ORIGINAL ARTICLE/ ARTIGO ORIGINAL

Effects of the COVID-19 Pandemic on the Risk of Developing Psychopathology in Children in Portugal: A Cross-Section Study
Efeitos da Pandemia COVID-19 no Risco de Desenvolvimento de Psicopatologia das Crianças em Portugal: Um Estudo com Dados Seccionais

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ABSTRACT

Introduction: This study is based on preliminary data from a 2021 survey of parents of children aged 3-13 years at the time of SARS-CoV-2 infection. The aim is to understand the consequences of SARS-CoV-2 infection on children's mental health.

Methods: Using the Strengths and Difficulties Questionnaire (SDQ) and survey data, we specified multiple linear regression models to explain the variation in the total SDQ and the variation in its five components - emotional symptoms, conduct problems, hyperactivity, peer relationship problems, and prosocial behaviour. We used explanatory variables selected according to current literature and other empirical studies, such as age, gender, household changes, confinement, hospitalization time, previous mental health care and long-COVID symptoms (headache, sleep problems, concentration problems, fatigue).

Results: The results showed that age was not statistically significant in any of the estimated models. The gender variable proved to be significant in three models (total SDQ, conduct problems, hyperactivity) and the results show that girls have fewer problems when compared to boys.

Conclusion: Results suggest that intensive care hospitalisation and long-COVID symptoms increase the risk of psychopathology.

RESUMO

Introdução: Este estudo baseia-se nos dados preliminares de um inquérito feito no ano 2021 aos pais de crianças com idades compreendidas entre os 3 e os 13 anos à data da infeção por SARS-CoV-2. O objetivo é compreender os efeitos da infeção por SARS-CoV-2 na saúde mental das crianças.

Métodos: Utilizando o Questionário de Capacidades e Dificuldades e os dados do inquérito, especificámos modelos de regressão linear múltipla para explicar a variação do SDQ total e a variação das suas cinco componentes - sintomas emocionais, problemas de comportamento, hiperatividade, problemas de relacionamento, comportamento pró-social. Foram utilizadas variáveis explicativas consideradas relevantes pela teoria e por outros estudos empíricos, tais como: idade, género, alteração familiar, confinamento, tempo de internamento, seguimento de saúde mental prévio e sintomas *long*-COVID (cefaleias, problemas do sono, da concentração, fadiga).

Resultados: Os resultados evidenciaram que a idade não se revelou estatisticamente significativa em nenhum dos modelos estimados. A variável género revelou-se significativa em três modelos (SDQ total, problemas do comportamento, hiperatividade) e os resultados evidenciam que raparigas têm menos problemas quando comparadas com os rapazes.

Conclusão: Os resultados sugerem que o internamento em cuidados intensivos e os sintomas *long*-COVID aumentam o risco de psicopatologia

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INTRODUCTION

There is empirical evidence that the pandemic of COVID-19 has affected the mental health of children and adolescents and that these effects are persistent in the long term.[1-7] The World Health Organisation (WHO) has also expressed concern about these long-term symptoms, which have come to be referred to as long-COVID or post-COVID-19 syndrome - persistent symptoms of fatigue, dyspnea, cognitive problems, sleep problems, concentration problems, headaches, muscle pain and heart problems.[8-12]

The National Institute for Health and Care Excellence (NICE) published guidance on the long-term effects of COVID-19 in 2020. The long-COVID concept is used " to describe signs and symptoms that continue or develop after acute COVID-19. It includes both ongoing symptomatic (from 4 to 12 weeks and post-COVID-19 syndrome (12 weeks or more)".[13]

The Strengths and Difficulties Questionnaire (SDQ) is one of the most used questionnaires to assess mental health problems in children and adolescents.[1-6,14-20]

The SDQ presents 25 statements .There are five domains (conduct problems, emotional symptoms, hyperactivity, peer problems, prosocial behavior) and five items for each domain.[19]

Some authors used the SDQ and an econometric model with panel data and concluded that the health quality of children and adolescents decreased during the pandemic and that depressive, anxiety and psychosomatic symptoms increased. The study suggests that female gender and older people had fewer mental health problems and that a healthy family environment and social health support improve the mental health of children and adolescents.[1]

Long-COVID affects children severely with sleep problems, headaches, concentration problems and fatigue being some of the most prevalent symptoms. Therefore, international guidance is essential to treat long-COVID in children and ongoing research is needed to assess the impact of new variants.[10,21-22]

In Portugal, COVID-19 has also profoundly changed the lives of children and adolescents.[23-28]

All these studies aim to find out how COVID-19 has influenced the mental health of children and adolescents.

