

Impact of COVID-19 vaccination on parental and childhood stress levels in Greece

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Abstract. – OBJECTIVE: The impact of COVID-19 vaccination on parental and childhood stress levels has not been thoroughly investigated. Our aim was to explore the above relationship and identify factors that may influence the dissemination of stress within the family during the pandemic.

SUBJECTS AND METHODS: A cross-sectional e-survey was conducted among a nationwide sample of parents in May 2021 in Greece. Parental stress was assessed using the Perceived Stress Scale (PSS) and the Revised Impact of Event Scale (IES-R) tools. Childhood mental well-being was evaluated with the Children's Revised Impact of Event 13 (CRIES 13) scale.

RESULTS: 1,703 unique questionnaires were analyzed; 19.5% of responders were completely vaccinated, 23.7% were partially vaccinated, 38.3% were awaiting vaccination, and 18.5% were classified as vaccine-hesitant (15.2% would delay, and 3.3% refused the vaccination). Stress levels were significantly lower in completely or partially vaccinated parents than in vaccine-hesitant ones ($p < 0.001$ for PSS/IES-R). Vaccination status emerged as a strong and independent predictor of PSS and IES-R. A significant decrease in PSS and IES-R scores was observed in 991 participants between March 2020 and May 2021 ($p < 0.001$ for PSS/IES-R). Vaccine uptake was associated with lower PSS and IES-R scores, irrespective of the phase of the pandemic or other sociodemographic factors. The CRIES 13 score of the participant's children ($n = 2,969$) was 19.4 ± 14.9 and positively correlated with the PSS and IES-R scores. Children whose parents were vaccinated had lower stress levels than those of vaccine-hesitant parents ($p < 0.001$).

CONCLUSIONS: Parental vaccination against COVID-19 is a significant stress and anxiety predictor for both parents and their offspring. Parental and childhood stress levels were correlated,

while the effect of vaccination was independent of the pandemic phase. The campaigns to promote vaccine uptake against COVID-19 should also highlight its potential benefit on the psychological well-being of the family.

Key Words:

Vaccination against COVID-19, Parental stress, Childhood stress, Pandemic.

Introduction

Similar to previous infectious disease outbreaks, the COVID-19 pandemic has been recognized as a particularly stressful event for both adults and children¹⁻⁷. Although children are less severely affected by the coronavirus itself, containment measures (social distancing, school closures, traveling restrictions, etc.), together with the financial consequences of the pandemic, had a significant impact on the mental well-being of the youth⁸⁻¹⁶. In addition, the offspring of parents with high anxiety levels during the COVID-19 pandemic were proven more susceptible to psychiatric disorders^{5,7,8,17}. In a previous study¹⁸, we found that the impact of the pandemic on parental stress in Greece was substantial and that those caring for children with more severe or chronic disorders were more profoundly affected. These findings are in accordance with similar studies conducted by others during the same period^{19,20}.

Vaccination against COVID-19 has been available worldwide since January 2021²¹. Despite the concerns raised by vaccine-hesitant groups²²⁻²³, vaccination has consistently been proven safe and effective, especially in preventing the more severe

re forms of the disease²⁴. However, the effect of vaccination against COVID-19 on mental health has not been thoroughly investigated. A study²⁵ on a nationwide US sample showed that getting the first dose of the vaccine had a favorable effect on the mental well-being of the participants, and a recently published survey from Poland confirmed that fully vaccinated individuals have lower levels of anxiety than those partially vaccinated or awaiting vaccination²⁶. However, similar data on children and adolescents are lacking.

The aim of the present study was to assess the impact of COVID-19 vaccination on the anxiety levels of parents and their offspring and to identify factors that may influence stress dissemination within the family during the COVID-19 pandemic in Greece. Our main hypothesis is that vaccinated parents and their children may experience lower stress levels than those observed in the vaccine-hesitant ones, independently of other confounding factors.

