

Body-mass index, nutrition and physical activity in children and adolescents with Down syndrome

Índice de massa corporal, nutrição e atividade física em crianças e adolescentes com síndrome de Down

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ABSTRACT: *Objective:* To describe and compare the nutritional habits, physical activity, and body mass index (BMI) of children and adolescents with Down syndrome followed up in the specialized outpatient clinic of a tertiary hospital in southern Brazil. *Method:* Cross-sectional study conducted from the analysis of medical records of patients with Down syndrome at school age and adolescents followed up at the Complexo Hospital de Clínicas da Universidade Federal do Paraná. The diet was considered adequate if it consisted of foods from all groups in the three main meals and one or two snacks and water in the intervals. A sedentary lifestyle was defined as physical activity time of fewer than 300 minutes per week. Nutritional status was assessed using BMI curves from the World Health Organization, 2007. *Results:* The study included 755 patients, of whom 236 (31.3%) were children and 519 (68.7%) were adolescents. Overweight and obesity were observed in 10.7% and 14.8% of the population, respectively, without significant gender differences. Inadequate diet was observed in 34.6% and sedentarism in 23.7% of the patients. High BMI was observed in 20.3% of children and 27.9% of adolescents ($p=0.026$). Sedentarism was observed in 29.5% of adolescents and 11% of children ($p<0.001$). Inadequate diet was also more prevalent in adolescents but without statistical difference. Patients with high BMI, compared to eutrophic patients, had a higher prevalence of inadequate diet and sedentarism, with statistical significance. In this subgroup, sedentarism was observed in 25%

of children and 57.2% of adolescents ($p<0.001$). *Conclusion:* Adolescents with Down syndrome have higher rates of high BMI and sedentarism compared to children. Specific studies in health education for this population are necessary to promote healthy lifestyle habits and effectively prevent obesity.

Keywords: Down syndrome; Healthy diet; Obesity; Overweight; Sedentary behavior.

RESUMO: *Objetivo:* Descrever e comparar hábito nutricional, prática de atividade física e índice de massa corporal (IMC) de crianças e adolescentes com síndrome de Down acompanhados em ambulatório especializado de um hospital terciário no sul do Brasil. *Método:* Estudo transversal realizado a partir da análise de prontuário de pacientes com síndrome de Down em idade escolar e adolescentes acompanhados em ambulatório especializado do Complexo Hospital de Clínicas da Universidade Federal do Paraná. A alimentação foi considerada adequada se consistisse em alimentos de todos os grupos nas três refeições principais e um ou dois lanches e água nos intervalos. Sedentarismo foi definido como tempo de atividade física inferior a 300 minutos por semana. O estado nutricional foi avaliado usando as curvas de IMC da Organização Mundial da Saúde, 2007. *Resultados:* O estudo incluiu 755 pacientes, sendo 236 (31,3%) crianças e 519 (68,7%) adolescentes. Sobrepeso e obesidade foram observados

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em 10,7% e 14,8% da população, respectivamente, sem diferença significativa entre os gêneros. Alimentação inadequada foi observada em 34,6% e sedentarismo em 23,7% dos pacientes. IMC elevado foi observado em 20,3% das crianças e 27,9% dos adolescentes ($p=0,026$). Observou-se sedentarismo em 29,5% dos adolescentes e 11% das crianças ($p<0,001$). Alimentação inadequada também foi mais prevalente em adolescentes, porém sem diferença estatística. Pacientes com IMC elevado, em comparação com eutróficos, tiveram maior prevalência de alimentação inadequada e sedentarismo, com significância

INTRODUCTION

Down syndrome is considered the most prevalent chromosomal disorder, characterized by trisomy 21¹. Estimated rate of births is 12.6 cases per 10,000 population with Down syndrome in the United States from 2006 to 2010, with approximately 5.300 births annually².

