

Asthmatic children and their mothers in COVID-19 pandemic: psychosocial impact of the virus outbreak in a post lockdown scenario

Daniela Di Riso

University of Padua

Silvia Spaggiari (✉ silvia.spaggiari@studenti.unipd.it)

University of Padua

Elena Cambrisi

University of Padua

Valentina Ferraro

University of Padua

Silvia Carraro

University of Padua

Stefania Zanconato

University of Padua

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Abstract

Italy has been the first country outside Asia to struggle with the COVID-19 outbreak. To contain the transmission of the virus, by March 10th, 2020, the Italian Government imposed strict domestic quarantine policies and temporary closure of non-essential businesses and schools. Although growing literature explored the impact of the pandemic on non-referred children and families, few studies focused on the psychosocial impact of Covid-19 in chronically ill children and their caregivers.

Methods. The present study investigated asthma control and children and mothers' psychological functioning (i.e.: psychological well-being, fear of contagion, and mothers' Covid-19 related fears) in 45 asthmatic children aged 7-to-14, compared to a control sample. They were administered an online survey after the lockdown (from the 28th May to 23rd August 2020).

Results. Results showed higher levels of concern for contagion for asthmatic children, but no difference in psychosocial functioning. Mothers reported more Covid-19 related fears, and greater worries according to the resumption of their children's activities. Moreover, they indicated a global worsening in their psychological well-being during the lockdown. Furthermore, as to the clinical sample, the multivariate regression model showed that a worsening of mothers' psychological and children's physical well-being was associated with a worsening of children's psychological well-being during the lockdown.

Conclusions. The results of this study indicate that mothers of asthmatic children can be more prone to experience psychological fatigue in a pandemic scenario. Special programs should be scheduled to sustain caregivers of chronically ill children.

1. Introduction

By the end of January 2020, the World Health Organization declared great concern about some cases of COVID-19 registered in China¹. Italy was the first country outside Asia and the first in Europe accounting for verified Coronavirus cases. On March 9th, the Italian Government ordered a national lockdown to limit the spread of COVID-19, imposing strict domestic quarantine policies, temporary closure of non-essential businesses and schools of every order and degree (Phase 1). These mandatory limitations changed over time, with a prudent reopening of selected commerce services (Phase 2 - from May 4th to June 14th) and softened movement restrictions (from May 18th). Phase 3 started on June 15th : Government authorized the resumption of all the activities, including recreation centers for children and adolescents with no more restrictions on people's mobility. Many studies focused on Italian children's physical and psychological functioning, reporting poor sleep quality and an increase in emotional symptoms, such as sadness or restlessness during Phase 1^{2, 3, 4}. Moreover, the extreme reduction of in-person contact with peers is reported to negatively affect children's perceived psychological well-being⁵. Concerning chronically ill children, literature stressed the importance to continue assuring therapy also in a home-confinement scenario, providing guidelines for specific chronic conditions (e.g. cancer⁶, cystic fibrosis⁷). Very few studies explored the psychological effects of the Covid-19 pandemic on chronically ill children and their families^{8,9,10}.

Asthma is the most common chronic disease in childhood. In the initial phases of the pandemic, patients with chronic lung diseases, including moderate-severe asthma and allergy were considered at a potential higher risk of developing severe COVID-19 than otherwise healthy people. Nonetheless, the association between asthma and COVID-19 was unclear and still debated at the beginning of the pandemic^{11,12,13,14}. According to epidemiological studies, it seems that during the home-confinement there have been a significant decrease in pediatric asthma admissions¹⁵. However, literature reported that children with milder symptoms of asthma could be more at risk of worsening their symptomatology, due to the priority given to severe respiratory diseases, the greater exposure to indoor noxious environments, or the decrease of medical in-person exams in COVID-19 scenario^{16,17,18}. Therefore, considering that asthma exacerbations in childhood are often related to viral infections, asthmatic children and their parents could be more worried about having worse outcomes if contracting COVID-19 and undertreating of eventual SARS-CoV-2 related respiratory symptoms¹⁹. Furthermore, the similarities between asthma and Covid-19 symptoms may represent another reason for concern for asthmatic children's mothers, also considering the gradual reopening of activities in a post lockdown scenario¹⁶. As far as we know, no previous studies explored the psychological impact of Coronavirus outbreak on asthmatic pediatric patients and their caregivers. Researches suggest that the risk of having respiratory attacks is associated with higher separation anxiety symptoms in asthmatic children, which may be amplified in a post lockdown scenario²⁰.