Subjects and Methods

Study Participants

This was a nationwide cross-sectional study in Greece, based on an internet-questionnaire survey (e-survey). The study adhered to the CHERRIES guidelines of the EQUATOR network. A convenience sample of parents with healthy children or children with underlying disorders was enrolled through a network of collaborating pediatricians (19 pediatricians; at least one from each of the 13 Administrative Regions of Greece). Potential participants were identified from the pediatricians' patient lists and were contacted via email or a personal message on social media platforms.

Questionnaire

The questionnaire was developed in the Google Forms platform. It consisted of four sections: (1) introduction; (2) section on general information and demographics; (3) section on children's medical history; and (4) section on psychometric testing, which included the validated Greek versions of the Perceived Stress Scale (PSS) (10 questions)^{27,28}, the Revised Impact of Event Scale (IES-R) (22 questions)²⁹⁻³¹, and the Children's Revised Impact of Event 13 (CRIES 13) scale³²⁻³⁴. PSS is a widely used test for measuring stress perception; it captures the feelings and thoughts of participants and identifies how unpredictable, uncontrollable, and overloaded they find their

life^{27,28}. IES-R is a self-report tool that measures the subjective psychological response caused by a stressful event²⁹⁻³¹. CRIES 13 is designed to measure the psychological impact of a stressful event on children as perceived by their parents³²⁻³⁴. The questionnaires were anonymous to guarantee confidentiality. The survey was released from 15 May 2021 (12:00) to 22 May 2021 (23:59), and the responses were stored in a secure database.

Ethics

The study was approved by the Ethics Committee of the University Hospital of Patras, Greece (Approval Act 129/10.2.2020). Information regarding the study aims, and the consent form were available to the participants on the introduction page.

Statistical Analysis

Categorical variables are presented as number of cases (%) and compared with the Chi-square test. Continuous variables, including PSS, IES-R, and CRIES 13 scores, are presented as mean \pm standard deviation (SD) and range and compared with the Student's *t*-test. An IES-R score ≥ 38 was considered diagnostic for post-traumatic stress disorder³⁰. PSS, IES-R, and CRIES 13 scores were compared among multiple groups using one-way ANOVA with Tukey's post-hoc test for multiple comparisons. Univariable and multivariable linear regression models were used to assess the effect of sex, age, education level, place of residence, COVID-19 vaccine uptake, and chronic childhood disorders on PSS and IES-R scores. PSS and IES-R scores between the March 2020 and May 2021 survey were compared with paired *t*-tests. Linear mixed modeling with adjustment for repeated observations (March 2020 and May 2021 surveys) was used to assess the factors influencing the PSS and IES-R scores (year of survey, sex, age, education level, place of residence, COVID-19 vaccine, child with underlying disorders). Spearman's correlation was used to explore the correlation between CRIES 13 and PSS and between CRIES 13 and IES-R scores. Statistical analyses were performed using IBM SPSS version 27 (IBM Corp., Armonk, NY, USA). A statistical significance level of 5% was used in all analyses.

Results

Of the 1,960 parents invited, 1,745 entered the e-survey (unique viewers). Of them, 35 did

not consent to participate, while seven entries were deleted due to duplicate emails. Hence, 1,703 parents completed the questionnaires (estimated overall participation rate 86.9%; participation rate among unique viewers 97.6%). The baseline demographic characteristics of the participants are shown in Table I.

Parents of children with underlying disorders ($n=216$; 12.6%) did not report higher stress levels than those of healthy children (PSS 17.6 ± 6.6 vs. 16.9 ± 6.1 , $p=0.161$; IES-R 29.1 ± 14.1 vs. 27.5 ± 12.1 , $p=0.073$) (Figure 1). An IES-R score above 38 was found in 27.3% ($n=59$) of parents caring for children with underlying disorders vs. 16.7% ($n=249$) of those with healthy children ($p<0.001$).