Patients with Down syndrome are subject to several comorbidities with repercussions: congenital heart diseases, immunodeficiencies, hearing and visual deficits, sleep disorders, hypothyroidism, dysphagia, and gastrointestinal abnormalities³. The treatment of congenital heart diseases and immunodeficiencies allowed a longer life expectancy for this population, from 25-30 years in the 1970s to above 60 years after the 2000s³.

With increased survival, new challenges in health care have gained ground for the Down syndrome population, like, a sedentary lifestyle and obesity.

Children and adolescents with Down syndrome may present nutritional problems due to comorbidities related to the syndrome: hypotonia, oropharyngeal abnormalities, malformations and dysmotility of the gastrointestinal tract, hypothyroidism, celiac disease, type 1 diabetes mellitus, intellectual disability, and behavioral disorders. They can contribute both to low weight and nutritional deficit and to overweight conditions⁴.

Children and adolescents with Down syndrome present higher rates of overweight and obesity and perform fewer exercises when compared to their peers without Down syndrome⁵. This reality is due to the reflection of these conditions on long-term health, especially in the population with Down syndrome, in which obesity intensifies more prevalent comorbidities such as sleep apnea syndrome, diabetes, and cardiovascular diseases³.

This study aims to verify the prevalence of overweight and obesity, sedentarism, and inadequate nutrition in children and adolescents at a Down syndrome outpatient clinic in a tertiary hospital in Southern Brazil. Children and adolescents with Down syndrome present higher rates of overweight and obesity and perform fewer physical activities when compared to their peers without Down syndrome⁵. The study of this reality is due to the reflection of these conditions on long-term health, especially in the population with trisomy 21, in which

estatística. Nesse subgrupo, o sedentarismo foi observado em 25% das crianças e 57,2% dos adolescentes ($p<0,001$). *Conclusão:* Adolescentes com síndrome de Down apresentam maiores taxas de IMC elevado e sedentarismo comparados com crianças. Estudos específicos em educação em saúde para essa população são necessários com o objetivo de promover hábitos de vida saudáveis e prevenir a obesidade com efetividade.

Palavras-chave: Comportamento sedentário; Dieta saudável; Obesidade; Síndrome de Down; Sobrepeso.

obesity intensifies more prevalent comorbidities such as sleep apnea syndrome, diabetes, and cardiovascular diseases³.

This study aims to verify the prevalence of overweight and obesity, sedentarism, and inadequate nutrition in children and adolescents with Down syndrome followed up in a specialized outpatient clinic in a tertiary hospital in southern Brazil.

METHODS

It is a cross-sectional, observational, descriptive study carried out from a retrospective analysis of data from the medical records at the Down syndrome clinic covering the period 2014-2016. Patients younger than seven years and older than 20 years old were excluded. Patients aged seven to nine years, 11 months and 29 days old were classified as school-age children, while patients between 10 and 19 years old were defined as adolescents.

A total of 1207 patients who were being followed up in the hospital were selected during the study period. Of these, 171 patients were excluded from the study because they were older than 19 years old, while 281 were excluded due to their age under seven years old. Thus, 755 school-age children or adolescents were included. All patients included in the study had compensated congenital heart and hypothyroidism.

An adequate diet consisted of foods from all food groups in the three main meals and one or two snacks and water in the breaks. Moderate or intense exercise of fewer than 300 minutes per week was considered sedentarism. Nutritional status was assessed using the 2007 World Health Organization (WHO) body mass index (BMI) curves. Obesity was defined as BMI for age within the z-score range between +3 and +2, overweight between +2 and +1, eutrophy between +1 and -2, and thinness between -2 and -3. High BMI was defined as BMI for age within the z-score range between +3 and +1.

Numerical quantitative variables were median and compared using the Mann-Whitney test. Qualitative variables were absolute and relative frequencies and compared using the Chi-Square test. For both tests, we considered a 5% significance level.

This study was approved by the Research Ethics Committee of the Clinical Hospital of the Federal University

of Paraná (Brazil Platform No. 04542712.3.0000.0096).

