

Weight Trends in Children and Adolescents During the COVID-19 Pandemic and its Relationship with Psychological Distress

Filipe Pinheiro¹ , Victor Viana¹ , Carla Rêgo² 

Port J Pediatr 2023;54(1):21-31

DOI: <https://doi.org/10.25754/pjp.2023.26991>

Abstract

Introduction: The COVID-19 pandemic has led to a biopsychosocial health deterioration in children and adolescents. However, there is a lack of knowledge about its impact on weight status. This study aimed to assess the body mass index trends in children and adolescents over more than one year of the COVID-19 pandemic. Moreover, this research examined the association of “children and adolescents” overall body mass index changes with psychological distress and specific household characteristics.

Methods: This cross-sectional study with a retrospective component was carried out in a Portuguese hospital with a convenience sample of 422 children and adolescents (mean age = 12.4 ± 2.9 years) and one of their parents. A validated online questionnaire was administered to both groups to evaluate their psychological distress. Multiple linear regression was used to identify the body mass index change predictors.

Results: The COVID-19 pandemic has caused weight gain in children ($p < 0.001$), increasing the prevalence of overweight and obesity. The first lockdown alone accounted for the observed results, as the remaining time was characterized by a gradual decrease in body mass index, though insufficient to reach pre-pandemic levels ($p = 0.015$). Associated factors included “children and adolescents” body mass index, stress, and specific household characteristics.

Discussion: This study contradicted the hypothesis that weight would increase proportionately to the number of months of school closure. It also underscores children’s difficulties in losing the weight gained during the first lockdown. Finally, the association of weight gain with environmental and psychological factors highlighted the importance of their consideration in the therapeutical approach towards excessive weight gain.

Keywords: Adolescent; Body Mass Index; Child; COVID-19/complications; Overweight; Pediatric Obesity; Psychological Distress; Quarantine/psychology; Weight Gain

Keypoints

What is known:

- The lives of younger people underwent unprecedented changes due to the COVID-19 pandemic containment measures.
- Children and adolescents gained excessive weight during the first lockdown of this pandemic.
- This pandemic heightened the symptoms of psychological distress in children and adolescents.

What is added:

- More than a year of the COVID-19 pandemic resulted in weight gain in children, increasing the prevalence of overweight and obesity.
- This study contradicted the hypothesis that childhood obesity would increase proportionately to the number of months of school closure.
- The overall weight increase was more significant in those with previous adequate weight status and was associated with psychosocial and household determinants.

Introduction

Although younger individuals are at lower risk of developing the severe form of coronavirus disease

2019 (COVID-19),¹ their lives underwent unprecedented changes due to its containment measures. In almost all countries, governments were forced to implement several policies to minimize social interactions, such as physical

1. Faculdade de Ciências da Nutrição e Alimentação, Universidade do Porto, Porto, Portugal

2. Centro da Criança e do Adolescente, Hospital CUF Porto, Porto, Portugal

Corresponding Author

Filipe Pinheiro | E-mail: filipe.nit@hotmail.com

Address: Faculdade de Ciências da Nutrição e Alimentação, Universidade do Porto, Rua do Campo Alegre 823, 4150-180 Porto, Portugal

Received: 28/04/2022 | Accepted: 13/10/2022 | Published online: 01/12/2022 | Published: 01/01/2023

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distancing, nationwide school closures, quarantines, and in extreme cases, full lockdowns. Portugal, where this study was conducted, followed the same pattern with two governmentally mandated full lockdowns:

- From March 18 to May 2, 2020;
- From January 15 to March 14, 2021.