Of the study participants, 332 (19.5%) were completely vaccinated against COVID-19, 403 (23.7%) were partially vaccinated, 652 (38.3%) reported that they were waiting for their appointment, and 316 (18.5%) were vaccine-hesitant (259 would delay getting the vaccine and 57 have decided not to get vaccinated). There was no difference in the vaccination status between parents of children with or without comorbidities (Chi-square $p=0.683$). Stress levels were significantly lower in completely or partially vaccinated parents ($n=735$) as compared to those who were vaccine-hesitant ($n=316$) ($p<0.001$ for multiple-group comparisons and t -test $p<0.001$ for the difference between vaccinated and hesitant, for both PSS and IES-R) (Figure 2). An IES-R score above 38 was found in 17.6% ($n=130$) of the completely/partially vaccinated parents vs. 31.3% ($n=99$) in vaccine-hesitant participants ($p<0.001$). In the multivariable analysis, vaccination status emerged as a strong

predictor of PSS and IES-R scores, independently of parental sex, age, education, place of residence, and underlying children's disorders (Table II).

A total of 991 parents (156 with children with comorbidities) also took part in the survey conducted on March 202018. These represent 89.7% of the study participants in the 2020 survey and 58.2% of the study participants in the present survey. Their demographic characteristics are shown in Table III. A significant decrease was observed in parental PSS and IES-R scores between March 2020 and May 2021 (Figure 3). In the multivariable analysis, vaccine uptake (complete/partial) was associated with lower PSS and IES-R scores, irrespective of the survey year, presence of children's disorders, and other demographic characteristics (Table IV).

In the May 2021 survey, data from 2,969 children (age 9.7 ± 5.5 years) were available. The CRIES 13 score was 19.4 ± 14.9 , positively correlated with age ($r=0.304$, $p<0.001$). The children whose parents were completely or partially vaccinated had lower stress levels than those of vaccine-hesitant parents ($p<0.001$ for multiple-group comparisons and t -test $p<0.001$ for the difference between vaccinated and hesitant) (Figure 4). There was a positive correlation between CRIES 13 and PSS and between CRIES 13 and IES-R scores ($r=0.340$, $p<0.001$ and $r=0.243$, $p<0.001$, respectively).

Discussion

In this study, we assessed the impact of COVID-19 vaccination on the psychological

Table I. Demographics of participating parents according to underlying child morbidity.

	Parents of healthy children	Parents of children with chronic or severe disorders
N	1487	216
Mothers*	1038 (69.8)	184 (85.2)
Age (years)*	40.1 ± 8.4 (18 - 70)	43.5 ± 7 (27 - 66)
Education**		
Primary	1 (0.1)	1 (0.5)
Secondary	259 (17.4)	55 (25.5)
Tertiary- No University	500 (33.6)	61 (28.2)
Tertiary- University	727 (48.9)	99 (45.8)
Residence		
Urban	1101 (74)	144 (66.7)
Semi-urban	227 (15.3)	39 (18.1)
Rural	159 (10.7)	33 (15.3)
Vaccination against SARS-CoV-2 (complete or partial)	631 (42.4)	104 (48.1)

Data are presented as numbers (%) or mean \pm SD (range). * $p<0.001$; ** $p=0.011$ for the differences between groups.

