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ORIGINAL ARTICLE

Physical and mental health impacts during COVID-19 quarantine in adolescents with preexisting chronic immunocompromised conditions

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Abstract

Objective: To evaluate physical and mental health indicators in adolescents with preexisting chronic immunocompromised conditions during coronavirus disease 2019 (COVID-19) quarantine.
Methods: A cross-sectional study included 355 adolescents with chronic conditions and 111 healthy adolescents. An online self-rated survey was used to investigate socio-demographic features, healthcare routine, and the quarantine impact on physical and mental health. The validated self-reported version of the Strengths and Difficulties Questionnaire (SDQ) was also applied.
Results: The median of age [14 (10—18) vs. 15 (10—18) years, $p = 0.733$] and frequencies of female (61% vs. 60%, $p = 0.970$) were similar between adolescents with preexisting chronic conditions and healthy adolescents during quarantine of COVID-19 pandemic. The frequencies of

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abnormal total difficulties score of SDQ were similar in patients and controls (30% vs. 31%, p = 0.775). Logistic regression analysis showed that being female (OR = 1.965; 95% CI = 1.091−3.541, p = 0.024), fear of underlying disease activity/complication (OR = 1.009; 95%CI = 1.001−1.018, p = 0.030) were associated with severe psychosocial dysfunction in adolescents with chronic conditions, whereas school homework (OR = 0.449; 95% CI = 0.206−0.981, p = 0.045) and physical activity (OR = 0.990; 95% CI = 0.981−0.999, p = 0.030) were protective factors. Further analysis of patients with chronic immunocompromised conditions and previous diagnosis of mental disorders (9%) compared with patients without diagnosis showed higher median of total difficulties score (p = 0.001), emotional (p = 0.005), conduct (p = 0.007), peer problems (p = 0.001) and hyperactivity (p = 0.034) in the former group.

Conclusion: Adolescents with preexisting chronic immunocompromised conditions during COVID-19 quarantine were not at higher risk of adverse health indicators. Being female, fear of underlying disease activity/complication, and household members working outside of the home were relevant issues for adolescents with preexisting chronic conditions. This study reinforces the need to establish mental health strategies for teens with chronic conditions, particularly during the pandemic.

Introduction

The coronavirus disease 2019 (COVID-19) emerged in China at the end of 2019.[1] The World Health Organization declared a pandemic in March 2020, as a result of the rapid increase of cases in adult[2] and pediatric population[3] around the world, including in Brazil.[4]

In response to this pandemic, governments implemented policies to decrease the rate of this new severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection. Brazilian adolescents were subjected to restrictions during the COVID-19 pandemic, such as stay-at-home orders, social distancing, face masks use, and closures of leisure activities and schools, impacting learning and social connection.[5]

Indeed, social connection is a fundamental part of the psychosocial development in adolescence, therefore quarantine has a potentially negative impact on the physical and mental health of adolescents.[6] Cross-sectional[7] and longitudinal studies[6,8] conducted through quarantine/lockdown due to COVID-19 pandemic indicated worsen the quality of sleep[7] reduced physical activity,[6,8] as well as an increase in intrafamilial violence, screen time and emotional issues.[6] Nevertheless, these studies have predominantly assessed previously healthy adolescents from the general population.[6,7]

For adolescents with preexisting chronic immunosuppressed and/or immune-mediated conditions, quarantine during the COVID-19 pandemic also represented postponement of usual health care.[9] However, to the authors' knowledge, the impact of the COVID-19 pandemic on the physical and mental health of this vulnerable population, including simultaneous analysis of various chronic conditions, has not been systematically studied yet.

Therefore, the objective of the present study was to evaluate physical and mental health indicators of adolescents with preexisting chronic immunosuppressed and/or immune-mediated conditions and compare them to healthy adolescents on quarantine during the COVID-19 pandemic. Furthermore, to investigate the characteristic of patients with higher levels of psychopathology and the role of previous mental disorders on current functioning and well-being.

Material and methods

Participants

A cross-sectional study was conducted with a convenience sample of 555 adolescents (10−18 years) with preexisting chronic immunosuppressed and/or immune-mediated conditions, during the COVID-19 pandemic in Brazil. All adolescents with preexisting chronic conditions were enrolled from a single tertiary university hospital. Patients were excluded due to incomplete survey data (n = 48) or if they did not accept to participate in the study (n = 152). Therefore, 355 adolescents were included in this study.

The following 11 pre-existing chronic immunosuppressed and/or immune-mediated conditions were assessed according to established classification criteria for each disease: gastrointestinal and liver conditions (inflammatory bowel disease,[10] celiac disease,[11] eosinophilic esophagitis,[12] autoimmune hepatitis[13]); rheumatic conditions (juvenile systemic lupus erythematosus,[14] juvenile dermatomyositis,[15] juvenile idiopathic arthritis),[16] and kidney conditions (glomerulopathies[17] and chronic kidney disease stages 4 and 5).[18] Adolescents with previous liver and kidney transplants were also included. Previous diagnoses of psychiatric diseases before the COVID-19 pandemic were established according to the 5th edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM 5).[19]

Healthy adolescents (n = 149) between 10 and 18 years old were recruited by advertising on various media (radio, television, daily newspapers, Facebook, and Instagram). Participation required approval of parent/legal guardians. Participants were excluded due to incomplete survey data (n = 15) or if they did not accept to participate in the study (n = 23). Therefore, 111 healthy adolescents comprised the control group. Supplementary Figure 1 includes a flowchart of the research methodology (Supplementary Fig. 1).