While these measures were necessary to combat the COVID-19 pandemic by slowing the spread of the virus, paradoxically, they also posed additional risks for obesity and mental health, especially among young people.^{2,3}

Schoolchildren gain proportionally more weight during the summer break than during the rest of the year due to their low physical activity and lack of a proper sleep pattern and diet.^{4,5} It was suggested that the absence of structured time during school closures and the cessation of organized physical activity would mimic many of the risk factors that have been shown to promote weight gain during the summer break and ultimately increase the risk for childhood obesity.⁶ Accordingly, although existing work is limited to its initial stages, the first evidence suggests that the COVID-19 pandemic led to excess weight gain in children and adolescents.⁷ Associated factors included increased energy intake, consumption of ultra-processed and calorie-dense foods, and decreased physical activity.^{7,8} In contrast, positive lifestyle changes, such as increased home cooking and higher consumption of vegetables and fruits, were also reported during this period.^{8,9}

Children and adolescents are particularly at risk of experiencing psychological distress during the COVID-19 pandemic. According to a bioecological framework, their well-being is determined by their interactions with various environmental systems.¹⁰ However, social restriction measures have severely impacted children and adolescents' surroundings, from the immediate family and school settings to broader social, economic, and cultural contexts.¹¹ As a result, several psychosocial protective factors that are essential for coping with stressful situations have been lost, such as supportive social interactions (eg, face-to-face interactions with friends and extended family) and access to psychological support services.^{12,13} Furthermore, children and adolescents have lower self-regulation, emotional regulation, and cognitive resources than adults, causing additional difficulties in understanding and coping with this situation's complexity.¹⁴⁻¹⁶ Accordingly, the findings of previous studies have shown that the COVID-19 pandemic resulted in a high prevalence of COVID-19-related fear¹⁷ and heightened symptoms of stress, anxiety, and depression in younger individuals compared with pre-pandemic estimates.¹⁷⁻¹⁹

"Children and adolescents" increased time at home

during the lockdowns highlighted the importance of the household in mitigating the physical and emotional burden of the COVID-19 pandemic. For example, the increased interaction with parents during this time accentuated the importance of the parent-child relationship in coping with this situation.¹² However, pandemic-related stressors posed additional challenges to this relationship and potentially exposed children and adolescents to the spillover effects of a stressful home environment.²⁰ Nevertheless, previous research suggests that a good parent-child relationship and certain household characteristics, such as the presence of an outdoor area in the home, were protective factors against psychological distress during this time.^{21,22}

Although the results of previous studies have shown that children and adolescents gained excessive weight during the first COVID-19 lockdown,⁷ to our knowledge, there have been no studies describing the effects of its following phases on body weight. Moreover, due to the potential role of psychological distress and specific household characteristics in weight fluctuations,²³ it is important to investigate their association during the COVID-19 pandemic. To address these gaps in the literature, we aimed to:

- Examine the body mass index (BMI) trends in children and adolescents over more than one year of the COVID-19 pandemic;
- Assess how psychological distress and specific household characteristics were related to their overall BMI change.

Methods

Design and participants

This cross-sectional study with a retrospective component was carried out in a private hospital in Portugal. A convenience sample of children and adolescents aged 8 to 17 years and one of their parents was used. The study included the completion of an online questionnaire (cross-sectional component) and the analysis of anthropometric trends of children and adolescents during the pandemic (retrospective component). The inclusion criterion was the presence of at least one routine pediatric examination with anthropometric data (weight and height) during two different periods:

- Up to one year before the decree of the first lockdown (from March 18, 2019, to March 17, 2020);
- From the end of the first lockdown to the end of the study (from May 3, 2020, to May 31, 2021).

Subjects were excluded if they were taking medications

that potentially affected their weight during the time covered by the anthropometric data analysis, if they had a history of eating disorders, mental disorders, or neurocognitive disorders, and if they were unable to consent to the study.

Procedure

We reviewed subjects' clinical records for data on gender, age, anthropometric measures, fulfillment of inclusion and exclusion criteria, and email address. Anthropometric measurements were always performed by hospital pediatricians, with children and adolescents wearing only underwear. Weight and height were each measured using a SECA 220° scale and a SECA 200° stadiometer. In May 2021, the subjects and one of their parents completed an online questionnaire.

Questionnaire

The questionnaire was conducted online via QuestionPro (<https://www.questionpro.com/>) and included two different versions, one for the parents and one for the children and adolescents. Participants were asked to respond separately and autonomously to their respective versions. The design of the questionnaire aimed to capture children and adolescents' psychological distress and specific household characteristics that might influence their experience of the pandemic, including parents' psychological distress. All measures used in each version of the questionnaire are summarized in Table 1.