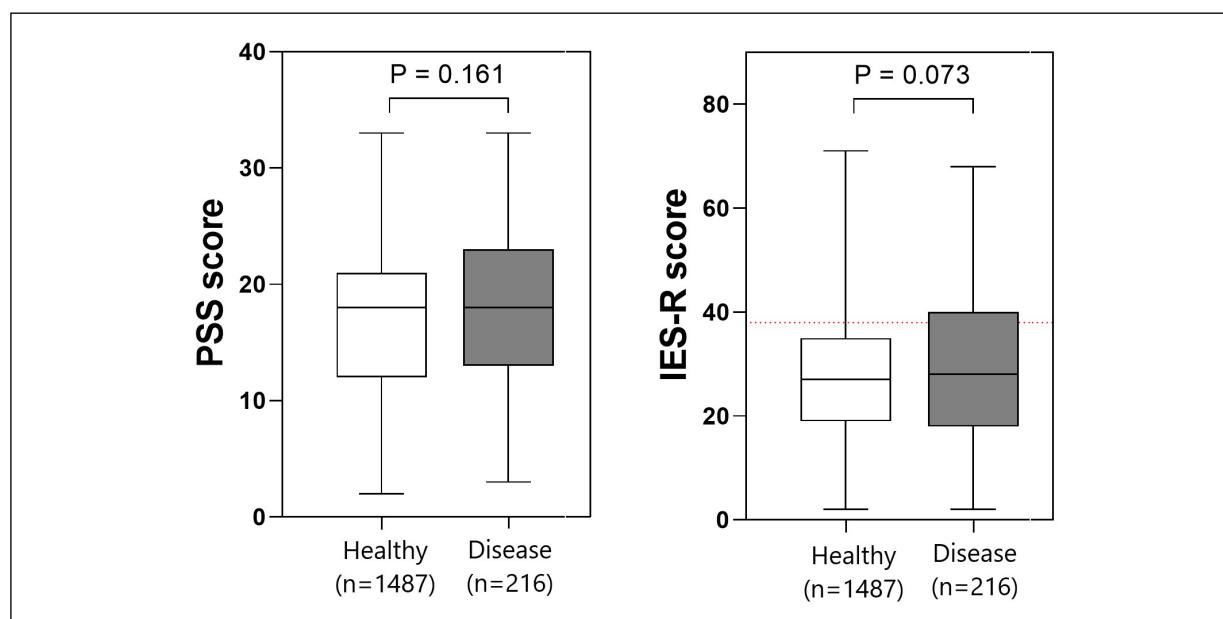


Figure 1. Comparison of stress levels between parents of healthy children and comorbidities. Comparisons were performed with paired *t*-tests. PSS: perceived stress scale; IES-R: impact of event scale revised.

well-being of parents and their offspring in a nationwide population sample in Greece. As expected, parental stress levels have been reduced one year after the onset of the pandemic. However, the most important finding was that vaccinated participants reported significantly lower anxiety levels than their vaccine-hesitant counterparts. Parental and childhood stress levels were correlated, while the effect of COVID-19 vaccination on mental well-being was independent of the phase of the pandemic or other demographic confounders.

In a similar survey conducted at the onset of the pandemic in Greece (March 2020)¹⁸, we found that caring for children with severe or

chronic underlying disorders was a significant predictor of parental stress. However, such an association was not proven in the present study. The fact that the knowledge on COVID-19 has gradually been built up in the community and it has become clear that children – even those with underlying disorders – are less severely affected by the virus may explain this difference.

The vaccination against COVID-19 reduced the parental stress in our cohort, irrespective of the phase of the pandemic. Several studies³⁵ have shown that psychosomatic symptoms peaked worldwide during the initial phase of the outbreak (i.e., in the spring of 2020 in Greece) but declined to pre-pandemic levels over the next months.

Table II. Determinants of PSS and IES-R scores (May 2021 e-survey).

	PSS		IES-R	
	Unadjusted effect	Adjusted effect	Unadjusted effect	Adjusted effect
Female sex	0.169*	0.199*	0.224*	0.240*
Age	-0.14*	-0.12*	-0.099*	-0.103*
Education (higher)	-0.095*	-0.041	-0.024	-0.028
Residence (urban)	0.022	0.023	0.012	0.017
SARS-CoV-2 vaccination (complete/partial)	0.169*	0.117*	0.135*	0.111*
Child with underlying disorder	0.016	0.013	0.043	0.028

PSS: perceived stress scale; IES-R: impact of event scale revised. Data are linear regression coefficients beta. Unadjusted effects refer to the effect of each parameter separately (univariable linear regression). Adjusted effects represent the effect of these parameters when adjusted for each other (multivariate linear regression). **p*<0.001.