Procedures

The survey was answered between July 13 and October 7, 2020, by cellphone, computer, or tablet. The survey was conducted in Portuguese and at least six emails or messages were sent to improve the response rate. During this period, quarantine due to the COVID-19 pandemic occurred in São Paulo metropolitan city. At that moment in order to contain the spread of SARS-CoV-2 infection, lifestyle restrictions included stay-at-home orders, social isolation, closure of schools, parks, and trails. The wear of face masks remained mandatory throughout this period.

This online survey was conducted using Research Electronic Data Capture (REDCap®). This is a safe web tool planned to support data capture for research studies. It also audits trails for tracking data manipulation and allows automated data export procedures for statistical analyses. The Brazilian National Committee for Research Ethics (CONEP number 4.081.961) approved the present study. The informed consent and assent terms were signed in the introduction of the online survey by all parents/legal guardians and adolescents.

Instruments

The survey was divided into two parts, information was related to the past month. The estimated time for responses for both two parts was nearly 15 min. The first part included a semi-structured questionnaire with 37 questions about socio-demographic data, educational issues, healthcare routine, general information on COVID-19, the impact of quarantine on mental health during COVID-19 the pandemic. The questionnaire items were reviewed by experts for quality assurance. The response formats used were multiple choices, dichotomous (yes and no), or ordinary based on visual analog scale (VAS) (ranging from 0 to 10) and also included nine open questions. The questions were related to the following topics:

1) Socio-demographic data (age, sex, race/ethnicity, number of rooms in the residence, and number of household members in the residence).
2) Educational data
   - Level of education (elementary school, middle school, high school, or not studying)
   - Attending school before COVID-19 pandemic (yes/no)
   - Online teaching-learning (yes/no)
   - Public or private school (yes/no)
   - School homework during COVID-19 pandemic (no homework, $\leq$ 3 h/day, or $>$ 3 h/day)
3) Healthcare routine
   - Medical appointment before pandemic (once every 2 months or less, once every 3 months, or once every 4 months or more)
   - Medical appointment during pandemic (discontinued, decreased, or unchanged)
   - Forgetting to take your medication frequency (not forgetting, 1–2 days, or $\geq$ 3 days per week)
   - Seasonal influenza vaccine use (yes/no)
4) General information on COVID-19 pandemic
   - COVID-19 information source (family and friends, health professionals, or social media/television/radio)
   - Reliable COVID-19 information (yes/no)
   - Compliance to "Stay-Home" policy (yes/no)
5) Impact of COVID-19 quarantine
   - Household members with COVID-19 (yes/no)
   - Life routine changed after the "physical distancing" policy (yes/no)
   - Housework (no housework, $\leq$ 1 h/day, or $>$ 1 h/day)
   - Taking care of elderly people (not taking care, $\leq$ 1 h/day, or $>$ 1 h/day)
   - Reduction of sleep duration (yes/no)
   - Sleep time delay (yes/no)
   - Screen time ($\leq$ 3 h/day, 4–6 h/day, and $\geq$ 7 h/day)
   - Screen time increased during the pandemic (yes/no)
   - Alcohol use during pandemic (increased, did not change, decreased, or do not drink alcohol)
   - Financial status during pandemic (worsen, did not change, or improve)
   - Household members working outside of home (yes/no)
   - Intrafamilial violence during pandemic (yes/no)
6) VAS scale in the last month (0–10)
   - Fear of COVID-19 ranged from 0 (no fear) to 10 (with extreme fear)
   - Fear of underlying disease activity/complication ranged from 0 (no fear) to 10 (with extreme fear)
   - Fear of immunosuppressive use ranged from 0 (no fear) to 10 (with extreme fear)
   - Physical activity per week ranged from 0 (without any physical activity) to 10 (vigorous physical activity daily)

The second part of the survey included the Portuguese validated version of the Strengths and Difficulties Questionnaire (SDQ), based on responses relative to the previous month.[20] The authors used the self-report portion of SDQ in adolescents, including 25 items, divided into five domains: emotional problems, conduct problems, hyperactivity/inattention, peer problems, and prosocial behavior. Each item can be answered in a 3-point ordered response format, as "not true", "somewhat true" and "certainly true" and scores range from 0 to 2 for each answer. The scores for each of the domains range from 0 to 10. The sum of emotional, conduct, hyperactivity/inattention, and peer problems generate the total difficulties score and ranges from 0 to 40. The SDQ also provides an impact supplement that screens emotional or behavioral problems, their duration, and the impact of these problems on the family's daily life. The patients were assigned in two groups according to the more recent four-band categorization of self-reported SDQ: abnormal (cut-off points "high/low" and "very high/very low") and normal/borderline (cut-off points "close to average" and "slightly raised/slighted lowered").[21,22]