Table 1. Questionnaire measures

Parents' version	
Measures	Description
Sociodemographic	Both parents' age and education levels.
Anthropometric	Self-reported height and weight (at the time of response to the questionnaire).
Household characteristics	Questions about specific household characteristics that potentially determined how the pandemic was experienced: How many people live in the household?; Is there any outdoor space in the dwelling where the child / adolescent can play or relax freely and safely?; Has the household income decreased in this period?; Is / have any of the parents been on layoff or remote working regimes?; Did any close relatives of the child / adolescent have been diagnosed with COVID-19?; Did the child / adolescent have been diagnosed with COVID-19?.
Psychological distress	
DASS21	Depression anxiety and stress scale - DASS21. This 21-item tool assesses psychological distress symptoms in three dimensions: stress, anxiety, and depression. Each dimension contains seven items. In each item, subjects rate the extent of certain symptoms they had experienced over the previous week on a four-point Likert scale (did not apply to me at all = 0 to applied to me very much = 3). ⁵⁴ Each dimension score equals the sum of the corresponding seven questions multiplied by two to give the final score. Each subscale score ranges from 0 to 42, with the highest scores meaning higher symptoms of the respective dimension. ⁵⁴ In this study, the validated version for the Portuguese adult population ⁵⁵ was applied, showing good internal consistency: Cronbach's alphas for stress, anxiety, and depression dimensions were respectively 0.90, 0.82, and 0.87.
Fear of COVID-19 scale	It is a seven-item one-dimensional scale assessing intrinsic fear of COVID-19 (FCV-19S). In each item, subjects rate their feelings towards a phrase using a five-point Likert scale (strongly disagree = 1 to strongly agree = 5). Total scale score ranges from 7 to 35, with higher scores representing higher fear. The validated version for the Portuguese population was applied. ⁵⁶ This instrument showed good internal consistency in this study (Cronbach's alpha = 0.84).
Children and adolescents' version	
Measures	Description
Psychological distress	
DASS21-C	Children and adolescents' version of the DASS21. Although it has the same fundamentals, organization, and score system as the DASS21 (see above), there are some language modifications to the items so children can comprehend these. This study used its Portuguese version validated using children and adolescents older than 8 years of age. ⁵⁷ In this study, this tool showed good internal consistency: Cronbach's alphas for stress, anxiety, and depression dimensions were respectively 0.89, 0.85, and 0.87.
Fear of COVID-19 scale	The same instrument as that administered to the parents (see above). Previously applied and validated in children and adolescents. ^{47,58} In this study, it showed good internal consistency (Cronbach's alpha = 0.83).
KIDSCREEN-52	
Parent relations and home life	Single dimension inserted in the health-related quality of life instrument KIDSCREEN-52. This dimension has six items and examines the parent-child relationship and atmosphere at home. Importance is attached to whether the child / adolescent feels loved and supported by the family, whether the atmosphere at home is comfortable or not, and if the child / adolescent feels treated fairly. ⁵⁹ The replies are rated on a five-point Likert scale. Its total score ranges from 0 to 100, with higher scores indicating better outcomes. It showed good internal consistency in this study (Cronbach's alpha = 0.82).



Definitions

The participants were divided into two groups. The first consisted of subjects aged 8 to 9 years, referred to as children. The second group consisted of subjects aged 10 to 17 years, referred to as adolescents. The results of their anthropometric measurements were expressed in BMI z-scores and then categorized according to the World Health Organization (WHO) cut-off points.²⁴ To evaluate the BMI trends of the subjects during the pandemic, BMI z-scores were clustered chronologically (according to the lockdowns) into four different group periods:

- Baseline period (BAS): from March 18, 2019, to March 17, 2020;
- After the first lockdown period (AFT1L): from May to August 2020;
- Before the second lockdown period (BEF2L): from September 2020 to January 14, 2021;
- During the second lockdown period (DUR2L): from January 15, 2021, to May 31, 2021.

In the case of more than one consultation during the BAS period, the most recent one was selected. The period DUR2L included consultations after the second total lockdown because a partial lockdown was still in effect during the considered additional time, in which schools were closed and remote work was mandatory.