Moreover, the literature mention that mothers who report general psychosocial well-being are more prone to handle the management of their children's asthma and to contain their eventual concerns about the disease²¹.

The general aim of the present paper was to assess the psychological functioning and the Covid-19 related fears in a group of asthmatic children and their mothers in a post lockdown period, to evaluate the effects of home-confinement experiences (Phase 1) in a reopening scenario (Phase 2).

2. Methods

2.1. Subjects

Sixty-four asthmatic children aged 7 to 14 years and their mothers were recruited among those regularly followed at the Unit of Pediatric Allergy and Respiratory medicine of the Women's and Children's Health Department (University of Padova, Italy). Nineteen mothers did not agree to participate to this research. Therefore 45 asthmatic children and their mothers were enrolled. Exclusion criteria were comorbidity with psychiatric or other chronic diseases, poor comprehension of Italian language, severe asthma treated with biological drugs. Forty-one healthy children matched for age and gender to the clinical sample and their mothers were recruited as a control sample. Exclusion criteria were comorbidity with psychiatric or other chronic diseases, and poor comprehension of the Italian language. Mothers of the two groups did not differ according to age, schooling, occupation, and working situation during and after home-confinement.

2.2. Procedure

A survey online was administered from the 28th May to 23rd August 2020. The study was introduced to parents by pediatric pulmonologists during a check-up phone call scheduled in April-May 2020 for a reassessment of asthma. Families who agreed to participate were sent an email including the link for the

survey and an alphanumeric code to insert at the beginning of the form. Children completed their part immediately after their mothers' one and each section took about 20 minutes. To begin with, mothers were asked about their socio-demographic characteristics (for example gender, age, schooling, and employment). Secondly, mothers and children had to fill a survey created ad hoc for our study which included questions related to the COVID-19 pandemic (e.g., how much they felt worried about the COVID-19 infection) and perceived change in physical and psychological well-being comparing a pre and post-COVID-19 period, and, specifically for children, questions about contacts with friends during and after the home confinement. Lastly, they both had to complete standardized self-report questionnaires, assessing respectively general well-being (General Health Questionnaire, GHQ-12)^{30,31} and COVID-19 related fears (Multidimensional Assessment of COVID-19 – Related Fears, MAC-RF)³² for mothers, and psychological adjustment (Strengths and Difficulties Questionnaire, SDQ)^{25,26}, and separation anxiety (Separation Anxiety factor of the Spence Children Anxiety Scale, SCAS-SAD)^{27,28,29} for children.

As to the control sample, the study was introduced to families recruited through word of mouth. The procedure was the same as for the clinical sample. The surveys were almost identical, except for items regarding asthma.

Besides, the medical team provided clinical data regarding the control (Asthma Control Test, ACT^{22,23}, Global Initiative for Asthma (GINA) score²⁴) and the severity of asthma (GINA therapeutic steps²⁴), obtained during asthma reassessment in April-May 2020.

The project was approved by the Institutional Ethical Committee of Padua (Prot. n. 3671). The research project was performed in accordance with Ethical and Deontological codes of Italian Psychologists. A detailed informant consent needed to be signed to join the survey, both from the mother and the child if 12 years old. 45 mothers gave their consent for their own study participation. As to the 45 children an informed consent was obtained from a parent or legal guardian. Children over 12 included in this study also signed an ad hoc informed consent. No reward was offered for enrollment.

2.3 Measures

Children asthma control and severity

Asthma Control Test (ACT)^{22,23} is a validated screening tool completed by children (and parents for children under 12 years old) that addresses asthma control. The version for children younger than 12 years old includes 4 questions for the child (like “Do you cough because of your asthma?”) and 3 questions for parents (like “During the last 4 weeks, how many days did your child have any daytime asthma symptoms?”) rated respectively on a 4 and 6-point Likert scale, while the version for children over 12 years old is made up of 5 questions about activity limitation, shortness of breath, night-time symptoms, use of rescue limitation, and patient overall rating of asthma control over the previous four weeks. The questions are rated on a 5-point Likert scale. Higher scores indicate better-controlled asthma.