Therefore, the main aim of this research is to analyse the changes in the mental health of children and adolescents using the SDQ and its five subscales (emotional symptoms, conduct problems, hyperactivity, relationship problems and prosocial behaviour) and see what are their main explanatory factors. A second aim of the study is to compare our results with the results of other studies that used the SDQ and econometric models to explain the effects of COVID-19 on mental healthy of children and adolescents in Portugal and in other countries.

MATERIAL AND METHODS

The eligible population for this study was based on the number of children aged between 3 and 13 years old at the date of SARS-CoV-2 infection, who had been followed at the Department of Infectious Diseases of the Dona Estefânia Hospital (inpatient and/or outpatient) from March 2020 to April 2021. The caregivers of the children who met the inclusion criteria were contacted by phone to explain the summary objectives of the study and collect the caregiver's email address.

A form was then sent with the respective informed consent. This form included questions from a questionnaire developed by The Long COVID ISARIC Study Group which assesses the long-term impact of COVID-19 on children's health and well-being and the SDQ questionnaire. The final sample included all individuals from the eligible population whose caregivers responded to at least one of the two telephone invitations to the study. The following situations were defined as exclusion criteria: institutionalized or emigrated patients at the time of the telephone contact.

The survey was sent to 85 people and the sample size was not defined a priori. Later more questionnaires were received. In total we got 117 responses. However, the need to present the study at a national conference in 2021 meant that only the 85 surveys available at the time were used.

Based on the collected data we specified several cross--section multiple linear regression models to explain the variation in the total SDQ and its five subscales. We used the following explanatory variables defined as follows:

Table 1. Definition of explanatory variables

Explanatory variables	Definition
AGE	Quantitative variable ; 3£ Age£ 13;
GENDER	Qualitative variable; =0, if it´s a boy; =1, if it´s a girl;
INFECTION IN THE FAMILY	= 0, if there is no infections; =1, otherwise;

Explanatory variables	Definition
FAMILY CHANGE	= 0, if there is no change; =1, otherwise;
HOME CONFINEMENT	= 0, if absence from kindergarten or school is less than 1 month; =1, otherwise;
HOSPITALISATION TIME	= number of days;
INTENSIVE CARE HOSPITALISATION	= 0, if the patient has not been in intensive care; =1, otherwise;
PREVIOUS CHRONIC DISEASES	= number of chronic illnesses before Covid-19 infection;
PREVIOUS MENTAL HEALTH CARE	= 0, if patient had no previous follows-up; =1,otherwise;
LONG COVID HEADACHES	= 0,if patient had no symptoms or they were less than 1 month; =1, otherwise;
LONG COVID SLEEP PROBLEMS	= 0,if patient had no symptoms or they were less than 1 month; =1, otherwise;
LONG COVID CONCENTRATION PROBLEMS	= 0,if patient had no symptoms or they were less than 1 month; =1, otherwise;
LONG COVID FATIGUE	= 0,if patient had no symptoms or they were less than 1 month; =1, otherwise;
SLEEP PROBLEMS	= 0, if patient had no sleep problems after Covid infection; =1, otherwise;
GENERAL HEALTH POST COVID	= 0, if the health is very bad, bad or fair; =1, otherwise.

The usual assumptions of econometric models (normality and homoscedasticity of the random residual variable and exogeneity of the regressors) are respected.

We used the IBM Statiscal Package for Social Sciences (IBM SPSS), version 28 to estimate the parameters of the regression equations.

The study was approved by the Ethics Committee of Hospital Dona Estefânia (with the reference 1098/2021).

RESULTS

The descriptive statistics of the quantitative variables used in the regression equations allow us to characterize the distribution of the values of each variable: minimum value and maximum value, mean, median and mode, standard deviation and asymmetry of the distribution (whether the values are concentrated near the lowest values or near the highest.)

Table 2. Descriptive statistics of quantitative variables used in the models

	SDQ total	Emotional Symptoms	Conduct Problems	Hyperactivity	Peer Relationship Problems	Prosocial Behaviour	Age	Hospitalisation Time	Previous Chronic Diseases
N	85	85	85	85	85	85	85	85	85
MEAN	10.67	2.64	1.91	4.49	1.64	8.39	9.32	2.47	0.66
MEDIAN	10.00	2.00	2.00	4.00	1.00	9.00	10.00	0.00	0.00
MODE	9.00	1.00	1.00	4.00	0.00	10.00	13.00	0.00	0.00
STANDARD DEVIATION	5.169	1.908	1.501	2.515	1.580	1.677	2.748	4.447	0.983
SKEWNESS	0.306	0.540	-0.402	0.364	0.997	-1.306	-0.217	1.814	1.817
MINIMUM	1	0	0	0	0	2	4	0	0
MAXIMUM	25	8	6	10	7	10	13	18	5