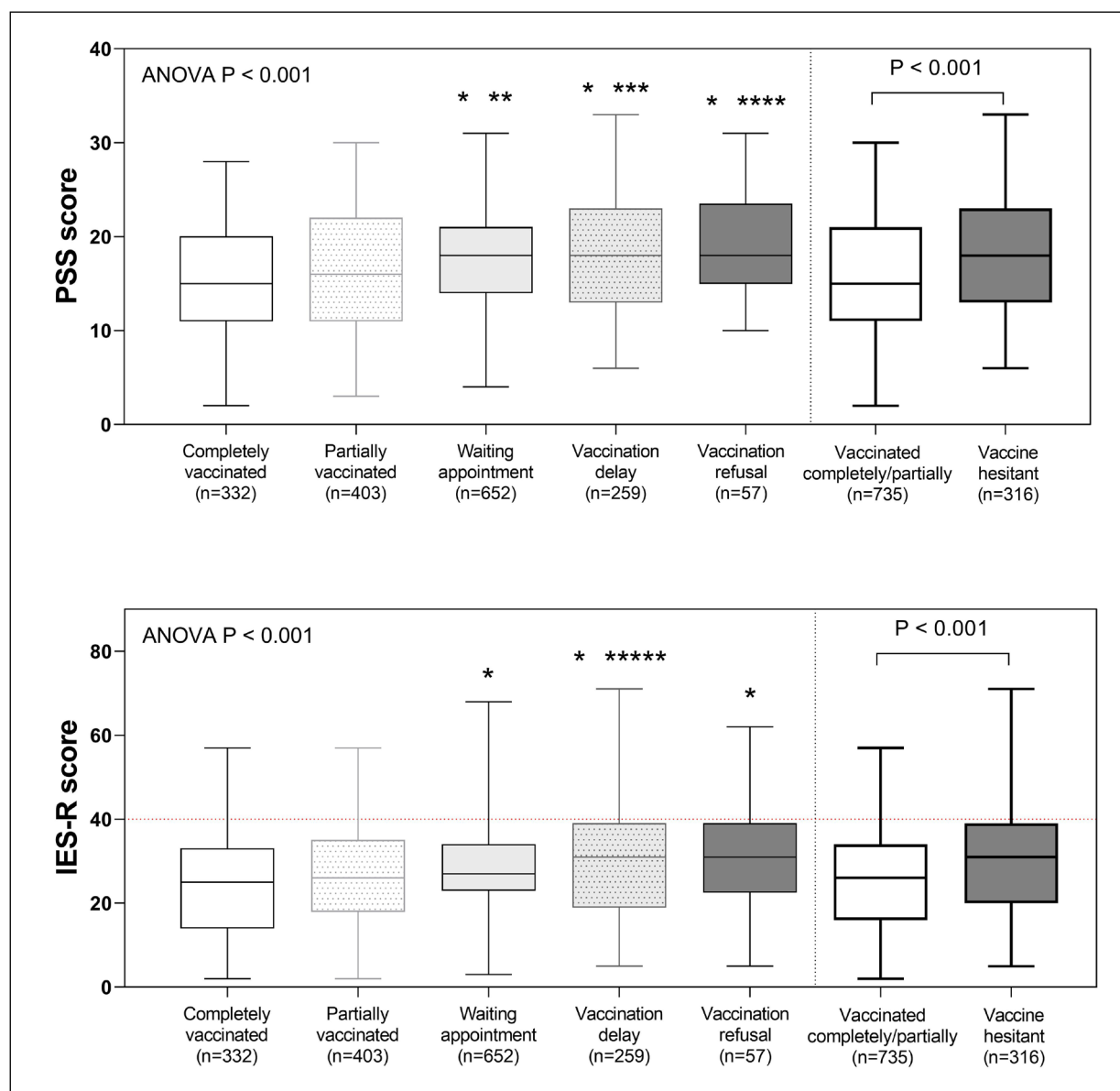


Figure 2. Parental stress according to vaccination status. PSS and IES-R scores (box-and-whisker plots). Left panels: score comparisons according to the vaccination status (one-way ANOVA with Tukey's multiple comparisons test). Right panels: score comparisons between vaccinated and vaccine-hesitant participants (student's *t*-test). Red dotted line: cut-off IES-R score for post-traumatic stress disorder diagnosis. * $p < 0.001$ compared to completely vaccinated; ** $p = 0.002$ compared to partially vaccinated; *** $p < 0.001$ compared to partially vaccinated; **** $p = 0.011$ compared to partially vaccinated; ***** $p = 0.003$ compared to partially vaccinated.