Statistical analysis

Descriptive statistics on participants baseline characteristics were reported as frequencies and percentages for categorical variables, mean and standard deviation (SD) for normal continuous variables, and median and interquartile range (IQR) for non-normal continuous variables. Cardinal variables were screened for normality violations using their skewness and kurtosis coefficients. Prior to data analysis, non-normal variables were normalized by a two-step transformation.²⁵ Internal consistency of the psychometric instruments was analyzed with Cronbach's alpha. A one-way repeated measures analysis of variance (ANOVA) test (with Bonferroni correction) was performed to identify significant differences in BMI z-scores between the different group periods. Finally, a multiple linear regression model was applied to identify the predictors of the observed overall change in BMI (dependent variable).

All statistical analyses were performed using the Statistical Package for the Social Sciences version 26[®] (SPSS, IBM Corp, Armonk, NY, USA), considering a significance of 5%.

Results

Of the 649 invited subjects, a final sample of 422 participants completed both versions of the questionnaire. Descriptive data on the sample sociodemographic, household, and parent anthropometric characteristics, assessed at the time of questionnaire completion, are presented in Table 2. Among the children and adolescents (59.2% female and 71.6% adolescents), the mean age was 12.4 ± 2.9 years (children 9.0 ± 0.6 years, adolescents 13.7 ± 2.4 years). Of the parents, more than half (50.7%) were overweight/obese and were highly educated (88.2% reported having a college degree). In addition, most households were composed of three or four members (73.0%) and included an outdoor space (81.5%). Complementarily, Table 3 provides data about the distribution of weight status of children and adolescents in the BAS and DUR2L periods. Although the prevalence of overweight and obesity rates increased by 2.6% between these periods for the total sample, this increase was greater for children (7.5%) than for adolescents (1%).

Table 4 shows the chronological evolution of the mean BMI z-scores of children and adolescents for the total sample and stratified by age, gender, and BMI category. For the total sample, there was a significant increase in BMI z-scores between the periods BAS and AFT1L ($p < 0.001$) and a decrease between the periods AFT1L and DUR2L ($p = 0.019$) (Table 3). Nevertheless, the overall period evaluated here (BAS - DUR2L) resulted in a significant increase in body weight ($p = 0.015$). Regarding gender, an increase in BMI was observed during the first lockdown (BAS - AFT1L) in both males and females, however, only among males when considering the total evaluated period ($p < 0.001$). Furthermore, considering age, although BMI increased during the first lockdown in both children and adolescents, only children had their BMI increased during the overall evaluated time ($p < 0.001$) (Table 4). Finally, regarding weight status, BMI increased during the first lockdown in all groups, except the thinness group (Table 4). However, only normal-weighted subjects maintained this increase throughout the evaluated time ($p < 0.001$). In contrast, the BMI of the overweight subjects decreased in comparison to the baseline period ($p = 0.023$) (Table 4).

Table 5 presents the median scores of the psychometric instruments administered to the children, adolescents, and their parents. According to Lovibond and Lovibond recommended cut-offs of Depression Anxiety and Stress Scale (DASS-21), the prevalence of perceived above-normal symptoms of depression (depression score of ≥ 10), anxiety (anxiety score of ≥ 8), and stress (stress

score of ≥ 15) among children was 24.2%, 26.7%, and 30.8%, respectively. For adolescents, the corresponding levels for the same dimensions were 27.2%, 28.5%, and 31.8%, and for parents, 17.8%, 15.9%, and 29.1%.

In this study, a significant multiple regression model was found for the predictors of overall weight gain ($F(22,346) = 7.375, p < 0.001$), with an adjusted coefficient of determination (r^2) of 0.276 (Table 6). In this model, children and adolescents baseline BMI z-score, the Parent Relations and Home Life dimension score, the reduction in family income during the pandemic, and the

presence of an outdoor area in the household negatively predicted the recorded weight gain. In contrast, child and adolescent stress, parental BMI, and the presence of close relatives previously diagnosed with COVID-19 were positively associated with this outcome.