RESULTS

Of the 755 patients included in the study, 339 (44.9%) were female, 236 (31.3%) were children, and 519 (68.7%) were adolescents. The subgroup of children included 103 (43.6%) female patients with a median age of 8 years old. The subgroup of adolescents had 236 (45.5%) female patients and a median age of 13 years old.

A high BMI was observed in 193 (25.6%) patients, with overweight being observed in 81 (10.7%) and obesity

in 112 (14.8%) study participants. Individuals who were classified as eutrophic in relation to BMI corresponded to 545 (72.2%) and thinness to 17 (2.3%) patients. Regarding gender, 97 (23.3%) male and 96 (28.3%) female patients had high BMI ($p=0,117$), overweight was observed in 37 (8.9%) males and 44 (13%) females ($p=0.07$), and obesity in 60 (14.4%) male and 52 (15.3%) female patients ($p = 0.725$).

There were 261 (34.6%) individuals with inadequate nutrition and 179 (23.7%) with sedentarism.

The comparative analysis between the subgroups of children and adolescents regarding BMI, nutrition, and sedentary lifestyle is in Table 1.

Table 1 - Comparison of BMI, diet and physical activity variables among children and adolescents

Variable	Child (236)	Adolescent (519)	p-value
High BMI n, %	48 (20.3%)	145 (27.9%)	0,026
Thinness n, %	9 (3.8%)	8 (1.54%)	0,051
Eutrophy n, %	179 (75.8%)	366 (70.5%)	0,130
Overweight n, %	21 (8.9%)	60 (11.6%)	0,273
Obesity n, %	27 (11.4%)	85 (16.4%)	0,077
Inadequate nutrition n, %	74 (31.4%)	187 (36%)	0,211
Sedentary lifestyle n, %	26 (11%)	153 (29.5%)	< 0,001

Chi-square test; Legend: BMI = Body Mass Index = Weight (Kg) / Height (m)²

There were 409 (54.2%) patients with congenital heart disease: 136 (57.6%) children and 273 (52.6%) adolescents ($p = 0.199$). There were 169 (22.4%) with hypothyroidism: 41 (17.4%) children and 128 (24.7%) adolescents ($p = 0.026$). Nevertheless, all patients in the study were compensated.

The comparison between eutrophic patients

according to BMI and patients with high BMI is in Table 2.

In the subgroup of patients with high BMI, there were 48 (24.9%) children and 145 (75.1%) adolescents. In this subpopulation, 37 (77.1%) children and 125 (86.2%) adolescents had inadequate diet ($p = 0.136$). As for the practice of physical activity, 12 (25.0%) children and 83 (57.2%) adolescents were classified as sedentary ($p < 0.001$).

Table 2 - Comparison of diet and physical activity variables between eutrophic and high BMI patients

Variable	Eutrophy (545)	High BMI (193)	p-value
Inadequate nutrition n, %	95 (17.4%)	162 (83.9%)	< 0,001
Sedentary lifestyle n, %	78 (14.3%)	95 (49.2%)	< 0,001

Chi-square test; Legend: BMI = Body Mass Index = Weight (Kg) / Height (m)²

DISCUSSION

The overall prevalence of overweight in the sample was 10,7%, while the prevalence of obesity was 14,8%, with no statistical difference between genders. Although the literature points to a possible higher prevalence of overweight in girls with Down syndrome⁵, the present study did not demonstrate this difference. Pierce et al., in a study with 412 children and adolescents with Down syndrome in the United States, observed higher rates of overweight and obesity compared to the present study: 23 and 20,6%, respectively, and the BMI was higher in the

female subgroup, as well as the prevalence of overweight and obesity was higher when compared to youngsters without Down syndrome⁶.

The analysis of associated comorbidities showed a high prevalence of heart disease in the population, but with no statistical difference between children and adolescents. Hypothyroidism, on the other hand, was significantly more prevalent in adolescents, but since all included patients had compensated disease this variable was not considered confounding.

The comparative analysis between the subgroups of children and adolescents showed a higher prevalence of

both overweight and obesity in the second subgroup, but without statistical significance. Nevertheless, the single variable elevated BMI was statistically more prevalent in adolescents, which may result from the fragmented sample size in each subgroup with overweight and obesity, so that together they produce statistical significance.

