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COVID-19 PANDEMIC AND ITS METABOLIC, GLYCEMIC AND WEIGHT-STATURE IMPACTS ON DM1 CHILDREN AND ADOLESCENTS

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Abstract: The social restrictions needed to reduce the spread of COVID-19 have changed the nutrition, sleep, and physical activity patterns of children and adolescents. Such changes result in inflammatory complications, manifesting through pressure, lipid levels, or insulin resistance. Thus, the present research aimed to evaluate the impacts of the COVID-19 pandemic on the glycemic, metabolic, and weight-height profile of DM1 children and adolescents. A cross-sectional and descriptive study was carried out through the collection and analysis of laboratory tests recorded in the medical records of 28 children and adolescents being followed up at a diabetes clinic in the interior of São Paulo. A significant increase was identified only concerning weight, height, and Body Mass Index among the children in the study, which may represent the natural development of patients between the evaluated time. However, there was no difference at p value ≤ 0.05 in relation to the glycemic and metabolic pattern of this sample. Thus, it can be suggested that the outpatient follow-up was effective even in the pandemic context, what did not significantly affect the general metabolic profile of the children and adolescents in the research. Same comments as I did above.
Keywords: COVID-19. Children. Adolescents. Metabolism. DM1.

INTRODUCTION

The 2019 Coronavirus (COVID-19) pandemic has infected million of people worldwide and affected the entire population, including children (ages 5-12) and adolescents (ages 13-17) who, in late April 2020, made the transition to remote learning after school closures. This fact, added to socio-behavioral adaptations, such as social distancing and quarantine, has impacted this population's daily activities and lifestyle (BATES et al., 2020; IRWIN et al., 2022).

Preliminary evidence suggests that social restrictions needed to reduce the spread of COVID-19 have increased sedentary behavior (MARGARITIS et al., 2020), altered sleep patterns (BECKER et al., 2020), and reduced opportunities for children and adolescents to practice physical activities (MOORE et al., 2020). Even if they occur in a limited period, these changes may favor long-term cardiometabolic and psychological alterations (BATES et al., 2020; TSO et al., 2022).

Nutrition, sleep, and physical activity are essential for proper growth and development. As for nutrition, it is known that cheap and high-calorie foods have been increasingly chosen among the population and, similar to the school recess period, studies indicate that the COVID-19 pandemic has increased the consumption of industrialized food products, contributing to overweight children and adolescents (COSTA et al., 2020; RIBEIRO et al., 2020; KROM et al., 2022). Verifying weight in relation to age and height are important measure in identifying the state of health and nutrition and allows the planning of health promotion and disease prevention actions (WHO, 2006).

The sleep pattern of children and adolescents (circadian cycle) was also altered during quarantine. Studies have reported changes such as irregular schedules, increased hours of sleep, and difficulties falling asleep or staying asleep (BATES et al., 2020; ZHOU et al., 2020; TSO et al., 2022). Such changes directly affect attention, learning, behavior, memory, emotional regulation, and physical and mental well-being. They are also associated with the risk of accidents, high blood pressure, obesity, diabetes, and depression (PARUTHI et al., 2016).

Regarding physical activity, it is known that the recommendations for this age group are 60 minutes daily (BULL et al., 2020). However, even those who meet this recommendation may not be protected against health damage from excessive sedentary behavior, including screen time of more than 2 hours a day (Bull et al., 2020; KNELL et al., 2019). Recent studies show an incredible increase in screen time among children and adolescents, reaching more than 8 hours a day, with only 90 minutes being related to remote learning during the COVID-19 pandemic (DUNTON et al., 2020; PIETROBELLI et al., 2020).

Inadequate nutrition added to less practice of physical exercises, increased sedentary behavior, and less time and/or quality of sleep, results in inflammatory complications, that can be manifested through blood pressure and lipid levels or even insulin resistance. These are risk factors in the pathogenesis of obesity and type 2 diabetes mellitus (DM2), which have increased incidence in this age group, and, in addition, are aggravating the development of coronary heart disease and metabolic syndrome (FERREIRA et al., 2020; SCAPATICCI et al., 2022).