Discussion

To our knowledge, this study was the first to examine the weight trends of children and adolescents during

Table 2. Sociodemographic, anthropometric, and household characteristics, assessed at the time of the questionnaire response, stratified by age group

Characteristics	Total (n = 422)		Children (n = 120)		Adolescents (n = 302)	
	n (mean)	% (SD)	n (mean)	% (SD)	n (mean)	% (SD)
Children / adolescents						
Age	(12.4)	(2.9)	(9.0)	(0.6)	(13.7)	(2.4)
Gender						
Male	172	40.8	50	41.7	122	40.4
Female	250	59.2	70	58.3	180	59.6
Parents						
Age	(45.6)	(4.4)	(43.5)	(4.1)	(46.5)	(4.3)
Education level*						
Without a college degree	50	11.8	14	11.7	36	11.9
With a college degree	372	88.2	106	88.3	266	88.1
Weight status						
Normal weight	208	49.3	59	49.2	149	49.3
Overweight	176	41.7	51	42.5	125	41.4
Obesity	38	9.0	10	8.3	28	9.3
Household characteristics						
Members						
≤ 2	20	4.7	4	3.3	16	5.3
3-4	308	73.0	89	74.2	219	72.5
> 4	94	22.3	27	22.5	67	22.2
Outdoor space						
Yes	344	81.5	96	80.0	248	82.1
No	78	18.5	24	20.0	54	17.9
COVID-19 pandemic						
Work regime						
No changes	120	28.4	25	20.8	95	31.5
Remote work and / or layoff	302	71.6	95	79.2	207	68.5
Household income						
Did not decrease	340	80.6	96	80.0	244	80.8
Decreased	82	19.4	24	20.0	58	19.2
Diagnosed with COVID-19						
Close relative	64	15.2	11	9.2	53	17.5
Child / adolescent	29	6.9	5	4.2	24	7.9

BMI - body mass index; SD - standard deviation.

* Parent with the highest education level.



more than one year of the COVID-19 pandemic. The overall period studied here resulted in weight gain, but only in children and individuals with normal weight. These findings were accompanied by an increase in the rates of overweight and obesity. By time intervals, the first lockdown alone was responsible for the observed result, as the remaining time correlated with a gradual decrease in BMI. In contrast, subjects with overweight unexpectedly lost weight during the evaluated period. In addition, we investigated whether psychological distress and specific household-related factors were associated

with weight gain. Several positively associated factors were found, such as child and adolescent stress, parental BMI, and the presence of a close relative previously diagnosed with COVID-19. On the other hand, a good parent-child relationship and home atmosphere, the reduction in family income, and the existence of an outdoor area in the household negatively predicted this outcome. Overall, these results provided new insights into how and why the COVID-19 pandemic affected the weight of children and adolescents.

Table 3. Weight status of children and adolescents at the baseline and during the second lockdown periods, for the entire sample and stratified by age

Weight status	Total		Children		Adolescents	
	Baseline (%)	DUR2L (%)	Baseline (%)	DUR2L (%)	Baseline (%)	DUR2L (%)
Thinness	0.9	0.9	0.0	0.0	1.3	1.3
Normal weight	62.6	60.0	67.5	60.0	60.9	59.9
Overweight	23.7	26.3	18.3	25.0	25.8	26.8
Obesity	12.8	12.8	14.2	15.0	11.9	11.9

DUR2L - during the second lockdown.

Table 4. Trends of the body mass index z-scores during the pandemic period, considering each phase of the pandemic, for the entire sample and stratified by gender, age, and weight status

Characteristics	BAS	AFT1L	BEF2L	DUR2L	Overall ^d
	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	
Total	0.61 ± 1.23	0.74 ± 1.24 ^a	0.72 ± 1.23 ^a	0.68 ± 1.17 ^{a,b}	0.015
Gender					
Male	0.49 ± 1.31	0.60 ± 1.28 ^a	0.69 ± 1.31 ^{a,b}	0.62 ± 1.24 ^{a,c}	0.004
Female	0.69 ± 1.16	0.84 ± 1.21 ^a	0.74 ± 1.17 ^b	0.72 ± 1.12 ^b	1
Age group					
Children	0.61 ± 1.25	0.83 ± 1.23 ^a	0.80 ± 1.24 ^a	0.80 ± 1.17 ^a	< 0.001
Adolescents	0.61 ± 1.22	0.71 ± 1.25 ^a	0.69 ± 1.23 ^a	0.62 ± 1.17 ^{b,c}	1
Weight status					
Thinness	-2.34 ± 0.42	-2.21 ± 0.39	-2.20 ± 0.72	-1.89 ± 0.69	1
Normal weight	-0.16 ± 0.77	0.00 ± 0.83 ^a	0.01 ± 0.82 ^a	0.01 ± 0.79 ^a	< 0.001
Overweight	1.50 ± 0.30	1.57 ± 0.42 ^a	1.45 ± 0.47 ^b	1.34 ± 0.51 ^{a,b,c}	0.023
Obesity	2.55 ± 0.54	2.66 ± 0.54 ^a	2.67 ± 0.63 ^a	2.55 ± 0.55 ^c	1

