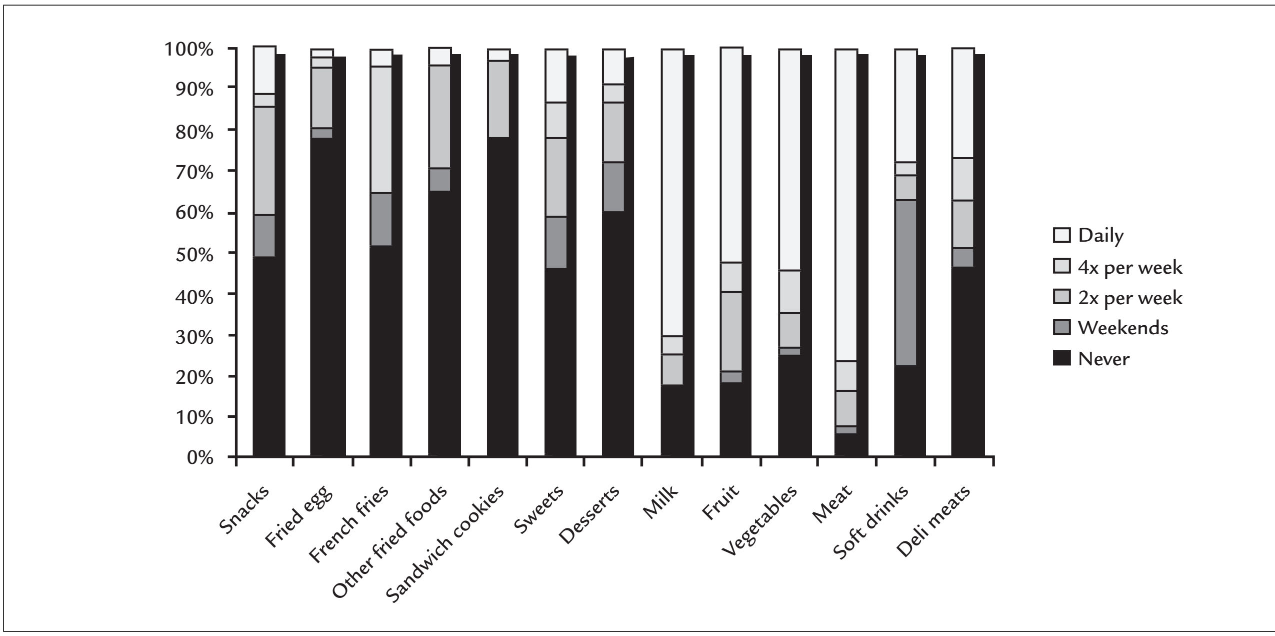

FIGURE 1 Distribution of food frequency.

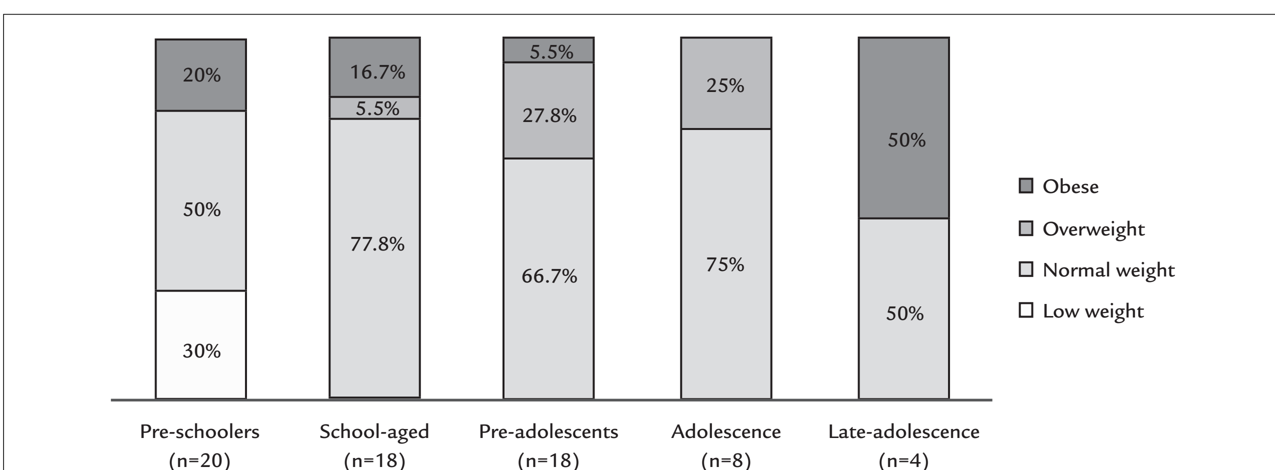

FIGURE 2 Nutritional status according to specific curves for DS. Pre-schoolers: 2 to 5 years; school-aged: 6 to 9 years; pre-adolescents: 10 to 14 years; adolescence: 15 to 17 years; late-adolescence: 18 to 19 years.

The prevalence of overweight and obesity was lower than expected in this study comparing the BMI curves for age as recommended by the WHO[11] and the curves specific for DS.[4] We can raise some important aspects to understand these findings. First, the growth curves for DS take into account the smallest increase in weight and height and therefore the value of the BMI should be classified differently than the growth curves for children without DS.[4,6]

Even though BMI for gender and age is the method of choice for assessing nutritional status as recommended by the WHO, different studies[14-16] only adopt weight/age and height/age curves as proposed by Cronk et al.[6] The prevalence of overweight in these studies varies between 16 and 30%. In people with DS, the basal metabolic rate is significantly lower than that of individuals matched by age and gender without the syndrome.[17] This may explain in part why people with DS are classified more often as overweight and/or obese.