With social isolation, changes in eating habits are expected, as a decrease in physical activities, an increase in sedentary behavior, and lower quality of sleep and, consequently, an increased risk of inflammatory disorders, which can culminate in obesity, diabetes mellitus, arterial hypertension, and metabolic syndrome. In this way, it can be considered that multiple pandemics will be observed since there is the presence, in addition to Covid-19, of physical inactivity and increased obesity, fact that will lead to numerous comorbidities resulting from social isolation (PITANGA et al., 2020; BOZZOLA et al., 2022).

Thus, this research aimed to evaluate the impacts of the COVID-19 pandemic on the glycemic, metabolic and weight-height profile of 28 children and adolescents with type 1 diabetes mellitus (DM1), being able

to contribute to reflection and planning to improve the life habits of this public during this pandemic period.

METHODS

This cross-sectional and descriptive study was carried out through the analysis of medical records of children and adolescents participating in a diabetes clinic in the interior of São Paulo.

This clinic serves children and adolescents with immediate type 1 diabetes mellitus, medium-term gestational diabetes, type 1 diabetes mellitus, and long-term type 2 diabetes mellitus, from Monday to Friday, with prior scheduling due to referral from Primary Care. From 2019 to 2021, the clinic saw an average of 114 patients a year, and during the pandemic, many assessments were carried out online.

For data collection, an instrument was built containing the following information: weight, height, lipid profile total cholesterol, low-density lipoprotein (LDL-c), high-density lipoprotein (HDL-c), and triglycerides), fasting blood glucose, glycated hemoglobin (HbA1C), and thyroid-stimulating hormone (TSH).

Children and adolescents (5 to 17 years old) who were being followed up at the diabetes clinic and who had at least two collection records of the tests to be analyzed were included in the study, the first in the pre-pandemic time interval (January 2019 to February 2021) and the second, pandemic, (June 2020 to July 2021).

Data collection was carried out by the researchers in July and August 2021 through analysis of the medical records, collecting two measures of the following information: weight, height, lipid profile (total cholesterol, LDL-c, HDL-c, and triglycerides), blood glucose fasting, HbA1C, and TSH, considering the stipulated time intervals. After analyzing 90 medical records, only 28 met the inclusion criteria and made up the research sample.

The data set was analyzed using the SPSS software, version 24.0, considering statistical significance if $p < 0.05$.

This research proceeded with authorization from the ethics council, CAAE 43862921.5.0000.5496.

RESULTS

The mean age of the sample (28 participants) is 12.76 years old (12 female and 16 male).

Table 1 describes the means and standard deviations of the quantitative variables collected before and after the pandemic period (2019) and after the pandemic (2021). When comparing the averages of both periods, a significant increase in weight (kg), height (m), and Body Mass Index (kg/m^2) can be observed, which may represent the natural development of patients between the time evaluated. No significant differences were found for the other variables.

Table 2 compares the mean of the quantitative variables between genders. It is possible to notice that both genders present a significant difference in relation to weight (kg) and height (m). Still, only males show a significant difference for the index body mass (kg/m^2), which suggests a greater risk of uncontrolled biochemical parameters and a greater chance of future complications in this sex. No significant differences were found in the remaining variables.

Table 3 compares the percentage variation of quantitative variables between genders. No significant difference was found between the variables. However, the means of these variations were higher in males, except for high-density lipoprotein (HDL), which suggests lower adherence to treatment and control in this gender.