By analysing Table 2 we can see: the median occurs for low values of all variables (it means that at least 50% of the values are low values), except for the variables prosocial behaviour and age. Generally we have a positive asymmetry (mean > median, i.e. mean-median > 0) which reflects a skewness to the right of the distribution of the variable values (values are concentrated near the lowest values). The median age value (10) means that at least 50% of the children are 10 years old or younger. For the mode, the most frequent value is 13. It should be noted that hospitalization time varies between 0 and 18 days. The median in the hospitalisation time is equal to zero, meaning that at least 50% of the children have not been hospitalised. The number of previous chronic diseases varies between 0 and 5. The median value is also 0, meaning that at least 50% of the children had no previous chronic illness. As to the total SDQ, we found that the median is 10, meaning that at least 50% of the children have a score equal to or lower than 10, in a maximum of 25 (total SDQ varies between 0 and 40).

Table 3. Estimation Results

Independent Variables	SDQ total (I)	SDQ total (II)	Emotional Symptoms	Conduct Problems	Hyperactivity	Peer Relationship Problems	Prosocial Behaviour
Constant	17.04	14.20	3.82	2.04	4.34	0.88	7.17
	(4.96)***	(6.13)***	(4.01)***	(7.77)***	(10.62)***	(1.30)	(8.73)***
AGE	-0.07					0.08	
	(-0.34)					(1.34)	
GENDER	-1.68	-1.97		-0.78	-1.57	0.12	0.13
	(-1.54)	(-1.90)*		(-2.44)**	(-3.22)***	(0.36)	(0.34)
INFECTION IN THE FAMILY	-0.80		0.42			1.49	-0.33
	(-0.70)		(0.99)			(-1.40)	(-0.86)
FAMILY CHANGE	2.63	2.32	0.69	0.19		0.44	-0.41
	(1.73)*	(1.57)	(1.19)	(0.42)		(-1.24)	(-0.81)
HOME CONFINEMENT	-0.97						1.04
	(-0.79)						(2.66)***
HOSPITALISATION TIME	-0.34	-0.34	-0.10	-0.06	-0.08		
	(-2.04)**	(-2.19)**	(-1.59)	(-1.28)	(-1.12)		
INTENSIVE CARE HOSPITALISATION	6.04	6.05	1.23	1.60	2.19		
	(2.31)**	(2.37)**	(1.27)	(2.02)**	(1.82)*		
PREVIOUS CHRONIC DISEASES	0.99	0.88	0.21	0.24	0.49		
	(1.83)*	(1.68)*	(1.01)	(1.46)	(2.00)**		
PREVIOUS MENTAL HEALTH CARE	3.05	2.82			1.74	0.65	
	(2.40)**	(2.32)**			(3.02)***	(1.59)	
LONG COVID HEADACHES	3.26	3.05		1.40	0.63	0.11	
	(1.29)	(1.23)		(1.81)*	(0.54)	(0.38)	
LONG COVID SLEEP PROBLEMS	4.41	4.09	-064	0.56	2.74	0.79	-1.72
	(2.15)**	(2.03)**	(-0.86)	(0.90)	(2.89)***	(1.19)	(.2.72)***
LONG COVID CONCENTRATION PROBLEMS	1.57	1.41		-0.37	0.28	1.36	
	(0.71)	(0.65)		(-0.55)	(0.28)	(1.88)*	
LONG COVID FATIGUE	-3.11	-2.94		(-0.60	-1.69	-0.59	0.95
	(-1.81)*	(-1.75)*		(-1.15)	(-2.13)**	(-1.06)	(1.84)*
SLEEP PROBLEMS			0.97				
			(1.95)*				
GENERAL HEALTH POST COVID	-4.96	-4.47	-1.92				1.90
	(-2.16)**	(-2.04)**	(-2.22)**				(1.19)
N	85	85	85	85	85	85	85
Adjusted R ^{2}	0.207	0.221	0.103	0.103	0.264	0.079	0.098
F	2.568	3.172	2.210	2.068	4.344	1.717	2.306
	[0.005]	[0.001]	[0.036]	[0.043]	[0.001]	[0.093]	[0.034]

Doing the analysis of Table 3 equation by equation we have:

SDQ TOTAL (I): This is a general model in which all explanatory variables were included. We have 8 statistically significant independent variables (household changes, hospitalization time, intensive care hospitalisation, number of previous chronic diseases, previous mental health care, long-COVID fatigue and general health post-COVID). As regards the sign of the coefficients of these variables, two of the explanatory variables (hospitalisation time and long-COVID fatigue) had a negative sign, while the theoretically expected sign was positive.