Therefore, our findings suggest that vaccination against COVID-19 may be an independent determinant of mental well-being in the community. This is in line with the conclusions of a nationwide study²⁵ from the USA, in which a significant improvement in mental health indices was documented after the first dose of the COVID-19 vaccine, beyond the improvement already achieved since the first phase of the pandemic. Vaccinated individuals have a lower risk of getting and spre-

ading the virus, and with the proper precautions, they can resume most of their previous socio-economic activities. Thus, it would be reasonable to assume that vaccination against COVID-19 offers a sense of security that improves the quality of life and mental health during the pandemic²⁶.

In support of the above hypothesis, vaccine-hesitant participants reported higher stress levels in our study. However, this contradicts the results of a recent e-survey from Poland²⁶ (1,696

Table III. Demographics of parents participating in both 2020 and 2021 surveys according to underlying child morbidity

	Parents of healthy children	Parents of children with chronic or severe disorders
N	835	156
Mothers	579 (69.3)	125 (80.1)
Age (years)	39.8±8.2 (22-67)	44±7.3 (28-66)
Education		
Primary	-	1 (0,6)
Secondary	187 (22.4)	30 (19.2)
Tertiary - No University	210 (25.1)	44 (28.2)
Tertiary - University	438 (52.5)	81 (51.9)
Residence		
Urban	550 (65.8)	100 (64.1)
Semi-urban	155 (18.6)	29 (18.6)
Rural	130 (15.6)	27 (17.3)
Vaccination against SARS-CoV-2 (complete or partial)	401 (48)	76 (48.7)

Data are presented as numbers (%) or mean ± SD (range). No differences between the study groups were observed.

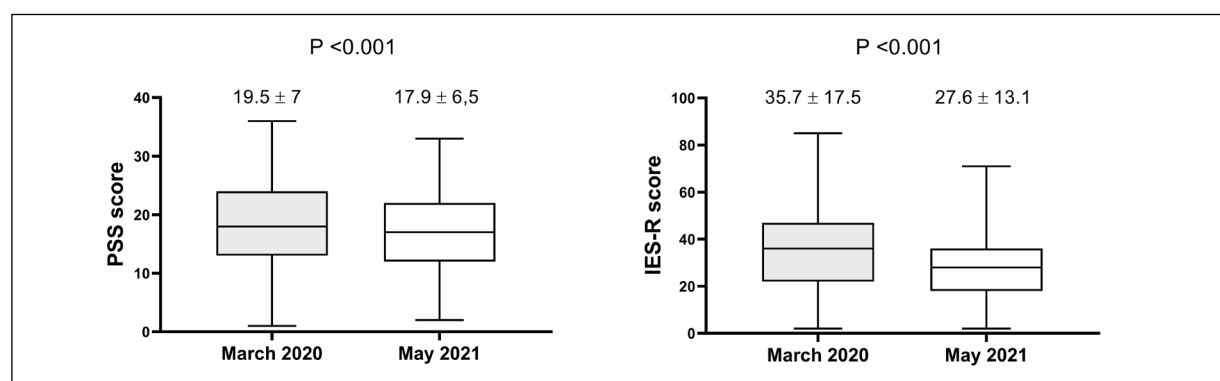


Figure 3. Parental stress levels in the 2020 and 2021 survey (n=991). Comparisons were performed with paired *t*-tests. PSS: perceived stress scale; IES-R: impact of event scale revised.