	Before pandemic		After pandemic		p-value
	Average	SD	Average	SD	
Weight (kg)	44,93	16,57	51,41	15,74	0,001*
Height (m)	1,50	0,20	1,56	0,16	0,001*
BMI (kg/m²)	19,26	3,768	20,50	3,617	0,006*
Total Cholesterol (mg/dL)	151,39	30,79	159,78	33,97	0,173
LDL (mg/dL)	78,41	27,18	84,62	26,89	0,195
HDL (mg/dL)	53,22	10,27	55,19	17,13	0,463
Triglycerides (mg/dL)	95,10	70,35	96,01	50,75	0,932
Fasting Glucose (mg/dL)	156,71	90,79	164,62	108,56	0,729
HbA1c (%)	8,17	1,96	8,25	1,91	0,842
TSH (uUI/mL)	2,98	1,40	3,30	1,93	0,435

Notes: BMI, Body Mass Index; LDL, Low-density lipoprotein; HDL, High density-lipoprotein; HbA1c, Glycated hemoglobin; TSH, Thyroid Stimulating Hormone.

* indicates a significant difference between pre-pandemic and post-pandemic periods by Student's t test based on homogeneity of variances for p-value ≤ 0.05.

Table 1 – Mean and standard deviation (SD) of the quantitative variables in the pre-pandemic and post-pandemic periods (n=28).

	Before pandemic		After pandemic		p-value	Before pandemic		After pandemic		p-value
	MASCULINE (n=16)		MASCULINE (n=16)			FEMININE (n=12)		FEMININE (n=12)		
	Average	SD	Average	SD		Average	SD	Average	SD	
Weight (kg)	46,5	15,7	53,7	13,9	0,001*	42,9	18,2	48,4	18,1	0,004*
Height (m)	1,5	0,2	1,6	0,1	0,001*	1,4	0,2	1,5	0,2	0,035*
BMI (kg/m²)	19,0	3,4	20,4	2,9	0,031*	19,6	4,3	20,7	4,5	0,119*
Total Cholesterol (mg/dL)	147,0	31,3	150,1	34,4	0,720	157,3	30,4	172,7	30,1	0,085
LDL (mg/dL)	78,1	33,0	82,1	24,2	0,565	78,8	18,1	88,0	31,0	0,172
HDL (mg/dL)	49,5	8,0	49,5	14,2	0,981	58,3	11,1	62,8	18,4	0,383
Triglycerides (mg/dL)	94,0	54,8	94,1	45,5	0,994	96,6	89,8	98,6	59,0	0,92
Fasting Glucose (mg/dL)	169,7	106,0	176,5	131,2	0,860	139,4	65,9	148,8	70,6	0,597
HbA1c (%)	8,1	2,0	8,0	2,0	0,833	8,3	1,9	8,6	1,8	0,648
TSH (uUI/mL)	3,0	1,6	3,0	0,9	0,980	3,0	1,1	3,7	2,8	0,372

Notes: BMI, Body Mass Index; LDL, Low-density lipoprotein; HDL, High density-lipoprotein; HbA1c, Glycated hemoglobin; TSH, Thyroid Stimulating Hormone.

* indicates a significant difference between the pre-pandemic and post-pandemic periods between genders by Student's t test based on the homogeneity of variances for p-value ≤ 0.05.

Table 2 - Comparison of mean and standard deviation (SD) of variables in the pre-pandemic and post-pandemic periods between genders

DELTA %	MASCULINE		FEMININE		p-value
	Average	SD	Average	SD	
Total Cholesterol	8,81	24,29	4,94	13,59	0,625
LDL	10,12	26,41	2,84	24,81	0,466
HDL	-0,28	30,99	9,88	23,49	0,352
Triglycerides	44,69	78,88	2,07	64,35	0,139
Fasting Glucose	47,96	107,65	-7,46	39,59	0,102
HbA1c	5,18	29,02	3,87	38,9	0,919
TSH	41	76,82	10,78	70,99	0,297
BMI	8,2	11,24	6,19	12,13	0,655

Notes: BMI, Body Mass Index; LDL, Low-density lipoprotein; HDL, High density-lipoprotein; HbA1c, Glycated hemoglobin; TSH, Thyroid Stimulating Hormone.

Table 3: Comparison of mean and standard deviation (SD) of delta % between genders.