Global Initiative for Asthma (GINA) score. The Global Initiative for Asthma (GINA) guidelines²⁴ classify asthma control through medical staff investigation of 5 factors: daytime symptoms, night awakening, need for relievers, limitation to physical activity, and spirometry parameters. Based on the GINA guidelines²⁴, three levels

of asthma control were identified: well-controlled (score 0), partially controlled (scores 1 and 2), uncontrolled (scores 3 and 4).

GINA therapeutic steps, based on the GINA guidelines²⁴, classify asthma severity according to the pharmacological regimen needed (types of medicines, dosages, and frequencies of administration) into 5 therapeutic steps: 1 and 2 for mild asthma, 3 and 4 for moderate asthma, and 5 for severe asthma.

Children's psychological functioning

Strengths and Difficulties Questionnaire (SDQ)^{25,26}. The questionnaire is a validated behavioral screening tool composed of 25 items, rated on a 3-points Likert scale (from 0 = not true to 2 = certainly true) and divided into 5 subscales: emotional symptoms, conduct problems, hyperactivity and inattention, peer problems, and prosocial behaviors. By adding the first four scales, a total difficulties score can be calculated. Higher scores indicate more problematic behavioral traits²⁶. In this study, Cronbach's α for the total score (TDS), the internalizing symptoms scale (INT), the externalizing symptoms scale (EXT), and the prosocial behaviors scale (PROS) were respectively $\alpha(\text{TDS}) = 0.651$, $\alpha(\text{INT}) = 0.490$, $\alpha(\text{EXT}) = 0.636$, and $\alpha(\text{PROS}) = 0.305$.

Separation anxiety factor of the Spence Children Anxiety Scale (SCAS-SAD)^{27,28,29}. The separation anxiety factor is one of the 6 factors which compose the SCAS questionnaire (the other factors are: panic and agoraphobia, fears of physical injury, social phobia, obsessive-compulsive problems, and generalized anxiety/overanxious symptoms); for the purpose of this study, only this factor was used. It includes 7 items on a 4-points Likert scale (from 0 = never to 3 = always) that assess separation anxiety symptoms. Higher scores indicate higher levels of separation anxiety symptoms. In the present study, Cronbach's α for the separation anxiety factor was $\alpha(\text{SCAS-SAD}) = 0.731$.

Mothers' psychological functioning

General Health Questionnaire (GHQ-12)^{30,31}. This questionnaire allows evaluating the presence of minor psychological disorder in primary care settings through the administration of 12 items rated on a 4-point Likert scale (from 1 = more than usual to 3 = much less than usual). GHQ-12 total score can be classified in three ranges: no presence of difficulties (lower scores), presence of minor difficulties, and presence of important difficulties (higher scores) which may indicate the need for professional intervention. In this study, Cronbach's α was $\alpha(\text{GHQ-12}) = 0.701$.

Multidimensional Assessment of COVID-19 – Related Fears (MAC-RF)³². The questionnaire is composed of 8 items that investigate 8 types of COVID-19 related fears: fear of the body, fear for the body, fear of others, fear for others, fear of knowing, fear of not knowing, fear of action, fear of inaction. Items are grouped into 4 subscales: fears related to the body, fears related to meaningful relationships, difficulties in cognitive monitoring of concerns, and behavioral difficulties related to fear. Respondents have to rate all 8 items on a 5-point Likert scale (from 0 = very unlike me to 4 = very like me). By adding all items' rates, a total score is obtained. The higher it is, the more Covid-19 related fears are clinical. In this study, Cronbach's α was $\alpha(\text{MAC-RF}) = 0.767$.

2.4 Data analysis

Student's T-test was performed to assess the differences between mothers and children of the two samples in standardized questionnaires' scores (GHQ-12 and MAC-RF for mothers; SDQ and SCAS-SAD for children) and in some selected psychosocial variables from the survey created ad hoc for this study. As to the mentioned variables, it was verified that data are normally distributed by using the Shapiro-Wilk test.