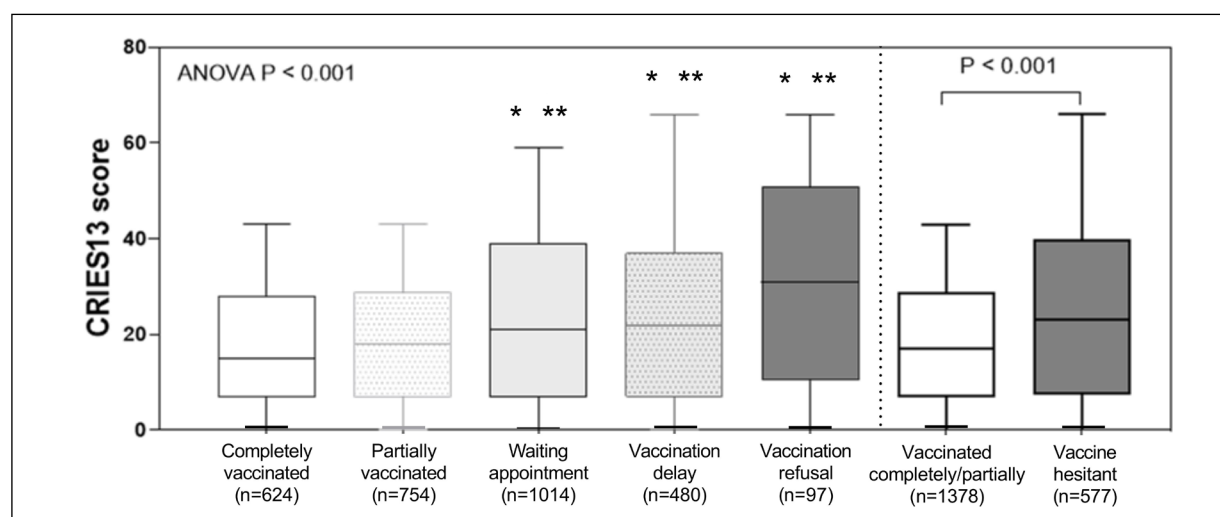


Figure 4. Children's stress levels (CRIES 13 score) according to parental vaccination status. Left panel: score comparisons according to parental vaccination status (one-way ANOVA with Tukey's multiple comparisons test). Right panel: score comparisons between children of vaccinated and vaccine-hesitant parents (student's *t*-test). **p*<0.001 compared to completely vaccinated; ***p*<0.001 compared to partially vaccinated.

Table IV. Determinants of PSS and IES-R scores among parents participating in both 2020 and 2021 surveys (n = 991).

	PSS		IES-R	
	Unadjusted effect	Adjusted effect	Unadjusted effect	Adjusted effect
Time of survey (May 2021)	-0.451*	-0.238*	-0.511*	-0.343*
Female sex	0.154*	0.021	0.203*	0.013
Age	-0.133*	-0.034	-0.079**	-0.022
Education (higher)	-0.043**	-0.011	-0.028	-0.008
Residence (urban)	0.022	0.014	0.017	0.010
SARS-CoV-2 vaccination (complete/partial)	0.304*	0.181*	0.386*	0.218*
Child with underlying disorder	0.012	0.011	0.023	0.020

PSS: perceived stress scale; IES-R: impact of event scale revised. Linear mixed modeling with adjustment for repeated observations (year of the survey). Data are linear regression coefficients beta. Unadjusted effects refer to the effect of each parameter separately. Adjusted effects represent the effect of these parameters when adjusted for each other. * $p < 0.001$; ** $p < 0.05$.

responders, aged 18-29 years), in which those who declared no intention to get vaccinated had the lowest sense of anxiety among the study participants. The authors attributed this interesting finding to the fact that vaccine ‘opponents’ have typically adopted a peculiar approach towards the pandemic (e.g., denial, conspiracy theories, etc.), which may eventually result in a false sense of security compared to the rest of the society²⁶. Nevertheless, the fully vaccinated participants in that study had lower anxiety levels than those partially vaccinated or awaiting vaccination²⁶. Various sociodemographic factors (age, education, religious beliefs, parenthood, etc.), as well as the different psychometric tools used (a questionnaire focused on anxiety due to COVID-19 vs. the more ‘general’ PSS/IES-R questionnaires), may have contributed to the differences between the study mentioned above and ours. Of note, the rate of those who refused the vaccine was 17.9% in Poland but only 3.3% (57/1,703) in Greece.

