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Original Research

Exploring the Association Between Comorbidity Status and Emotional and Behavioral Disorder Risk in Children Following COVID-19 Infection

Winengku B Adi[1], Ronny T. Wirasto[2], P. Sumarni[2], Carla R. Marchira[2]

[1]Department of Psychiatry Dr Sardjito General Hospital, Yogyakarta, Indonesia
[2]Department of Psychiatry FKKMK Universitas Gadjah Mada, Yogyakarta, Indonesia

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Correspondence Author:
Email: winengkuadi@gmail.com

Abstracts

Introduction: The COVID-19 pandemic had a substantial influence on various aspects of global life. It is essential to understand the relationship between short-term COVID-19 infections and ensuing emotional and behavioral symptoms. However, the limited research on long-term impacts of COVID-19 infections and inadequate surveillance raise concerns. This gap is particularly critical given the reported 57% increase in depression and anxiety, and a 31% rise in suicidal ideation. Acknowledging the seriousness of the situation is essential, requiring combined efforts to address these issues effectively. **Methods:** This study employed an observational analytical approach engaging a prospective cohort design, without of experimental interventions. The Strength and Difficulties Questionnaire (SDQ) was used to measure the risk of emotional and behavioral disorders linked to comorbidity status. Twenty-nine children were selected as study participants. Data analysis involved chi-square tests and logistic regression, with statistical significance set at $p < 0.05$. **Results:** Results show that 48.3% of participants experienced emotional and behavioral difficulties. Emotional symptoms constitute 27.6%, behavioral issues 31%, hyperactivity and peer-related concerns 48.3%, while prosocial behavior is merely 6.9%. Comorbidity status was significantly associated with the likelihood of emotional problems, affecting 54.5% of participants ($p=0.028$, and $C=0.426$). **Conclusions:** Comorbidity status enhances the vulnerability to emotional and behavioral disorders among children post-COVID-19 infection. However, statistical significance was observed only for emotional problems.

Keywords: Adolescent, Behavior and Emotional problems, Child, Comorbidity

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INTRODUCTION

The COVID-19 pandemic began in December 2019 with the discovery of a highly transmissible coronavirus in China [1]. In response, numerous countries enforced lockdown measures, restricting travel in and out of their borders. Indonesia also implemented extensive social restrictions. Studies have indicated that these measures adversely affected the mental well-being of communities, including children [2].

Various factors contribute to mental health challenges in children during the pandemic. These include the transition to online learning, limited social interaction with peers, and constraints on visiting public spaces due to pandemic-related regulations. The adoption of hybrid schooling models as conditions stabilize post-pandemic can induce stress and anxiety among children [3] , [4].

Empirical studies have explored the correlation between COVID-19 infection and mental health issues in adults [5], [6]. Children may experience anxiety due to insufficient emotional and psychological support from their parents during the pandemic [7]. The pandemic's disruption of children's social activities may elevate their risk of experiencing violence [8].

A study by Ludwig-Walz, et al. [9] revealed increased depression among children in Europe during the pandemic, especially among girls. Another study suggests that loneliness resulting from social isolation and the loss of loved ones during the COVID-19 pandemic can precipitate long-term mental health issues, with effects persisting for up to nine years [10]. Additionally, children with comorbidities face worse mental health outcomes following the pandemic [11]. Tsankov, et al. [12] found that children born with congenital diseases face a heightened risk of severe symptoms and mortality from COVID-19 compared to those without these conditions.

García-Fernández, et al. [13] reported a 31.1% rise in psychiatric ER cases related to suicide attempts or ideation in Spain in 2021, compared to 2018–2020. A study in China highlighted behavioral disorders, such as anxiety and irritability, among children aged 3 to 18 [14]. In England, children aged 11 to 16 exhibit a lower level of anxiety compared to those aged 4 to 10 [10].

Wiguna, et al. [15] examined the pandemic's impact and found increased risks of disrupted peer relationships (38.1%), diminished pro-social behavior (28.1%), and conduct issues (15%) during the initial and subsequent stages of the pandemic in Indonesia. Indrawati, et al. [16] in Indonesia revealed the alarming prevalence of mental health disorders, with over half of children (57.6%) experiencing conditions like depression, fear, and anxiety. These findings highlight the need for timely intervention to protect children's mental well-being in the long term.