Although inadequate diet was also more prevalent in adolescents, it was not statistically significant. On the other hand, a sedentary lifestyle was statistically higher in adolescents.

O'Shea et al.⁷ also observed increased BMI values with age in children in adolescents aged four to 16 years old with Down syndrome. The study by Pierce et al.⁶ also demonstrated a higher prevalence of obesity in adolescents.

Basil et al. carried out a retrospective cohort with 303 children and adolescents with Down syndrome. They reported higher rates of overweight and obesity: 47.8% and 22.4%, higher when compared to their peers without DS. It was no difference between genders in the obesity rate, like in our study. The authors observed an increase in BMI values in adolescents older than 12 years old.⁸

Many reasons may explain an increased BMI in Down syndrome patients compared to their peers without Down syndrome. Besides the prevalent comorbidities in Down syndrome that may influence weight gain, like the pattern of energy intake and consumption influenced the BMI. The study of Polfuss et al.⁹ using the doubly labelled water method showed that children with DS expend an average of 1.813 kcal/d, while their peers without Down syndrome expended 2.646 kcal/d. Mageniz et al.¹⁰ observed an average consumption of 1,807.1 kcal/d, while children without Down syndrome consumed an average of 1,491.3 kcal/d.

Similarly, Grammatikopoulou et al.¹¹ compared children aged two to nine years old and adolescents aged 10 to 18 years old concerning caloric intake and weight. They observed in adolescents overweight and obesity rates of 61% and 22%, respectively, while these values were 36.4% for overweight and no cases of obesity in children, and in adolescents, the consumption of cholesterol and saturated fat was higher.

It suggests a lower energy expenditure and a higher caloric intake present in adolescents. Possibly, physical activity and food choices are players in this picture. As this study shows, adolescents had concomitantly higher rates of high BMI and sedentary lifestyle, suggesting that the increase in overweight and obesity in this age group was due to the development of worse lifestyle habits with age. Jobling et al.¹² observed the dietary and physical activity

status among adolescents aged 11 to 18 years old with Down syndrome by questionnaire and concluded teens named foods but selected foods rich in fats and sugars when asked to prepare a healthy meal. In addition, they described that more than half of the sample reported foods high in fat and sugar as their favourite foods, and more than two-thirds stated that they eat these foods daily. Most of them exercised, but none knew how often they needed to do to have a healthy lifestyle.

Greater autonomy to make choices in adolescence is a factor for higher rates of overweight and obesity in teens with Down syndrome. Control of diet by family influences lower BMI values.

It reinforces a periodic medical follow-up and a constant health education program for Down syndrome patients and their families. Curtin et al.¹³ developed a randomized controlled clinical trial to evaluate if parent training in behavioral intervention would be able to decrease body weight in adolescents with Down syndrome compared to nutrition and physical activity education alone. After six months of intervention, the authors observed that the behavioral training group had a lower mean weight and increased daily physical activity better than the control group. This observation suggests that nutritional counselling and exercise alone, although still beneficial, had a lower impact than parent training to help adolescents with Down syndrome with healthy eating and physical activity.

The main limitations of the present study were the development from the retrospective collection of data in medical records associated and the restriction to a single care centre. Other limitations were the unavailability of information on the metabolic profile, data on the pubertal stage and hormonal profile.

CONCLUSION

This study shows that adolescents with DS had higher rates of high BMI and a sedentary lifestyle than children. Overweight and obesity in this population can worsen the prevalent comorbidities in DS, especially diabetes, sleep apnea syndrome, and cardiovascular diseases.³ The follow-up of patients in this condition should be regular and specialized, focusing on stimulating and enabling parental participation in the health care of teens with DS, especially adolescents, to maintain healthy habits and prevent overweight and obesity.¹³ More research studying the most appropriate health education interventions for this population and their families is necessary to offer a more effective health promotion.

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