Partial two-tailed correlations were performed between clinical parameters of asthma control and severity (GINA, ACT, and GINA therapeutic steps), mothers' standardized questionnaires (GHQ-12 and MAC-RF), and selected psychosocial variables of the survey (e.g. worries for contagion, physical and psychological well-being). Correlations were controlled for the time passed from the end of the lockdown (May 18th, 2020) to the survey administration. In parallel, children's medical measures were correlated with children's psychosocial measures (SDQ and SAD factor of the SCAS) and selected indexes of the survey (e.g. worries for contagion, contacts with friends).

As to the clinical sample, a multiple linear regression model was performed to assess which variables were predictive of children's psychological well-being. The child's psychological well-being was used as a dependent variable, and children's age and gender, time from the end of home-confinement, GINA scores, GINA therapeutic steps, children's concerns for contagion and physical well-being, mothers' psychological and physical well-being and mothers' total MAC-RF score, as independent variables. Children's psychological well-being variable consisted of a 3 point scale (0 = my general psychological well-being is better now than last year when I was going to school; 1 = my general psychological well-being is now the same as last year when I was going to school; 2 = my general well-being is now worse than last year when I was going to school). Higher scores indicated lower levels of well-being, during the lockdown, than the previous year. For all the analyses, a p-value < 0.05 was considered statistically significant. Statistical analysis was performed using SPSS v22.0 software package (SPSS Inc., Chicago, USA).

3. Results

Forty-five children ($M_{age}= 10.67$, $SD_{age}= 2.29$) with asthma were enrolled in this study (77.8% males). In the present sample, 80% of the children had well-controlled asthma, as reported by the GINA scores. As to asthma severity, assessed by GINA therapeutic steps, 44.5% had mild asthma while 55.6% had moderate asthma. Rhinitis was present in 60% of the sample. Also, their mothers ($n = 45$) were included in the study ($M_{age}=43.93$, $SD_{age}=5.298$). Most of the mothers had a high-school diploma (46.7%) and their professions were mainly intellectual and executive (48.9%).

Differences between clinical and control samples in standardized questionnaires and selected variables of the ad hoc survey

Most of the asthmatic children reported scores at non-clinical range for SDQ (97.8%) and SCAS-SAD (73.3%).

As to the comparisons between asthmatic and control children groups, no differences were found in SDQ and SCAS-SAD scores.

Considering some selected variables of the ad hoc survey, asthmatic children reported higher levels of fear to be infected by Covid-19, if compared to healthy peers ($p = 0.000$). Results are shown in Table 1.

Table 1

Differences between clinical and control children samples' scores in standardized questionnaires and in some selected variables of the ad hoc survey calculated using student's T-test. Standard deviations are reported.

		Clinical sample (N = 45)		Control sample (N = 41)		t	p
		Mean	SD	Mean	SD		
Standardized variables	SDQ						
	<i>Emotional symptoms</i>	2.00	1.537	1.88	1.552	.366	.716
	<i>Conduct problems</i>	2.29	1.547	2.59	1.658	-.858	.393
	<i>Hyperactivity/inattention</i>	3.47	1.973	3.93	2.054	-1.059	.292
	<i>Peer problems</i>	1.36	1.569	1.10	1.357	.812	.419
	<i>Prosocial behaviors</i>	8.98	1.971	8.41	1.549	1.463	.147
	<i>Total score</i>	9.11	4.628	9.49	3.451	-.425	.672
	<i>Internalizing</i>	2.80	2.242	2.66	1.797	.321	.749
	<i>Externalizing</i>	4.76	2.732	5.39	2.626	-1.096	.276
SCAS							
	<i>Separation anxiety factor</i>	5.31	3.704	4.68	3.357	.821	.414
Variables of the survey	Concerns for contagion	1.91	.596	1.41	.547	4.012	.000
	<i>Contacts with friends</i>	.91	.288	.90	.300	.137	.892
	<i>Contacts with friends during home confinement</i>	2.02	.851	2.27	.804	-1.307	.195
	<i>Current contacts with friends</i>	2.10	.860	2.11	.843	-.055	.957
	<i>Psychological well-being</i>	2.58	.583	2.39	.703	1.351	.180
	<i>Concerns about the resumption of activities</i>	2.62	1.114	2.51	1.143	.452	.652

Regarding the general well-being of asthmatic children's mothers measured with GHQ-12, 51.1% of them reported psychological suffering, and 31.1% possible need for intervention. As to Covid-19 related fears assessed with MAC-RF, 57.8% of the clinical sample's mothers reported psychological suffering, and 13.3% possible need for intervention.