For example, in our study, 85.3% of individuals classified as normal weight according to the curve specific for DS, would be 6.3% obese or 82.4% of overweight according to the WHO curves. In practice, in the absence of specific curves, or in the routine of professionals, when there are limitations to their use, it is important to monitor the growth and development of these children. If the curves used are those recommended by the WHO, it should be kept in mind that the interpretation will be different.

At the Pediatric Cardiology Clinic of Instituto de Cardiologia, patients with DS are also treated by nutritionists in order to primarily prevent cardiovascular risk factors. Therefore, these patients and caregivers can receive nutritional guidance to adopt eating habits healthier than those expected in the general population.[18-20]

Eating habits were adequate in this population. Nutrition education occurs in childhood, so it is important to offer a healthy diet, with the introduction of varied foods, appropriate for the age and development of children and adolescents. Thus, nutritional management is critical for young people who have cardiovascular risk factors such as obesity. Children and adolescents with this genetic abnormality should have a healthy diet, adapted to their clinical conditions. According to the data collected in our study based on a 24-hour record, most participants of both genders consume adequate amounts of carbohydrate, protein and lipids according to the Dietary Reference Intakes (DRI) recommendations.[21]

The prevalence of overweight and obesity in children with congenital heart disease was similar to that described in the literature for children with non-congenital disease. In Brazil, the high prevalence of overweight in children and adolescents, in general, has been a cause for concern, because other risk factors for ischemic heart disease such as high blood pressure, glucose intolerance, dyslipidemia and sedentary lifestyle have emerged. These modifiable risk factors have been well discussed in the literature on children without heart disease.[22]

Vitamin E, which in this study was associated with the classification of BMI, is a fat-soluble antioxidant that occurs naturally. This micronutrient has been proposed for the prevention and protection of cardiovascular events.[23-26] But although studies have 15 or more years of follow up, vitamin E supplementation in the primary and secondary prevention of acute myocardial infarction (AMI) and atherosclerosis has not yet demonstrated statistical difference between groups.[23-26]

Some limitations of this study should be considered. Since this is a cross-sectional study, without monitoring over time, it was not possible to establish a temporal relationship between eating habits and the presence of overweight in individuals with DS. In our study, in particular, the findings of healthy eating and normal macronutrient distribution among children and adolescents with DS can be explained as the awareness of the problem by families, with action taken towards habit changes. Rigorous clinical monitoring of this group of patients may have been an influence, although that cannot be directly stated based on the study. Thus, our data can contribute to the planning of new studies with follow-up over time or intervention.

Given the results of this study, the need for people with Down syndrome to receive unique attention from health teams is observed. Even though this study includes a small sample, we were able to demonstrate that children with this condition can present appropriate parameters, receiving a nutritionally adequate and balanced diet in terms of macro- and micronutrients, and being physically active. Encouraging health professionals to strengthen family members and/or legal guardians to seek proper monitoring of these children from birth, enabling adequate and healthy development, is essential for this to occur properly.

Our study reveals the need for an expanded and detailed assessment thus obtaining more reliable results and the proper interpretation of the nutritional status of these individuals, due to their unique growth and development. Thus, reviews on specific curves for DS would be the recommended practice for health professionals so as to avoid precipitated diagnosis of overweight and/or obesity in this population.

The almost complete lack of national data, the relevance of the topic, and findings consistent with other studies show the importance of monitoring, thorough investigation and proper anthropometric assessment in patients with DS. Thus, the present findings can serve as a basis for planning studies of dietary intervention and/or physical activity, as well as planning of preventive measures.

Conclusion

The results of this study showed that children and adolescents with DS are mostly considered as normal weight for age when evaluated using BMI curves specific for DS, taking into account and highlighting the importance of a different interpretation for the growth and development of these individuals. With regard to eating habits, there was an adequate intake of nutrients according to the recommendations and association between BMI classification and intake of polyunsaturated fatty acids and vitamin E.

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Resumo

Curvas de crescimento na síndrome de Down com cardiopatia congênita

Objetivo: avaliar hábitos alimentares, estado nutricional e frequência alimentar em crianças e adolescentes com síndrome de Down (SD) portadores de cardiopatia congênita (CC). Adicionalmente, procurou-se comparar classificações de índice de massa corpórea (IMC) de acordo com curvas da Organização Mundial da Saúde (OMS) e curvas desenvolvidas para indivíduos com SD.
Método: estudo transversal com indivíduos portadores de SD e CC atendidos em um centro de referência para cardiologia, com idade entre 2 e 18 anos. Foram aferidos peso, altura, IMC, valor energético total (VET) e frequência alimentar. O estado nutricional foi analisado por meio de IMC para gênero e idade, utilizando-se curvas específicas para SD e curvas da OMS.
Resultados: foram avaliados 68 indivíduos portadores de SD com CC. O defeito do septo atrioventricular (DSAV) foi a cardiopatia mais frequente (52,9%). Houve diferença de classificação do IMC entre as curvas propostas para portadores de SD e pela OMS. Houve associação entre consumo de vitamina E e ácidos graxos poli-insaturados.
Conclusão: resultados mostraram que indivíduos com SD são, em sua maioria, considerados eutróficos para a idade quando avaliados pelas curvas específicas para SD. Avaliá-los de acordo com as curvas específicas para SD seria o recomendado para a prática dos profissionais da saúde, evitando-se diagnósticos precipitados de sobrepeso e/ou obesidade nessa população.

Palavras-chave: síndrome de Down, avaliação nutricional, antropometria, índice de massa corporal.

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