Statistical analysis

The sample size with 466 adolescents provided a power of 80% to find differences greater than 13.8% in the frequency of abnormal SDQ score among adolescents with chronic immunocompromised conditions and healthy controls (Graphpad StatMate 1.01, GraphPad Software, Inc., CA, USA). All statistical analyses were performed using Statistical Package for Social Sciences (SPSS) for Windows 24.0 (IBM

Corp., Armonk, NY, USA). Data were described as a number (frequency) for categorical variables, and median (range) or mean ± standard deviation (SD) for continuous variables, if they have a non-normal or normal distribution, respectively. Scores that had non-normal and normal distributions were compared by the Mann−Whitney test and *t* test, respectively. Differences of categorical variables were evaluated according to Fisher's exact test or Pearson chi-square test. Spearman rank correlation coefficient was used for testing correlations between total difficulties score and VAS of physical activity scale, sleep quality, fear of COVID-19, fear of underlying disease activity/complication, and fear of immunosuppressive use. The Kruskal−Wallis test was used to compare continuous variables with non-normal distribution in three groups of adolescent's chronic conditions (gastrointestinal and liver, rheumatologic, and kidney). Logistic regression analysis (Backward Stepwise) was performed to identify potential risk factors for abnormal categorization of SDQ. A p value < 0.05 was considered statistically significant.

Results

The median of age [14 (10−18) vs. 15 (10−18) years, $p = 0.733$] and frequencies of the female sex (61% vs. 60%, $p = 0.970$) were similar between adolescents with preexisting chronic conditions and healthy adolescents during quarantine of COVID-19 pandemic. The frequency of online teaching-learning during COVID-19 was significantly lower in patients than controls (83% vs. 93%, $p = 0.013$). A lower frequency of patients reported housework ($p = 0.002$) and taking care of elderly people ($p = 0.042$) compared to healthy adolescents (Table 1).

The frequencies of abnormal self-reported total difficulties score of SDQ was similar in patients and controls [(30%) vs. (31%), $p = 0.775$]. The median of hyperactivity/inattention [5 (0−10) vs. 5 (0−9), $p = 0.046$] was significantly lower in adolescents with preexisting chronic immunosuppressed and/or immune-mediated conditions compared with healthy adolescents during quarantine of COVID-19 pandemic and impact score [0 (0−10) vs. 1 (0−8), $p = 0.030$] were significantly reduced in the former group. No differences were observed regarding the median total difficulties score in both groups, or the frequencies and median of emotional problems, conduct problems, peer problems, and prosocial scores ($p > 0.05$).

Female sex (74% vs. 56%, $p = 0.003$) was significantly more frequent in abnormal total difficulties scores of SDQ compared to normal/borderline total difficulties scores categories, while homework was significantly reduced in the former group ($p = 0.032$) The frequencies of household members with COVID-19 (21% vs. 11%, $p = 0.023$), reduction of sleep duration (50% vs. 28%, $p = 0.0002$), sleep time delay (71% vs. 59%, $p = 0.039$), household members working outside of home (96% vs. 82%, $p < 0.001$), and intrafamilial violence during pandemic (28% vs. 17%, $p = 0.029$) were significantly higher in patients with abnormal scores. Otherwise, physical activity per week [1.1 (0−10) vs. 2.9 (0−10), $p < 0.001$] was significantly reduced in patients with abnormal total difficulties score. Finally, fear of disease activity or complication was significantly higher in abnormal subgroup [7.7 (0−10) vs. 5.1 (0−10), $p < 0.001$] (Table 2).

Logistic regression analysis showed that household members working outside of home (OR = 4.405; 95% CI = 1.444−13.439, $p = 0.009$), female sex (OR = 1.965; 95% CI = 1.091−3.541, $p = 0.024$) and fear of underlying disease activity or complication by VAS (OR = 1.009; 95% CI = 1.001−1.018, $p = 0.030$) were independently associated with abnormal category of total difficulties score of SDQ in adolescents with preexisting chronic immunosuppressed and/or immune-mediated conditions. In contrast, school homework (OR = 0.449; 95% CI = 0.206−0.981, $p = 0.045$) and physical activity per week by VAS (OR = 0.990; 95% CI = 0.981−0.999, $p = 0.030$) were inversely associated with abnormal category of total difficulties scores of SDQ. The R^2 of the Nagelkerke test was 0.295.

A negative Spearman rank correlation coefficient was observed between total difficulties score of SDQ and physical activity per week by VAS ($r = -0.222$, $p < 0.001$). Positive Spearman rank correlation coefficient was observed between total difficulties score of SDQ and fear of underlying disease activity or complication by VAS ($r = 0.263$, $p < 0.001$) and total difficulties score of SDQ and fear of immunosuppressive use by VAS ($r = 0.185$, $p = 0.001$).

Previous diagnoses of mental disorders were detected in 31 of 342 patients (9%). These included depressive disorder ($n = 15$, 48.4%), anxiety disorder ($n = 13$, 42%), somatic symptom disorder ($n = 1$, 3.2%), unspecified neurodevelopmental disorder ($n = 1$, 3.2%) and psychotic disorder ($n = 1$, 3.2%).