According to the comparison between asthmatic children's mothers and control group mothers, no differences were found in GHQ scores ($p = 0.764$). Instead, mothers of the clinical group reported more concerns about

Covid-19 assessed by MAC-RF (Total MAC-RF score, $p = 0.002$), and in particular, fears related to the body ($p = 0.014$), fears related to meaningful relationships ($p = 0.004$), and behavioral difficulties related to fears ($p = 0.043$).

In respect to the ad hoc survey selected variables, mothers of the clinical sample reported higher fears for their or their children's contagion (respectively $p = 0.012$ and $p = 0.000$), and stronger concerns about resumption of their children's activities ($p = 0.000$). Moreover, mothers of the clinical sample reported a general worsening of their psychological well-being through a retrospective evaluation, showing a trend towards statistical significance ($p = 0.058$). Results are reported in Table 2.

Table 2

Differences between clinical and control mothers samples' scores in standardized questionnaires and in some selected variables of the ad hoc survey, calculated using student's T-test. Standard deviations are reported.

		Clinical sample (N = 45)		Control sample (N = 41)		t	p
		Mean	SD	Mean	SD		
Standardized variables	GHQ-12						
	<i>Total score</i>	18.00	4.592	17.76	2.764	.301	.764
	MAC-RF						
	Total score	14.04	5.543	9.98	5.994	3.271	.002
	Fears related to the body	3.56	2.302	2.37	2.059	2.517	.014
	Fears related to meaningful relationships	4.60	1.982	3.22	2.351	2.953	.004
	<i>Difficulties in cognitive monitoring of concerns</i>	2.71	1.561	2.07	1.571	1.887	.063
	Behavioral difficulties related to fear	3.18	1.934	2.32	1.955	2.051	.043
Variables of the survey	Concerns for contagion	1.93	.447	1.66	.530	2.587	.012
	Psychological well-being	2.62	.576	2.37	.662	1.921	.058
	<i>Physical well-being</i>	2.38	.490	2.24	.489	1.266	.209
	Worries for asthmatic son's contagion	2.16	.520	1.68	.521	4.203	.000
	<i>Child's psychological well-being (reported by mothers)</i>	2.51	.549	2.41	.499	.850	.398
	<i>Child's physical well-being (reported by mothers)</i>	2.22	.599	2.32	.471	-.811	.420
	<i>Communication</i>	4.18	.684	4.17	.834	.043	.966
	<i>Time spent with the son before home-confinement</i>	7.24	4.973	6.34	3.732	.945	.347
	<i>Time currently spent with the son</i>	10.16	5.784	10.51	5.613	-.290	.773
	Concerns about the resumptptions of child's activities	3.31	.874	2.54	.977	3.879	.000

Association between asthmatic children's medical measures and children and mothers' standardized questionnaires and selected variables of the ad hoc survey

Regarding asthmatic children, the GINA scores correlated with their self-perceived physical well-being ($r = .354$, $p = .025$). Considering children's standardized questionnaires, a significant positive correlation was found between the GINA scores and the "emotional symptoms" SDQ subscale ($r = .299$, $p = .049$) and the GINA scores and SCAS-separation anxiety factor ($r = .306$, $p = .043$). ACT was negatively correlated with SCAS-separation anxiety factor ($r = -.473$, $p = .001$).

No significant correlations emerged between the GINA therapeutic steps and children's variables (both standardized questionnaires and ad hoc survey's variables).

As to mothers, no significant correlations emerged.

Predictors of asthmatic children's psychological well-being

As to the clinical sample ($n = 45$), the multiple linear regression model (Table 3) showed that children's psychological well-being was predicted by their physical well-being and their mothers' psychological well-being. More specifically, a worsening of children's physical and mothers' psychological well-being were associated with a worsening of asthmatic children's psychological well-being.

Table 3
Multiple linear regression model of asthmatic children's psychological well-being (n = 45). *B*, unstandardized beta; *std. β*, standardized beta; *CI*, confidence intervals.