Studies have demonstrated that comorbid health conditions combined with COVID-19 infection in children has increased the prevalence of emotional and behavioral disorders. Consequently, longitudinal studies are needed to better understand these disorders in children affected by COVID-19. Failure to properly identify these disorders may lead to issues such as substance abuse and school dropout. These challenges stem not only from the virus itself but also from pandemic-related factors like bereavement, social isolation, and underlying health conditions.

METHODS

This study is part of a larger research initiative named LOCATE, carried out collaboratively by Gadjah Mada University, the University of Indonesia, and Airlangga University from 2021 to 2024. The main goal of this research is to ascertain the correlation between emotional and behavioral disorders and concurrent physical disorders in children who contracted COVID-19. The research was conducted over two visits to the children's polyclinic of RSUP Dr. Sardjito.

The study included pediatric patients

aged 4 to 18 who had tested positive for COVID-19 and met specific inclusion criteria: confirmed diagnosis via real-time Polymerase Chain Reaction (RT-PCR) from a nasopharyngeal swab, discharge from a hospital or health center, and willingness to participate. The study excluded patients with severe cognitive impairments, such as mental retardation, rendering them unable to comprehend and complete the research questionnaire, as well as those intending to relocate to another city. A sample size of 26 respondents was obtained through purposive sampling techniques [17].

Two questionnaires were used to collect data concerning emotional and behavioral issues. The first questionnaire collected demographic data, medical history, COVID-19 background, clinical symptoms, vital signs, and lab results. The second questionnaire was the Strengths and Difficulties Questionnaire (SDQ), comprising 25 items rated on a likert scale, designed to evaluate emotional concerns, hyperactive behavior, peer relationship challenges, and behavioral difficulties. It also incorporated a domain assessing pro-social behavior to gauge strengths. The cumulative score for the difficulty domain ranged from 0 to 15 for normal, 16 to 19 for borderline or threshold, and 20 to 40 for an abnormal score [15]. Participants were classified into two groups based on their risk level: individuals scoring 20 or higher were deemed at risk, while those scoring below 20 were categorized as normal. In community-based studies, child psychiatric screening tools often utilize the 90th percentile as the threshold for determining risk levels.

For individuals aged 11 to 17, emotional problems, hyperactivity, peer relationships, and behavioral issues are monitored across four domains. The risk level for each domain is determined by the total score. Specifically, for emotional problems, a total score below 6 is considered normal, whereas a score of 6 or higher indicates a risk. Similarly, for hyperactivity, a total score under 7 is categorized as normal, while a score of 7 or above signifies a risk. In the context of peer relationship problems, a total score below 5 is normal, whereas a score of 6 or higher indicates a risk. Finally, for conduct behavioral issues, a total score below 4 is considered normal, whereas a score of 5 or higher signifies a risk.

This project followed ethical guidelines, including obtaining informed consent to mitigate potential harm and uphold confidentiality and anonymity. The study's aims and objectives were clearly outlined, and participants provided informed consent prior to completing the questionnaires. Ethical approval for this study was granted by the Medical and Health Research Ethics Committee of the Faculty of Medicine, Public Health, and Nursing, Universitas Gadjah Mada (KE/FK/2003/EC/2023).

RESULTS

This investigation involved 29 pediatric patients aged between 4 and 17 years, all of whom had a confirmed diagnosis of COVID-19 verified by nasopharyngeal swab testing utilizing real-time polymerase chain reaction (RT-PCR). These patients received medical care as both inpatients and outpatients. However, patient recruitment proved challenging due to low response rates and parental reluctance to participate. The majority of the subjects (75.9%) fell within the age range of 11 to 17 years, with a nearly equal distribution of males (51.7%) and females (48.3%), with a mean age of 12.5 years.

Strengths and Difficulties Questionnaire results suggest that participants did not face significant overall emotional and behavioral risks. The risk percentages for individual categories were: total difficulties score (48.3%), symptoms related to emotional problems (27.6%), conduct-related behavioral problems (31%), hyperactivity (27.6%), peer-related issues (48.3%), and prosocial behavior (6.9%), as illustrated in **Table 1**.