AFT1L - after the first lockdown; BAS - baseline; BEF2L - before the second lockdown; DUR2L - during the second lockdown; SD - standard deviation. ^a *p* < 0.05 compared to BAS, ^b *p* < 0.05 compared to AFT1L, ^c *p* < 0.05 compared to DUR2L, ^d *p*-value of the total BMI z-score difference evaluated (DUR2L - BAS).

Table 5. "Psychometric instruments" scores and DASS-21 categories for children and adolescents and their parents.

Characteristics	Depression (DASS-21)	Anxiety (DASS-21)	Stress (DASS-21)	Fear of COVID-19 scale	Parent relations and home life*
	Median (IQR)	Median (IQR)	Median (IQR)	Mean ± SD	Mean ± SD
Children	4.0 (4.0)	4.0 (4.0)	8.0 (10.0)	17.9 ± 7.0	84.2 ± 14.5
Adolescents	4.0 (4.0)	4.0 (4.0)	8.0 (6.0)	15.7 ± 5.8	82.3 ± 16.1
Parents	2.0 (8.0)	2.0 (4.0)	8.0 (12.0)	17.9 ± 5.8	-

DASS - depression anxiety and stress; IQR - interquartile range; SD - standard deviation
* Single dimension from the KIDSCREEN-52 instrument.

Table 6. Factors associated with the overall weight gain during the pandemic in children and adolescents: multiple linear regression model

Independent variables*	Overall BMI z-score difference (BAS - DUR2L)			
	Adjusted r ²	Adjusted B	Statistic	p
	0.276			
Baseline BMI z-score		-0.354	-7.241	< 0.001
Age (child / adolescent)		-0.282	-5.274	< 0.001
Decreased household income [†]		-0.202	-4.322	< 0.001
Parents' BMI		0.161	3.177	0.002
Stress (child / adolescent)		0.143	1.980	0.049
Close relative diagnosed with COVID-19		0.126	2.191	0.029
Parent relations and home life [‡]		-0.108	-2.164	0.031
Outdoor space in the household [§]		-0.093	-2.041	0.042

BAS - baseline; BMI - body mass index; DUR2L - during the second lockdown.

* Adjusted for BMI (at the DUR2L period) and for sociodemographic and psychometric variables.

† As a dummy variable (0 = did not decrease, 1 = decreased).

‡ Single dimension from the KIDSCREEN-52 instrument.

§ As a dummy variable (0 = without an outdoor space, 1 = with an outdoor space).

This study supports previous findings showing that the first lockdown caused significant body weight gain in children and adolescents.⁷ In contrast, the decline in BMI z-scores over the remaining time evaluated here contradicted the hypothesis that childhood obesity rates would increase proportionately to the number of months of school closure.²⁶ Of particular relevance to these findings, recent studies have reported lower compliance with the social restriction measures as the pandemic stretched in time.²⁷⁻²⁹ Moreover, lower adherence to these measures correlated with higher engagement in social behaviors.^{28,29} Thus, we hypothesize that these social behaviors include lifestyle behaviors that promote weight adequacy (eg, physical activity), ultimately leading to weight loss. However, although there appears to be a trend toward weight decline over time for the total sample, pre-pandemic levels have not yet been reached. Moreover, children appear to have stabilized their weight after the first lockdown leading to an increase in the levels of overweight and obesity, which is of great concern. Hence, further studies are needed as it is not known if these trends will continue in the future.