Hours of school homework during COVID-19 pandemic ($p = 0.046$) and compliance to "stay-at-home" order (87% vs. 97%, $p = 0.019$) were significantly lower among patients with previous mental disorders with those without, whereas medical appointment before pandemic were significantly higher in this group ($p = 0.015$). The frequencies of household members with COVID-19 (26% vs. 13%, $p = 0.043$) and reduction of sleep duration (52% vs. 33%, $p = 0.048$) were significantly higher in those with mental disorders. Comparisons between patients with previous mental disorders with those without showed that the former group had increases in median of total difficulties score of SDQ [19 (5−32) vs. 13 (0−29), $p = 0.001$], emotional problems [6 (0−10) vs. 4 (0−10), $p = 0.005$], conduct problems [3 (0−8) vs. 4 (0−10), $p = 0.007$], hyperactivity/inattention [5 (0−10) vs. 4 (0−10), $p = 0.034$], and peer problems [3 (1−10) vs. 2 (0−9), $p = 0.001$] Moreover, the median of prosocial score [7 (3−10) vs. 8 (1−10), $p = 0.007$] was lower in patients with preexisting psychiatric disorders compared to those without psychiatric disorders. The frequencies of abnormal total difficulties score of SDQ were significantly higher (58% vs. 27%, $p \leq 0.001$) in the former group, as well as emotional ($p = 0.013$) and conduct disorders ($p = 0.046$) (Table 3).

Table 4 includes SDQ scores reported by adolescents with gastrointestinal and liver conditions *versus* adolescents with rheumatologic conditions *versus* adolescents with kidney conditions during quarantine of the COVID-19 pandemic. No differences were observed of total difficulties SDQ score, as well as peer problems, emotional, conduct, hyperactivity/inattention, and prosocial in these three groups of chronic conditions ($p > 0.05$, Table 4).

Table 1 Demographic data, information, and Impact of coronavirus infectious disease 2019 (COVID-19) pandemic reported by adolescents with preexisting chronic immunosuppressed and/or immune-mediated conditions versus healthy adolescents during quarantine.

Variables	Preexisting chronic conditions (*n* = 355)	Healthy (*n* = 111)	p
Socio-demographic			
Current age	14 (10-18)	15 (10-18)	0.733
Female sex	215 (61)	67 (60)	0.970
Caucasians	181 (51)	65 (59)	0.163
Number of rooms in the residence			
≤ 5	205 (58)	64 (58)	0.987
> 5	150 (42)	47 (42)	
Number of household's members in the residence			
≤ 3	113 (32)	34 (31)	0.812
>3	242 (68)	77 (69)	
Educational data			
Level of schooling			
Elementary school	212 (60)	60 (54)	NA
Middle school	116 (33)	41 (37)	
High school	18 (5)	6 (5)	
Not studying	9 (2)	4 (4)	
Attending school before COVID-19 pandemic	306 (86)	103 (93)	0.064
Online teaching-learning during COVID-19 pandemic	295 (83)	103 (93)	0.013
Public school	266 (75)	72 (65)	0.051
School homework during COVID-19 pandemic			
No homework	60 (17)	8 (7)	0.009
≤ 3 hours/day	149 (42)	42 (38)	
> 3 hours/day	146 (41)	61 (55)	
Healthcare routine during the pandemic			
Medical appointment before the pandemic			
Once every 2 months or less	184/335 (55)	-	-
Once every 3 months	91/335 (27)	-	
Once every 4 months or more	60/335 (18)	-	
Medical appointment during the pandemic			
Discontinued	116/335 (35)	-	-
Decreased	132/335 (39)	-	
Unchanged	87/335 (26)	-	
Forgetting to take your medication			
Without forgetting	219/314 (70)	-	-
1-2 days	81/314 (26)	-	
≥ 3 days	14/314 (4)	-	
Seasonal influenza vaccine use	246/352 (70)	71/109 (65)	0.350
General information of COVID-19 pandemic			
COVID-19 information source			
Family and friends	27 (8)	7 (6)	0.286
Health professionals	18 (5)	2 (2)	
Social media/television/radio	310 (87)	102 (92)	
Reliable COVID-19 information	263 (74)	65 (57)	< 0.001
Compliance to "stay-home" policy	342 (96)	105 (95)	0.418
Impact of COVID-19 quarantine			
Household members with COVID-19	49 (14)	16 (14)	0.871
Life routine changed after the "physical distancing" policy	329 (93)	103 (93)	0.967
Housework			
No housework	86 (24)	14 (13)	0.002
≤ 1 hours/day	164 (46)	46 (41)	
> 1 hours/day	105 (30)	51 (46)	

Table 1 (*Continued*)