TOTAL SDQ (II): The reduced form of the total SDQ model has three fewer explanatory variables in the model (these three variables are not statistically significant in the general model) and compared to the general model also eight statistically significant explanatory variables. The only change is that we now have the gender variable significant and the household changes is no longer statistically significant. The signs of the coefficients of the variables remained the same from the general model to the reduced model. It should be noted that the coefficient of the gender variable is -1.97, meaning that in the case of girls, the total SDQ has a lower score of 1.97 points when compared to boys. Therefore, girls in this age group (4-13 years old) have a lower risk of psychopathology. This data confirms what the literature defends.[29] Considering the principle of parsimony and the F test, this is a preferable specification.

EMOTIONAL PROBLEMS: In the emotional problems model we have two statistically significant variables (sleep problems and general health post-COVID). The variable sleep problems has a positive estimated coefficient and corresponds to what was theoretically expected. This means that an increase in sleep problems leads to an increase in emotional problems. The general health post--COVID variable has a negative coefficient meaning that an increase in general Health post-COVID leads to a decrease in emotional problems, as was theoretically expected. Note that the long-COVID sleep problems variable is not statistically significant.

CONDUCT PROBLEMS: In the conduct problems equation we have three statistically significant explanatory variables (gender, intensive care hospitalisation and long--COVID headaches) and all with the sign of the estimated coefficients equal to the theoretically expected sign. The variable gender has a negative estimated coefficient meaning that girls in relation to boys have fewer conduct problems. The intensive care hospitalisation variable has a positive estimated coefficient meaning that intensive care hospitalisation increases conduct problems. And the variable long-COVID Headaches also has a positive estimated coefficient meaning that the increase in this variable leads to an increase in conduct problems.

HYPERACTIVITY: In the hyperactivity equation, we have six statistically significant explanatory variables (gender, intensive care hospitalisation, previous chronic diseases, previous mental health care, long-COVID sleep problems and long-COVID fatigue). The gender variable

continues to have a negative effect on the dependent variable, i.e. girls on the hyperactivity scale score 1.57 points less compared to boys. Hospitalisation in intensive care increases the risk of hyperactivity. Similarly, when the number of previous chronic illnesses increases by one unit, the hyperactivity scale increases by 0.49 points. As for the variable previous mental health care, it has a positive coefficient with a value of 1.74. This result indicates that individuals who have been previously followed-up in mental health have a hyperactivity scale score 1.74 points higher than those who have not been followed-up. As for the variable long-COVID sleep problems, the estimated coefficient indicates that individuals with this symptom have a higher score in the hyperactivity scale than those who had no sleep problems or had this symptom for less than one month. The variable long-COVID fatigue has a negative coefficient, contrary to what was theoretically expected.

PEER RELATIONSHIP PROBLEMS: In the peer relationship problems model there is only one statistically significant variable for a significance level of 10% (long-COVID concentration problems, with a positive coefficient sign).

PROSOCIAL BEHAVIOUR: In the pro-social behavior equation we have three significant explanatory variables (confinement, long-COVID sleep problems and long--COVID fatigue). Note that the variables confinement and sleep problems long-COVID are strongly significant (significance level equal to 1%). As for the signs of the coefficients, confinement has a positive coefficient that was not theoretically expected. A possible explanation is that confinement has enhanced joint relationships and activities within the household, aspects that were not assessed in the parents' survey. Other authors who have looked at the impact of confinement on mental health have used explanatory variables that reflected family conditions such as the relationship of adolescents with parents and friends and the activities maintained by adolescents.[30] As for the coefficient of the variable sleep problems long-COVID, it is a negative coefficient, as was theoretically expected.

DISCUSSION

Analysing the descriptive statistics table we can see that the median value for the total SDQ is 10, which means that at least 50% of the children have a normal score (normal score ranges from 0 to 13). That is, at least 50% of the children do not present a risk of psychopathology.

Regarding the age variable we found that the age range of this sample varies between 4 and 13 years and that at least 50% of the children are 10 years old or younger. The results obtained do not include young people aged 14 years and above, which may be a limitation of our study.[22] It should be noted that the Co-SPACE studies involve children and teenagers from 4 to 16 years old with more than 8700 answers to an online questionnaire using the SDQ.[2-5]

Regarding the multiple regression equations (Table 3) we found that in the total SDQ model, in its general form, with all explanatory variables (SDQI) and reduced form,

with fewer explanatory variables, (SDQII), most of the variables are statistically significant.