Vaccine hesitancy, defined as delay in acceptance or refusal of vaccination, remains a major global threat³⁶, and has emerged as a significant obstacle in COVID-19 vaccine dissemination during the pandemic^{22,23}. In our study, 18.5% of the participating parents reported that they would delay their vaccination, while 3.3% have already decided against it. These rates are lower than those reported for the Greek population during the same period^{37,38}, which could be explained by the fact that our study included only adults who were parents. Parenthood may have positively affected vaccine acceptance among our participants, with the view of protecting themselves and their offspring from the disease. Although previous research³⁹ has shown that vaccine-he-

sitant individuals are unlikely to change their beliefs about the vaccines when becoming parents, the effect of the COVID-19 pandemic on such attitudes remains unknown and merits to be explored in the future.

To our knowledge, this is the first study reporting on the impact of vaccination against COVID-19 on the mental well-being of parents and their offspring. The main strength is that it was based on a large nationwide survey, using standardized tools and methodology. Inevitably, however, there are limitations. First, we should acknowledge the possibility of self-reporting bias when questionnaires such as the PSS and IES-R are used. In addition, the CRIES 13 questionnaire assesses childhood stress as perceived by the parents and not directly by the children. Nevertheless, all three tools have extensively been validated and used in the literature to assess mental distress at the population level. Second, vaccine-hesitant parents may have deliberately refused to participate in the study. Therefore, the positive impact of vaccination may have been overestimated. Third, our study participants were parents; hence, we cannot guarantee the applicability of our findings to the general adult population. Finally, the extent to which our results may be generalized to other countries is also unknown.

Our study adds to the limited body of literature in the field and should be considered important from a public health perspective. The positive impact on mental well-being should be emphasized as an additional benefit of COVID-19 vaccination, especially given the overall psychological burden of the pandemic for the family and society. Moreover, vaccine-hesitant parents,

as well as their offspring, may require particular attention with regard to their psychological well-being during the pandemic. This is an emerging phenomenon that has not been previously recognized. In particular, the hesitant parents who refuse the vaccine may suffer from a silent burden on their mental health and likely warrant additional support from relevant services.

Conclusions

In conclusion, in the present study, we have demonstrated that parental vaccination against COVID-19 is a significant predictor of stress and anxiety for parents and their children. Furthermore, parental and offspring stress levels were correlated, while the effect of vaccination was independent of the phase of the pandemic. Therefore, campaigns to promote vaccine uptake against COVID-19 may also highlight its potential benefit on the psychological well-being of the family.

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Conflict of Interest

All authors declare no conflicts of interest.

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None.

Authors' Contributions

Study conception and design were performed by S. Fouzas, D. Gkentzi, and P. Plotas. Material preparation and data collection were performed by P. Plotas, M. Terzi, N. Karantaglis, D. Gidaris, D. Cassimos, E. Kostopoulou, A. Karatza, and X. Sinopidis. Statistical analyses were conducted by S. Fouzas, P. Plotas, and A. Bertzouanis. The first draft of the manuscript was written by D. Gkentzi and S. Fouzas, while A. Tsaklidis and G. Dimitriou critically reviewed the manuscript. All authors commented on the manuscript draft versions and approved the article version to be published.

Availability of Data and Materials

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Ethics Approval

The study was conducted in accordance with the Declaration of Helsinki and approved by the Institutional Scientific Board of the University Hospital of Patras (Approval Act 129/10.2.2020).

Informed Consent

Written informed consent was obtained from the participants' parents before enrollment.

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