Variables	Preexisting chronic conditions (*n* = 355)	Healthy (*n* = 111)	p
Taking care of elderly people			
Not taking care	270 (76)	74 (67)	0.042
≤ 1 hours/day	36 (10)	21 (19)	
> 1 hours/day	49 (14)	16 (14)	
Physical activity per week (VAS 0−10)	2.5 (0-10)	3.0 (0-10)	0.700
Reduction of sleep duration	123 (35)	46 (42)	0.214
Sleep time delay	221 (62)	77 (70)	0.173
Screen time			
≤ 3 hours/day	37 (10)	7 (6)	0.072
4-6 hours/day	159 (45)	41 (37)	
≥ 7 hours/day	159 (45)	63 (57)	
Screen time increased during pandemic	308 (87)	102 (92)	0.147
Alcohol use during pandemic			
Increased	1 (0)	0 (0)	NA
Did not change	3 (1)	5 (4)	
Decreased	4 (1)	3 (3)	
Do not drink alcohol	347 (98)	103 (93)	
Financial status during the pandemic			
Worsen	127 (36)	49 (44)	NA
Did not change	216 (61)	56 (51)	
Improve	12 (3)	6 (5)	
Household members working outside of home	304 (86)	90 (81)	0,247
Intrafamilial violence during pandemic	69 (20)	31 (28)	0.057
VAS (0-10)			
Fear of COVID-19	6.3 (0-10)	5.3 (0-10)	0.451
Fear of underlying disease activity/ complication	5.9 (0-10)	-	-
Fear of immunosuppressive use	5.0 (0-10)	-	-
Preexisting chronic conditions			
Gastrointestinal and liver conditions	161 (45)		
Inflammatory bowel disease	44 (12)	-	-
Celiac disease	12 (3)	-	-
Eosinophilic esophagitis	23 (7)	-	-
Autoimmune hepatitis	29 (8)	-	-
Liver transplantation	53 (15)	-	-
Rheumatologic conditions	150 (43)		
Childhood systemic lupus erythematosus	43 (12)		
Juvenile dermatomyositis	23 (7)	-	-
Juvenile idiopathic arthritis	84 (24)	-	-
Kidney conditions	44 (12)	-	-

Results are presented in n (%), median (minimum-maximum values), mean (standard deviation).
NA, not applicable to assess Pearson's chi-square test; VAS, visual analog scale in the last month (scale 0−10).

Discussion

The present study demonstrated that preexisting chronic immunosuppressed and/or immune-mediated conditions in adolescence were not associated with major physical and mental health indicators during quarantine for the COVID-19 pandemic. Nevertheless, one-third of adolescents with chronic conditions presented high levels of psychopathology, particularly those patients with a previous diagnosis of mental disorders. Adolescents with abnormal levels of psychopathology were more frequently females, which had more fear of underlying disease activity/complication, more household members working outside of the home, less school homework, and less physical activity than those with borderline/normal levels of psychopathology.

The proportion of patient's abnormal levels of psychopathology following self-rated SDQ (30%) in the current study was similar to the frequencies of mental issues experienced by healthy adolescents (13−40%) during pandemic.[23] Household members working outside of home and fear of underlying disease activity/complication during quarantine could have had a negative impact on psychosocial well-being among young patients with chronic conditions. Indeed, the presence of family members working outside of the home and disease flare during the pandemic may have induced worries, loneliness and fear of SARS-CoV-2 infections in these adolescents.

In addition, adolescents with chronic conditions and abnormal levels of psychopathology were more frequently girls, which is consistent with the literature showing higher

Table 2 Demographic data, information, and impact of coronavirus infectious disease 2019 (COVID-19) pandemic reported by adolescents with preexisting chronic immunosuppressed and/or immune-mediated conditions during quarantine according to total difficulties of Strengths and Difficulties Questionnaire Scores (SDQ) categories: abnormal and normal/borderline.

Variables	Abnormal (n = 102)	Normal/borderline (n = 240)	p
Socio-demographic			
Age	14 (11-17)	15 (11-17)	0.828
Female sex	75 (74)	135 (56)	0.003
Caucasians	48 (47)	127 (53)	0.321
Number of rooms in the residence			
≤ 5	63 (62)	131 (55)	0.220
> 5	39 (38)	109 (45)	
Number of household's members in the residence			
≤ 3	31 (30)	78 (33)	0.702
>3	71 (70)	162 (67)	
Educational data			
Level of schooling			
Elementary school	66 (65)	135 (56)	NA
Middle school	31 (30)	83 (35)	
High school	4 (4)	14 (6)	
Not studying	1 (1)	8 (3)	
Attending school before COVID-19 pandemic	91 (89)	202 (84)	0.223
Online teaching-learning during COVID-19 pandemic	78 (76)	207 (86)	0.040
Public school	82 (80)	172 (72)	0.091
School homework during COVID-19 pandemic			
No homework	24 (24)	33 (14)	0.032
≤ 3 hours/day	44 (43)	97 (40)	
> 3 hours/day	34 (33)	110 (46)	
Healthcare routine during the pandemic			
Medical appointment before the pandemic			
Once every 2 months or less	54/95 (57)	119/227 (52)	0.592
Once every 3 months	27/95 (28)	64/227 (28)	
Once every 4 months or more	14/95 (15)	44/227 (20)	
Medical appointment during the pandemic			
Discontinued	33/95 (35)	79/227 (35)	0.988
Decreased	38/95 (40)	89/227 (39)	
Unchanged	24/95 (25)	59/227 (26)	
Forgetting to take your medication			
Without forgetting	56/91 (61)	153/212 (72)	0.164
1-2 days	29/91 (32)	51/212 (24)	
≥ 3 days	6/91 (7)	8/212 (4)	
Seasonal influenza vaccine use	65(64)	170 (71)	0.197
General information of COVID-19 pandemic			
COVID-19 information source			
Family and friends	10 (10)	16 (7)	0.530
Health professionals	4 (4)	13 (5)	
Social media/television/radio	88 (86)	211 (88)	
Reliable COVID-19 information	69 (68)	185 (77)	0.070
Compliance to "stay-home" policy	95 (93)	234 (98)	0.066
Impact of COVID-19 quarantine			
Households members with COVID-19	21 (21)	27 (11)	0.023
Life routine changed after the "physical distancing" policy	96 (94)	220 (92)	0.434
Housework			
No housework	28 (28)	54 (22)	0.064
≤ 1 h/day	37 (36)	120 (50)	
> 1 h/day	37 (36)	66 (28)	
Taking care of elderly people			
Not taking care	80 (78)	178 (74)	0.689
≤ 1 h/day	9 (9)	27 (11)	
> 1 h/day	13 (13)	35 (15)	