<i>Children's psychological well-being</i>				
	B (95% CI)	Std. β	t	p
<i>Intercept</i>	-.232 (-1.804, 1.339)		-.301	.766
<i>Children's age</i>	.064 (-.005, .134)	.253	1.880	.069
<i>Time from end of home-confinement</i>	-.001 (-.010, .008)	-.031	-.234	.817
<i>Child gender (2 = F)</i>	-.085 (-.441, .272)	-.061	-.484	.631
<i>GINA</i>	-.120 (-.288, .047)	-.208	-1.457	.154
<i>GINA therapeutic steps</i>	.049 (-.079, .176)	.104	.773	.445
<i>Children's concerns for contagion</i>	-.092 (-.341, .157)	-.094	-.752	.457
Mothers' psychological well-being	.473 (.208, .738)	.467	3.630	.001
<i>MAC-RF total score</i>	.006 (-.023, .035)	.060	.443	.660
Children's physical well-being	.630 (.353, .907)	.644	4.626	.000
<i>Mothers' physical well-being</i>	-.174 (-.498, .151)	-.146	-1.088	.284
Model fit	F(10,44) = 3.519			
	P = .003			
Adj. R ²	.364			

4. Discussion

The present paper focused on the assessment of asthmatic children and their mothers' psychological well-being compared to that of healthy peers, in an immediately post-lockdown scenario due to the Covid-19 pandemic. The link between asthma and Covid-19 was still debated at the time of the survey's administration¹¹. It was unclear if asthma might be considered a risk factor for SARS-CoV-2 infection or some treatment used to control it might be protective against the infection^{12,13}. Moreover, literature has not yet explored the psychological well-being of asthmatic children and their mothers in an immediately post lockdown scenario.

As for children, asthmatic patients did not differ from healthy peers in reporting psychological and separation anxiety symptoms, showing a normative functioning in a post lockdown period. Literature comparing asthmatic and healthy children evidenced inconsistent results. The extreme reduction of in-person relationships or contact with peers might negatively affect the children's perceived psychological well-being⁵. Considering specific asthma related aspects, on the one hand, mandatory home-staying might reduce the exposure to

allergens and infections that frequently elicit asthma attacks and could increase parental supervision for asthma symptoms management¹⁵. On the other hand, remaining at home could more frequently expose children to indoor noxious environments¹⁸. Interestingly, asthmatic children in this research reported an overall good level of asthma control during the lockdown, this might impact positively on their psychological symptoms. Noteworthy, the clinical sample in the present study did not include children with severe asthma

As for mothers, most of them showed higher levels of psychological suffering. Although the present study did not include mothers' psychological functioning evaluation before the Covid-19 outbreak, they reported a general perceived worsening of their psychological well-being in a post lockdown scenario. Moreover, they also had higher Covid-19-related fears, such as worries about their or their children's contagion, in comparison with control mothers. Given that mothers of clinical and control samples had similar sociodemographic characteristics (e.g. age, schooling, occupation), we could hypothesize that the increase in Covid-19-related fears could account for being a parent of an asthmatic child. Mothers' worries were mainly focused on the possible higher risk for their children in case of Covid-19 infection, because of their underlying chronic respiratory condition¹⁶. Future studies are needed to spread light on clinical mothers' fears. It would be also interesting to understand if they are more worried about themselves or about eventually infecting their children.

Considering the relationship between asthma control and children's psychological well-being, less controlled asthma seemed to be associated with higher emotional symptoms, such as sadness or worry, and separation anxiety symptoms as reported by children, although the majority of them showed an overall good level of asthma control. It is interesting to point out that the presence of an even low level of asthma symptoms was associated with more intense fears of being alone (such as during night-time), of being in another room in the house or far from the parents (separation anxiety factor), in a reopening scenario after the lockdown²⁰.

Finally, asthmatic children's psychological well-being was associated with their physical well-being and their mothers' psychological well-being. We can speculate that having good control of asthma symptoms is for children a protective factor in preventing the worsening of their psychological well-being during a pandemic characterized by severe pulmonary diseases. Moreover, mothers' psychological health might be crucial in helping asthmatic children to express psychological fatigue in Covid-19 pandemic scenarios. It might be hypothesized that mothers who are less worried and have a good psychological well-being are more prone to manage asthma therapies for their children and to better contain their children's possible worries²¹.