Concerning the variable age, an important socio--demographic variable in this type of studies,[2,3,6,7,31] was not significant in any of the models. This may be related to the fact that the age range of the sample was between 4 and 13 years, including only 5 adolescents in the sample.

Regarding the gender variable, which was significant in three models (SDQII, conduct problems and hyperactivity) the results show that girls have fewer problems compared to boys. Other studies confirm that girls experienced fewer mental health problems compared to boys during the COVID-19 pandemic.[1,3] However, Schum et al[3] concluded that boys have more conduct problems than girls, but as far as emotional problems are concerned, girls suffer more. According to these authors, conduct problems and emotional symptoms are worse in children with special educational needs and neurodevelopmental differences. Other authors also found that boys compared to girls had a smaller increase in emotional problems but a greater decrease in prosocial tendencies. The negative impacts on mental health were greater in one-parent and lower income families. Mental health effects on adolescents also varied according to pre-pandemic mental health status.[6]

The hospitalization time variable shows a negative coefficient, meaning that the more days of hospitalisation, the lower the risk of psychopathology. This result was not expected.

The Long-COVID sleep problems variable proved to be statistically significant for a significance level of at least 5% and with an estimated effect, equal to what was expected, in four models (SDQI, SDQII, hyperactivity and prosocial behaviour).

Although the adjusted R^2 are relatively low, which is frequent in models studying social behaviour and mental health problems, all models are valid (F-statistic).

To overcome the limitations found in the specification of some of the models it is necessary to introduce new explanatory variables and increase the sample size, preferably by continuing the survey in the next years. We could thus have panel data and the use of other estimators. Panel data also allows the introduction of lagged explanatory variables, namely the effect of the SDQ of the previous year.[6]

Stephenson et al[32] find that there is no diagnostic test for long COVID and that the symptoms of long COVID are caused by different factors-such as social isolation, anxiety, depression, educational problems-related to the pandemic and lockdown and not so much to the viral infection. This is a direction for future research to see if in the coming period without school closures and prolonged periods of confinement, SARS-CoV-2 infection will have the same impact on mental health.

CONCLUSION

The results suggest that intensive care hospitalisation increases the risk of psychopathology in general and conduct problems and hyperactivity in particular and that previous chronic diseases also contribute to an increased risk of psychopathology, especially hyperactivity.

Contrary to what was expected, the results show that an increase in hospitalisation time decreases the risk of psychopathology. One possible explanation for this result is the care provided by the medical and nursing team of the Infectious Diseases Department of the D. Estefânia Pediatric Hospital allowed for the creation of a stable and close environment, thus reducing the stress associated with the disease and hospital stay.

Regarding the long-COVID symptoms, we highlight that the long-COVID sleep problems variable increases the risk of psychopathology, especially hyperactivity, and decreases prosocial behaviour.

The girls had fewer conduct and hyperactivity problems than the boys.

Future research work needs to consider children with special education needs and relate gender differences to household income level.[3,18]

Proteção de Pessoas e Animais: Os autores declaram que os procedimentos seguidos estavam de acordo com os regulamentos estabelecidos pela Comissão de Ética responsável e de acordo com a Declaração de Helsínquia revista em 2013 e da Associação Médica Mundial.

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Declaração de Contribuição

IF: Redação do Manuscrito; Recolha de Dados; Revisão da Literatura; Análise Estatística.

HB e DS: Redação do Manuscrito; Recolha de Dados; Revisão da Literatura.

MT: Redação do Manuscrito; Revisão da Literatura.

JS: Revisão da Literatura; Revisão do Manuscrito.

Contributorship Statement

IF: Manuscript Writing; Data Collection; Literature Review; Statistical Analysis.

HB and DS: Manuscript Writing; Data Collection; Literature Review.

MT: Manuscript Writing; Literature Review.

JS: Literature Review; Manuscript Review

NOTES. The t-statistic is in round brackets. *, **, ***, statistically significant at 10%, 5%, 1%, respectively. The t-statistic tests the statistical significance of each regressor under the null hypothesis (Ho) of the regression coefficient being equal to 0. The F statistic tests the overall significance of the regression under the null hypothesis (Ho) that none of the explanatory variables has a significant effect on the dependent variable. All regression models pass the F-statistic test for a significance level of 1% and 5%, except the relationship problems model where the significance level is 10%.

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