Table 2 (*Continued*)

Variables	Abnormal (*n* = 102)	Normal/borderline (*n* = 240)	p
Physical activity per week (VAS scale 0−10)	1.1 (0-10)	2.9 (0-10)	<0.001
Reduction of sleep duration	51 (50)	68 (28)	0.0002
Sleep time delay	72 (71)	141 (59)	0.039
Screen time			
≤ 3 h/day	11 (11)	24 (10)	0.158
4−6 h/day	38 (37)	116 (48)	
≥ 7 h/day	53 (52)	100 (42)	
Screen time increased during pandemic	91 (89)	204 (85)	0.300
Alcohol use during pandemic			
Increased	1 (1)	0 (0)	NA
Did not change	1 (1)	2 (1)	
Decreased	1 (1)	3 (1)	
Do not drink alcohol	99 (97)	235 (98)	
Financial status during the pandemic			
Worsen,	48 (47)	75 (32)	NA
Did not change	51 (50)	157 (65)	
Improve	3 (3)	8 (3)	
Household members working outside of home	98 (96)	196 (82)	< 0.001
Intrafamilial violence during pandemic	28 (28)	41 (17)	0.029
VAS (0-10)			
Fear of COVID-19	7.0 (0-10)	6.2 (0-10)	0.342
Fear of underlying disease activity/complication	7.7 (0-10)	5.1 (0-10)	< 0.001
Fear of immunosuppressive use	5.0 (0-10)	5.0 (0-10)	0.059
Preexisting health conditions			
Gastrointestinal and liver conditions			
Inflammatory bowel disease	13 (13)	30 (13)	1.000
Celiac disease	4 (4)	8 (3)	0.756
Eosinophilic esophagitis	8 (8)	15 (6)	0.638
Autoimmune hepatitis	8 (8)	18 (8)	1.000
Liver transplantation	14 (13)	36 (15)	0.868
Rheumatologic conditions			
Childhood systemic lupus erythematosus	15 (15)	28 (12)	0.477
Juvenile dermatomyositis	8 (8)	15 (6)	0.638
Juvenile idiopathic arthritis	26 (25)	57 (24)	0.783
Kidney condition	6 (6)	33 (13)	0.040

Results are presented in n (%), median (minimum-maximum values).
NA, not applicable to assess Pearson's chi-square test; VAS, visual analog scale in the last month (scale 0−10).

rates of internalizing disorders in females compared to males.[24] Importantly, school homework and physical activity were protective factors for mental health. Because of the burden of school closures during the COVID-19 pandemic, the adolescents may have benefited from digital and broadcast remote learning with regular school homework, contributing to the improvement of their psychosocial functioning. Furthermore, this study noticed that psychopathology was correlated with excessive fear of immunosuppressive medication use. The exposure of immunosuppressed patients as a risk group for a more severe COVID-19 infection probably accounted for this exacerbated feeling of awareness.[25]

It is likely that the closure of schools, gym facilities, and public parks, trails, beaches, remote learning, and cancelation of sports competitions contributed to changes in the daily routine and lifestyle of adolescents with chronic conditions, which may lead to reductions in physical activity and sleep quality in the teens during COVID-19 pandemic, as also reported by others studies.[26]

In contrast with with authors' findings, there are reports that children and adolescents with chronic conditions had better mental status during the COVID-19 pandemic. The pediatric population with inflammatory bowel disease had the highest scores of social functioning during the COVID-19 pandemic, and without relevant impact on health-related quality of life (HRQoL) parameters.[27] Indeed, there are opportunities that may be associated with reduction of mental health issues in adolescents with chronic illnesses, such as reduced educational stress, increased time with relatives, reduced access to licit and illicit drugs, easier access to health care using the online appointment, and a unique opportunity to improve resilience.[28]

It is important to highlight that approximately 10% of the adolescent patients had a diagnosis of the mental disorder before the sanitary crisis. This result is supported by a meta-analysis that showed that the worldwide prevalence of mental disorders in children and adolescents is 13% on average.[29] In addition, youths with preexisting psychopathologies are at

Table 3 Demographic data, information reported, and impact of coronavirus infectious disease 2019 (COVID-19) pandemic reported by adolescents with preexisting chronic immunosuppressed and/or immune-mediated conditions and previous psychiatric disorder versus adolescents with preexisting immunosuppressed and/or immune-mediated chronic conditions without psychiatric disorder during quarantine.