Excessive weight gain in children results from a dynamic process in which genetic, behavioral, psychological, and environmental factors converge and act synergistically.^{30,31} In turn, the COVID-19 pandemic, oscillating between confinement and deconfinement phases for more than a year, posed additional risks towards this dynamic. Concomitantly, several factors had the potential to amplify or mitigate these risks, ultimately resulting in significant distinct weight changes between populations.

Considering the primary behavioral determinants of body weight (dietary habits and physical activity), while

research suggests a paradoxical change in diet quality,⁸ physical activity was substantially reduced during this period.³² Moreover, this reduction seemed to have been particularly higher in physically active subjects prior to the pandemic.^{32,33} Given that physical activity is higher in children³⁴ and in normal weighted subjects,³⁵ it could be inferred that this would lead to their higher risk of weight gain, as we observed. In contrast, we also reported that subjects with overweight had their weight decreased during the pandemic. These results are consistent with the limited literature on this topic, suggesting that the first lockdown did not change⁷ or even decreased³⁶ the weight of overweight children.

A further determinant of excessive weight gain is the deterioration of mental health, particularly in the form of psychological distress.³⁷ Compared to the results of a Portuguese study conducted in 2016 and 2017 using the same questionnaires (DASS-21 and DASS-21-C) for schoolchildren and their mothers, our study reported higher median scores for depression (4.0 vs 2.0), anxiety (4.0 vs 2.0), and stress (8.0 vs 4.0) in children.³⁸ These findings were also accompanied by higher levels of above-normal symptoms of depression (24.2% vs 18.1%) and anxiety (26.7% vs 20.6%). The levels of stress symptoms cannot be compared due to differences in data disposal. As with parents, the current timing in a pandemic context correlated with higher median levels of depression (2.0 vs 0.0), anxiety (2.0 vs 0.0), and stress (8.0 vs 6.0). Although these results should be cautiously interpreted due to differences in study design and population (mothers *versus* both parents), this is consistent with increased psychological distress reported in the literature.¹⁷ Congruently, stress (a dimension of psychological distress) and having a close relative previously diagnosed with COVID-19 (shown to



be associated with psychological distress in those closest to them)^{39,40} were associated with weight gain. There are several mechanisms linking psychological distress to weight gain, notably biological (eg, decreased brain receptors sensitivity to leptin and higher preference for foods high in sodium, fat, and sugar),^{41,42} psychological (eg, emotional eating),⁴³ and behavioral (eg, disruption of mealtimes)⁴⁴ mechanisms. However, the transversal assessment of the psychometric measures performed in this study limits the causal inferences drawn from it. Children and adolescents were forced by social restriction measures to spend most of their time at home, which increased their exposure to the household environment. This view could explain the positive association between parental BMI and the “subjects” weight gain. Given that adults with a higher baseline BMI were more likely to gain weight during the initial stages of the COVID-19 pandemic,⁴⁵ “subjects” greater exposure to their parents’ lifestyle habits (eg, dietary habits) throughout this period might have been critical to this outcome. Aligned with the same view, the dimension of Parent Relations and Home Life, in which higher scores indicate a good parent-child relationship and atmosphere at home, was inversely associated with weight gain. Pandemic-related stressors, such as increased worry and uncertainty among parents and children, have created conditions that have the potential to challenge the parent-child relationship.^{18,20} In turn, a negative parent-child relationship during the pandemic has been linked to several factors associated with weight gain, including food insecurity,⁴⁶ parental food control practices,⁴⁶ psychological distress,^{47,48} and decreased physical activity.²² However, a reduction in family income during the pandemic, a contributing factor to negative parent-child relationships,⁴⁹ was unexpectedly negatively associated with weight gain in this study. Therefore, further studies are needed to investigate the basis for this finding. Finally, research suggests that during the COVID-19 pandemic, the presence of an outdoor area in the home contributed to higher levels of physical activity³³ and better mental health,²¹ which is consistent with our findings. Complementarily, the findings of pre-pandemic studies have revealed the association of smaller living spaces with suicide, anxiety, and depression,^{50,51} and that housing proximity to nature can reduce stress, improve mood,⁵² and reduce the risk of obesity.⁵³

Overall, these results underline children’s difficulties in losing the excessive weight gained during the first lockdown. Further studies are needed to clarify if this trend will prevail in the future. In addition, awareness of the possible role of specific household characteristics

and stress in these difficulties may enable clinicians to provide better guidance to children in this regard. Thus, a family-centered, multidisciplinary approach is needed for a comprehensive understanding of the interplay of environmental, psychological, and behavioral factors in weight management.