This study has some limitations. First, data of psychological functioning before the lockdown were not available, thus requiring retrospective information. Furthermore, the small number of patients recruited makes it difficult to generalize the results. Moreover, the questionnaires' administration period was quite long (3 months). This study has also some strengths: the sample's characteristics, which include data from both children and mothers; the use of validated questionnaires. Besides, the administration of the survey after the quarantine period allowed to assess the short and long-term psychological effects of the restrictive policies, giving important information to manage adequate medical and psychological support programs.

In conclusion, these data suggest that mothers of asthmatic children could be more vulnerable in experiencing psychological fatigue, in a pandemic scenario. They had to face not only the stressors related to Covid-19 but also the triggers of managing children with respiratory diseases in such a pandemic. This study highlighted the

importance of planning specific programs to help families with special needs. For example, it would be useful to provide educational and psychological support for asthmatic children's mothers. Future investigation of the psychological functioning of asthmatic children's fathers is recommended, as well as a deeper exploration of mothers' worries in the pandemic scenario, especially whether their worries for contagion concern more themselves or their children.

Declarations

Data Availability

The datasets generated during and analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests:

The authors declare no competing interests.

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Author contribution:

D.D.R., V.F., S.C., S.Z., designed the study, D.D.R., E.C., S.S. analyzed data and wrote the manuscript. V.F., S.C., S.Z. had full access to all the data in the study and take responsibility for the integrity and the accuracy of the data analysis. All authors reviewed the manuscript.

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References

1. World Health Organization. WHO - CORONAVIRUS 2020. https://www.who.int/health-topics/coronavirus#tab=tab_1 (2020).
2. Di Giorgio, E., Di Riso, D., Mioni, G. & Cellini, N. The interplay between mothers' and children behavioral and psychological factors during COVID-19: an Italian study. *Eur. Child Adolesc. Psychiatry* **29**, (2020).
3. Cellini, N., Canale, N., Mioni, G. & Costa, S. Changes in sleep pattern, sense of time and digital media use during COVID-19 lockdown in Italy. *J. Sleep Res.* **29**, 1–5 (2020).
4. Spinelli, M., Lionetti, F., Pastore, M. & Fasolo, M. Parents' Stress and Children's Psychological Problems in Families Facing the COVID-19 Outbreak in Italy. *Front. Psychol.* **11**, 1–7 (2020).
5. Wang, G., Zhang, Y., Zhao, J., Zhang, J. & Jiang, F. Mitigate the effects of home confinement on children during the COVID-19 outbreak. *Lancet* **395**, 945–947 (2020).
6. Kotecha, R. S. Challenges posed by COVID-19 to children with cancer. *Lancet Oncol.* **21**, e235 (2020).