Variables	With previous psychiatric disorder (*n* = 31)	Without psychiatric disorder (*n* = 323)	p
Socio-demographic			
Age	15 (11-18)	14 (10-18)	0.062
Female sex	19 (61)	195 (60)	0.920
Caucasians	16 (52)	164 (51)	0.929
Number of rooms in the residence			
≤ 5	20 (65)	184 (57)	0.416
> 5	11 (35)	139 (43)	
Number of households member in the residence			
≤ 3	12 (39)	101 (31)	0.396
>3	19 (61)	222 (69)	
Educational issue,			
Level of schooling			
Elementary school	19 (61)	192 (59)	NA
Middle school	12 (39)	104 (32)	
High school	0 (0)	18 (6)	
Not studying	0 (0)	9 (3)	
Attending school before COVID-19 pandemic	24 (77)	281 (87)	0.140
Online teaching-learning during COVID-19 pandemic	22 (71)	272 (84)	0.077
Public school	25 (81)	240 (74)	0.437
School homework during COVID-19 pandemic			
No homework	9 (29)	51 (16)	0.046
≤ 3 h/day	15 (48)	133 (41)	
> 3 h/day	7 (23)	139 (43)	
Healthcare routine during the pandemic			
Medical appointment before the pandemic			
Once every 2 months or less	23/29 (79)	160/305 (53)	0.015
Once every 3 months	5/29 (17)	86/305 (28)	
Once every 4 months or more	1/29 (4)	59/305 (19)	
Medical appointment during the pandemic			
Discontinued	6/29 (21)	109/305 (36)	0.242
Decreased	13/29 (45)	119/305 (39)	
Unchanged	10/29 (34)	77/305 (25)	
Forgetting to take your medication			
Without forgetting	22 (71)	196/282 (69)	NA
1−2 days	5 (16)	76/282 (27)	
≥ 3 days	4 (13)	10/282 (4)	
Seasonal influenza vaccine use	24 (80)	221 (69)	0.203
General information of COVID-19 pandemic			
COVID-19 information source			
Family and friends	4 (13)	23 (7)	NA
Health professionals	1 (3)	17 (5)	
Social media/television/radio	26 (84)	283 (88)	
Reliable COVID-19 information	20 (64)	243 (75)	0.200
Compliance to “stay-home” policy	27 (87)	314 (97)	0.019
Impact of COVID-19 quarantine			
Households members with COVID-19	8 (26)	41 (13)	0.043
Life routine changed after the “physical distancing” policy	27 (87)	301 (93)	0.214
Housework			
No housework	8 (26)	78 (24)	0.408
≤ 1 h/day	11 (35)	152 (47)	
> 1 h/day	12 (39)	93 (29)	

Table 3 (*Continued*)

Variables	With previous psychiatric disorder (*n* = 31)	Without psychiatric disorder (*n* = 323)	p
Taking care of elderly people			
Not taking care	22 (71)	247 (77)	0.648
≤ 1 hours/day	3 (10)	33 (10)	
> 1 hours/day	6 (19)	43 (13)	
Physical activity per week (VAS 0−10)	1.1 (0-9.8)	2.5 (0-10)	0.063
Reduction of sleep duration	16 (52)	107 (33)	0.048
Sleep time delay	18 (58)	203 (63)	0.599
Screen time			
≤ 3 h/day	1 (3)	36 (11)	0.361
4−6 h/day	14 (45)	144 (45)	
≥ 7 h/day	16 (52)	143 (44)	
Screen time increased during pandemic	28 (90)	279 (86)	0.782
Alcohol use during pandemic			
Increased	0 (0)	1 (0)	NA
Did not change	0 (0)	3 (1)	
Decreased	1 (3)	3 (1)	
Do not drink alcohol	30 (97)	316 (98)	
Financial status during the pandemic			
Worsen,	19 (61)	108 (33)	NA
Did not change	12 (39)	203 (63)	
Improve	0 (0)	12 (4)	
Household members working outside of home	24 (77)	280 (87)	0.157
Intrafamilial violence during pandemic	8 (26)	61 (19)	0.353
VAS (0-10)			
Fear of COVID-19	7.3 (0-10)	6.1 (0-10)	0.970
Fear of underlying disease activity/complication	7.2 (0-10)	5.8 (0-10)	0.213
Fear of immunosuppressive use	5.0 (0-10)	5.0 (0-10)	0.171
Preexisting health conditions			
Gastrointestinal and liver conditions			
Inflammatory bowel disease	6 (19)	38 (12)	0.249
Celiac disease	3 (10)	9 (3)	0.087
Eosinophilic esophagitis	1 (3)	22 (7)	0.707
Autoimmune hepatitis	3 (10)	25 (8)	0.724
Liver transplantation	0 (0)	53 (16)	0.008
Rheumatologic conditions			
Childhood systemic lupus erythematosus	6 (19)	37 (11)	<0.001
Juvenile dermatomyositis	2 (6)	21 (7)	0.022
Juvenile idiopathic arthritis	6 (19)	78 (24)	0.662
Kidney condition	4 (13)	40 (12)	1.000
Strengths and Difficulties Questionnaire Scores (SDQ)			
Total difficulties score (0−40)	19 (5-32)	13 (0-29)	0.001
Abnormal total difficulties score	18 (58)	84 (27)	<0.001
Peer problems (0−10)	3 (1-10)	2 (0-9)	0.001
Emotional problems (0−10)	6 (0-10)	4 (0-10)	0.005
Emotional disorders	16 (52)	93 (30)	0.013
Conduct problems (0−10)	3 (0-8)	2 (0-9)	0.007
Conduct disorders	9 (29)	47 (15)	0.046
Hyperactivity/inattention (0−10)	5 (1-10)	4 (0-10)	0.034
Hyperactivity or inattention disorder	11 (36)	68 (22)	0.086
Prosocial (0-10)	7 (3-10)	8 (1-10)	0.007
Impact score (0-10)	1 (0-9)	0 (0-10)	0.050