This study has some strengths and some limitations. Among the strengths, we highlight the anthropometric measurements performed in children and adolescents with standardized methods and always by the same trained professionals and measurement instruments. As for limitations, the fact that the study was conducted in a private hospital did not ensure the representativeness of the population, especially at the socioeconomic level, limiting the external validity of this study. In addition, the online completion of the questionnaire might have affected the reliability of the responses to the psychometric instruments, the self-report of anthropometric measurements by parents might have led to their lower accuracy, and the cross-sectional nature of the study made it impossible to analyze the evolution of psychological distress during the pandemic, limiting the causal inferences that could be drawn.

Author Contributions

FP participated in the study conception or design. FP participated in acquisition of data. FP participated in the analysis or interpretation of data. FP participated in the drafting of the manuscript. VV and CR participated in the critical revision of the manuscript. All authors approved the final manuscript and are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Conflicts of Interest

The authors declare that there were no conflicts of interest in conducting this study.

Funding Sources

There were no external funding sources for the realization of this paper.

Protection of human and animal subjects

The authors declare that the procedures followed were in accordance with the regulations of the relevant clinical research ethics committee and with those of the Code of Ethics of the World Medical Association (Declaration of Helsinki 2013).

Provenance and peer review

Not commissioned; externally peer reviewed.

Confidentiality of data

The authors declare that they have followed the protocols of their work center on the publication of patient data.

Acknowledgments

The authors would like to extend sincere gratitude to all children, adolescents, and their parents for the time and

effort dedicated to participating in this study. They further wish to thank all the hospital pediatricians who helped in its implementation.

Awards and Presentations

This work was presented at the 25th Congress of the

Portuguese Society for the Study of Obesity (SPEO), receiving the award for the Best Oral Communication in Pediatrics.

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Evolução do Peso em Crianças e Adolescentes Durante a Pandemia de COVID-19 e sua Relação com Sofrimento Psicológico

Introdução: A pandemia de COVID-19 provocou a deterioração da saúde biopsicossocial nas crianças e adolescentes. Porém, pouco se sabe acerca do seu impacto no peso corporal. Objetivou-se avaliar a evolução do índice de massa corporal em crianças e adolescentes ao longo de mais de um ano da pandemia de COVID-19. Adicionalmente, examinou-se a associação das alterações do índice de massa corporal com o sofrimento psicológico e características específicas do ambiente doméstico.

Métodos: Realizou-se um estudo transversal com uma componente retrospectiva num hospital português com uma amostra de conveniência de 422 crianças e adolescentes (idade média = 12,4 ± 2,9 anos) e um dos seus pais. Um questionário online validado foi administrado a ambos os grupos para avaliar o sofrimento psicológico. Utilizou-se uma regressão linear múltipla para identificar preditores da mudança de índice de massa corporal.

Resultados: A pandemia de COVID-19 causou ganho de peso nas crianças ($p < 0,001$), aumentando a prevalência de excesso de peso e obesidade. Somente o primeiro

confinamento foi responsável pelo resultado observado, pois o tempo restante caracterizou-se por uma diminuição gradual do índice de massa corporal, porém insuficiente para atingir níveis pré-pandémicos ($p = 0,015$). Fatores associados incluíram o índice de massa corporal das crianças e adolescentes, stress e determinadas características do ambiente doméstico.

Discussão: Este estudo contraria a hipótese de que o peso aumentaria proporcionalmente ao tempo de fecho das escolas. Também ressalta as dificuldades das crianças em perder o peso ganho durante o primeiro confinamento. Por último, a associação do ganho de peso com fatores ambientais e psicológicos destaca a importância da sua consideração na terapêutica do excessivo ganho do peso.

Palavras-Chave: Adolescente; Angústia Psicológica; Aumento de Peso; COVID-19/complicações; Criança; Índice de Massa Corporal; Obesidade Pediátrica; Quarentena/psicologia