7. Colombo, C. *et al.* Impact of COVID-19 on people with cystic fibrosis. *Lancet Respir. Med.* **8**, e35–e36 (2020).
8. Košir, U. *et al.* The impact of COVID-19 on the cancer care of adolescents and young adults and their well-being: Results from an online survey conducted in the early stages of the pandemic. *Cancer* **126**, 4414–4422 (2020).
9. Pietrobelli, A. *et al.* Effects of COVID-19 Lockdown on Lifestyle Behaviors in Children with Obesity Living in Verona, Italy: A Longitudinal Study. *Obesity* **28**, 1382–1385 (2020).
10. Passanisi, S. *et al.* Quarantine Due to the COVID-19 Pandemic From the Perspective of Pediatric Patients With Type 1 Diabetes: A Web-Based Survey. *Front. Pediatr.* **8**, 1–6 (2020).
11. Chhiba, K. D. *et al.* Prevalence and characterization of asthma in hospitalized and non-hospitalized patients with COVID-19. *J. Allergy Clin. Immunol.* **146**, 307–314.e4 (2020).
12. Garcia-Pachon, E. *et al.* Asthma prevalence in patients with SARS-CoV-2 infection detected by RT-PCR not requiring hospitalization. *Respir. Med.* **171**, 106084 (2020).
13. Halpin, D. M. G., Faner, R., Sibila, O., Badia, J. R. & Agustí, A. Do chronic respiratory diseases or their treatment affect the risk of SARS-CoV-2 infection? *Lancet Respir. Med.* **8**, 436–438 (2020).
14. Papadopoulos, N. G. *et al.* Impact of COVID-19 on Pediatric Asthma: Practice Adjustments and Disease Burden. *J. Allergy Clin. Immunol. Pract.* **8**, 2592–2599.e3 (2020).
15. Krivec, U., Kofol Seliger, A. & Tursic, J. COVID-19 lockdown dropped the rate of paediatric asthma admissions. *Arch. Dis. Child.* **105**, 809–810 (2020).
16. Abrams, E. M., McGill, G., Bhopal, S. S., Sinha, I. & Fernandes, R. M. COVID-19, asthma, and return to school. *Lancet Respir. Med.* **2600**, 2019–2020 (2020).
17. Gupta, A., Bush, A. & Nagakumar, P. Asthma in children during the COVID-19 pandemic: lessons from lockdown and future directions for management. *Lancet Respir. Med.* **2600**, 19–20 (2020).
18. Oreskovic, N. M., Kinane, T. B., Aryee, E., Kuhlthau, K. A. & Perrin, J. M. The Unexpected Risks of COVID-19 on Asthma Control in Children. *J. Allergy Clin. Immunol. Pract.* **8**, 2489–2491 (2020).
19. Çölkesen, F. *et al.* The impact of SARS-CoV-2 transmission fear and COVID-19 pandemic on the mental health of patients with primary immunodeficiency disorders, severe asthma, and other high-risk groups. *JMIR Prepr.* Preprint at: <https://doi.org/10.2196/preprints.24853> (2020).
20. Fiese, B. H., Winter, M. A., Wamboldt, F. S., Anbar, R. D. & Wamboldt, M. Z. Do family mealtime interactions mediate the association between asthma symptoms and separation anxiety? *J. Child Psychol. Psychiatry Allied Discip.* **51**, 144–151 (2010).
21. DiGiovanni, C., Conley, J., Chiu, D. & Zaborski, J. Factors influencing compliance with quarantine in Toronto during the 2003 SARS outbreak. *Biosecur. Bioterror.* **2**, 265–272 (2004).
22. Nathan, R. A. *et al.* Development of the Asthma Control Test: A survey for assessing asthma control. *J. Allergy Clin. Immunol.* **113**, 59–65 (2004).
23. Schatz, M. *et al.* Asthma Control Test: Reliability, validity, and responsiveness in patients not previously followed by asthma specialists. *J. Allergy Clin. Immunol.* **117**, 549–556 (2006).
24. Global Initiative for Asthma. *Global strategy for asthma management and prevention.* <http://www.ginasthma.org/> (2020).

25. Goodman, R. Psychometric properties of the strengths and difficulties questionnaire. *J. Am. Acad. Child Adolesc. Psychiatry* **40**, 1337–1345 (2001).
26. Di Riso, D. *et al.* The Strengths and Difficulties Questionnaire (SDQ). Early evidence of its reliability and validity in a community sample of Italian children. *Pers. Individ. Dif.* **49**, 570–575 (2010).
27. Spence, S. H. Structure of anxiety symptoms among children: A confirmatory factor- analytic study. *J. Abnorm. Psychol.* **106**, 280–297 (1997).
28. Spence, S. H. A measure of anxiety symptoms among children. *Behav. Res. Ther.* **36**, 545–566 (1998).
29. Di Riso, D., Chessa, D., Bobbio, A. & Lis, A. Factorial structure of the SCAS and its relationship with the SDQ: A study with Italian children. *Eur. J. Psychol. Assess.* **29**, 28–35 (2013).
30. Goldberg, D. & Williams, P. *A user's guide to the General Health Questionnaire*. NFER-Nelson, Windsor, Berks (1988).
31. Piccinelli, M., Bisoffi, G., Bon, Maria Giovanna Cunico, L. & Tansella, M. Validity and test-retest reliability of the italian version of the 12-item General Health Questionnaire in general practice: A comparison between three scoring methods. *Compr. Psychiatry* **34**, 198–205 (1993).
32. Schimmenti, A., Starcevic, V., Giardina, A., Khazaal, Y. & Billieux, J. Multidimensional Assessment of COVID-19-Related Fears (MAC-RF): A Theory-Based Instrument for the Assessment of Clinically Relevant Fears During Pandemics. *Front. Psychiatry* **11**, (2020).