Results are presented in n (%), median (minimum-maximum values).
NA, not applicable to assess Pearson's chi-square test; VAS, visual analog scale in the last month (scale 0−10).

greater risk to show worse mental outcomes during the COVID-19 pandemic.[23] This study observed that patients with mental disorders also had poorer sleep quality. During this pandemic, adolescents may have reduced exposure to sunlight and prolonged day naps, contributing to sleep quality abnormalities and insomnia.[26] Therefore, regular sleep

Table 4 Strengths and Difficulties Questionnaire (SDQ) scores reported by adolescents with gastrointestinal and liver conditions versus adolescents with rheumatologic conditions versus adolescents with kidney conditions during quarantine of coronavirus infectious disease 2019 (COVID-19) pandemic.

SDQ domains (score)	Gastrointestinal and liver conditions (*n* = 154)	Rheumatologic conditions (*n* = 149)	Kidney conditions (*n* = 44)	p
Total difficulties score (0-40)	14 (0—30)	14 (1—32)	10 (0—24)	0.707
Abnormal total difficulties score	47 (31)	49 (33)	6 (15)	0.101
Peer problems (0-10)	2 (0—8)	2 (0—10)	2 (0—10)	0.898
Emotional problems (0-10)	4 (0—10)	5 (0—10)	3 (0—10)	0.073
Emotional disorders	43 (28)	57 (38)	9 (23)	0.071
Conduct problems (0-10)	2.5 (0—9)	2 (0—8)	2 (0—6)	0.475
Conduct disorders	28 (18)	24 (16)	4 (10)	0.486
Hyperactivity/inattention (0-10)	5 (0—10)	4 (0—10)	4 (0—9)	0.866
Hyperactivity or inattention disorder	36 (23)	38 (25)	5 (14)	0.245
Prosocial (0-10)	8 (1—10)	8 (4—10)	8 (0—10)	0.551
Impact score (0-10)	0 (0—10)	0 (0—8)	0 (0—5)	0.435

Results are presented in n (%), median (minimum-maximum values).

patterns and screen time parental control should be reinforced for these patients during quarantine.

The main strength of the present study was the assessment of a particularly high-risk subgroup of adolescents followed on a tertiary hospital with complex, chronic immunocompromised conditions who were quarantined during the COVID-19 pandemic. The inclusion of healthy controls and study groups balanced by age and sex was relevant herein, since both parameters may influence psychosocial functioning. Another positive feature of the study was the use of an international and self-reported validated tool with high reliability to measure psychosocial functioning in adolescents.[20,30] The authors also used an overall semi-structured self-reported survey, including broad information on teen habits and issues, allowing for a comprehensive characterization of this cohort.

This study has limitations. It had a cross-sectional design, thus causal relationships cannot be inferred, nor is it possible to determine whether and how the mental disorders reported in this study changed across the course of the pandemic. The authors did not assess validated coping, resilience, and sleep tools that are relevant factors for adolescents during this catastrophic COVID-19 pandemic.[20] The lack of evaluation of disease activity/damage parameters for each chronic condition was also a limitation since face-to-face appointments were postponed during the pandemic, precluding collecting these data. Also, it is important to note that telemedicine was implemented at the study's university hospital during this pandemic in order to meet the demand of vulnerable adolescents. Moreover, the sample size of adolescents with rare chronic conditions was relatively small and not nationally representative, therefore caution should be exercised in generalizing these findings. An additional limitation was the low number of healthy adolescent subjects observed herein, which is partially due to the difficulty to engage healthy adolescents to take part in research during the pandemic. The authors also did not assess validated tools of sleep quality and HRQoL parameters herein, and further study will be necessary for adolescents with these immunosuppressed chronic conditions. The impact of psychological functioning according to each different group of chronic conditions will also be required.

In conclusion, this study showed that adolescents with preexisting chronic immunosuppressed and/or immune-mediated conditions do not present higher rates of adverse outcomes during the pandemic. Nevertheless, one-third of them present high levels of psychopathology, which is associated with relevant demographic and health indicators This study reinforces the need for identifying at-risk individuals and deliver preventive strategies, particularly in this period of worldwide sanitary emergency.

Authorship criteria

All named authors approved the final draft of the manuscript, approved the submission to the Journal, and be willing to take responsibility for it in its entirety.

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Conflicts of interest

The authors declare no conflicts of interest.

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Supplementary materials

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