DISCUSSION

This study does not report significant changes in the metabolic level of children and adolescents in the pre- and post-pandemic period, only changes in height, weight, and BMI with a significant difference between the pre-pandemic and post-pandemic periods by the t Student test based on the homogeneity of variances, what is already expected due to the growth and gain of muscle and bone mass in the normal physiology of growth. However, the increase in BMI may be associated with a decrease in the practice of physical activities, as reported by a cohort study carried out with Dutch children, which revealed a significant reduction in physical activity and an increase in screen time (VELDE et al., 2021). In addition, other studies indicate an increase in BMI and metabolic profile. Still, it is difficult to find consistent data due to the few studies aimed at children and adolescents, as shown in a systematic review (DEVOE et al., 2022).

Likewise, NWOSU et al.(NWOSU et al., 2020) shows in an observational study carried out with children with DM1 in the United States, that there is no significant differences in the glycemic control of the sample, only changes in HbA1c in females. On the other hand, it is not observed in the present study, despite a coincident increase in HbA1c in females, was not a data with a significant difference for p-value ≤ 0.05.

Otherwise, Fernández et al. (FERNÁNDEZ et al., 2020) showed an improvement in the glycemic profile, but in adults in Spain, suggesting better self-control of lifestyle habits and medication administration. Following this line, a study in Indonesia that explored online education on children and adolescents with DM1 during the pandemic revealed an improvement in the quality of life and control of the disease in this population, this can be related to the closer relationship between parents and children, which may allow better adherence to insulin dosage and application time (ROCHMAH et al., 2021).

In another aspect, an Iranian study showed difficulty in maintaining healthy lifestyle habits during the pandemic, leading to an increase in the insulin dose. However, glycemic control did not worsen (HASAN TEHRANI et al., 2021). However, there is a direct relationship between the non-worsening of the glycemic profile and the

medication adjustment. A fact that did not happen in a Polish study, revealing a higher rate of diabetic ketoacidosis in children and adolescents due to a possible lack of control of DM1 treatment (PIETRZAK et al., 2022).

The lipid profile of the patients in the present study, despite not being significant, showed greater changes in total cholesterol and LDL-c levels, with a greater tendency to increase in females, despite HDL-c haing grown for this gender. Unfortunately, there are no consistent studies regarding changes in the lipid profile of youth with metabolic disorders evaluated during the pandemic. Furthermore, most studies have no significant difference in the change in glycemic profile for age.

The full impact of the pandemic on the lives of children and adolescents shows that there is a need for multidisciplinary follow-ups, such as a medical association with a nutritionist, and a physical educator, since there is a reduction in the practice of physical activity and a lack of body weight control. In the long term, there may be a change in the glycemic and lipid profile of these patients.

At a nutritional level, patients with metabolic imbalances and a higher BMI need guidance on food intake and how to associate it with everyday life. A study with Iranian adolescents showed a diet rich in fat and sodium pattern, mainly in obese boys, with lower consumption of trans fatty acids, saturated fatty acids, and sodium being recommended (ROUHANI et al., 2023). A systematic review explored applications for counting carbohydrates, what corroborated an improvement in the glycemic profile (DANTAS et al., 2023). These facts can be used in complementary nutritional consultation.

The difficulty of performing physical exercises can be instructed by physical educators, indicating ideas on how to practice activities indoors. The practice is important due to the impact of physical exercise on these patients, as shown by a survey of DM1 patients who underwent exercise bikes, which at the end of 12 weeks revealed an increase in muscle mass, an increase in the respiratory profile, and an improvement in the mitochondrial deficiency found in DM1 (Mikhail et al., 2022). It is essential to emphasize the practice of physical exercise since it regulates the body's inflammatory levels and helps to reduce insulin resistance and other metabolic repercussions (MINNITI el al., 2022).

CONCLUSION

Although this study did not show major changes at the glycemic and metabolic profile, this may suggest that outpatient follow-up was effective even in the pandemic context, as soon as the collected data remained controlled, despite the increase in BMI.

It is important to highlight that there are few studies in this area at the pediatric level, reiterating the importance of continuing this line of research. Therefore, this study contributes with data that can help in the impact generated by the pandemic on this population.

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