Table 1. Characteristics of research subjects (n=29)

		Mean	Standard Deviation	n	%
Age		12.52	3.60		
Age	4-10 y.o			7	24.1
	11-17 y.o			22	75.9
Gender	Boys			15	51.7
	girls			14	48.3
Comorbidity	Yes			11	37.9
	No			18	62.1
Total Difficulties		18.21	5.04		
Emotional problems		4.28	2.45		
Conduct behavior		2.97	1.84		
Hiperactivity		5.59	2.01		
Peer relationship problems		5.38	1.59		
Prosocial problems		8.45	1.53		
Total Difficulties	At risk			14	48.3
	Normal			15	51.7
Emotional problems	At risk			8	27.6
	Normal			21	72.4
Conduct behavior	At risk			9	31
	Normal			20	69
Hiperactivity	At risk			8	27.6
	Normal			21	72.4
Peer relationship problems	At risk			14	48.3
	Normal			15	51.7
Prosocial problems	At risk			2	6.9
	Normal			27	93.1

Bivariate analysis revealed no significant correlation between comorbidity status, age, gender, and the total difficulty score. In this investigation, it was observed that individuals with comorbidities had a higher likelihood of developing emotional disorders (54,5%) than those without comorbidities (11,1%). This difference was statistically significant (p=0.028; CI 95%=1.45-63.50). The association between comorbidity status and emotional symptoms was quantified using the contingency coefficient (C), yielding a value of 0.426 (see **Table 2**). No significant correlation was detected between age, gender, and emotional symptoms.

Table 2. Bivariate analysis between the comorbidity variables, age, gender, and the emotional problems

		Emotional problems				p	C	OR	CI 95%
		At risk		Normal					
		n	%	n	%				
Comorbidity	Yes	6	54.5	5	45.5	**0.028***$	0.426	9.60	1.45-63.50
	No	2	11.1	16	88.9				
Age	4-10 y.o	3	42.9	4	57.1	0.357$	0.189	2.55	0.42-15.41
	11-17 y.o	5	22.7	17	77.3				
Gender	Boys	3	20.0	12	80.0	0.427$	0.173	0.45	0.09-2.39
	Girls	5	35.7	9	64.3				

Bivariate analysis between comorbidity, age, gender and conduct behavior problems showed no significant relationship and bivariate analysis between comorbidity, age, gender and hyperactivity also showed no significant relationship.

No statistically significant correlation was found between comorbidity factors, gender, and peer-related problems through bivariate analysis. Nevertheless, children aged 4-10 years exhibited twice the proportion of peer-related problems compared to those aged 11-17 years, with a significant disparity in proportions (p=0.002). The contingency coefficient (C) of 0.504 indicates the association between these two variables, as shown in **Table 3**.

Table 3. Bivariate analysis between comorbidity, age, gender and peer relationships problems

		Peer problems				χ^2	df	p	C	OR	CI 95%
		At risk		Normal							
		n	%	n	%						
Comorbidity	Yes	6	54.5	5	45.5	0.28	1	0.597	0.098	1.50	0.33-6.77
	No	8	44.4	10	55.6						
Age	4-10 y.o	7	100.0	0	0.0			0.002*$	0.504	-	-
	11-17 y.o	7	31.8	15	68.2						
Gender	Boys	6	40.0	9	60.0	0.85	1	0.356	0.169	0.50	0.11-2.19
	Girls	8	57.1	6	42.9						

Bivariate analysis did not show a significant relationship between comorbidity, age, gender and prosociality. The outcomes of the multivariate analysis reveal a significant association between comorbidity status and emotional difficulties, yielding a p-value of 0.19, utilizing the backward method. Conversely, neither age nor gender exhibited any significant correlation with emotional problems. This finding is represented in **Table 4.** Furthermore, an R2 value of 28.8% suggests that comorbidities contribute to 28.8% of emotional symptoms, with the remainder likely influenced by other external factors beyond this study.

Table 4. The results of the logistic regression test have an impact on emotional problem

	B	S.E.	Wald	df	p	Exp (B)	95% C.I. Lower	Upper
Comorbidity	2.262	0.964	5.506	1	0.019*	9.600	1.451	63.500

DISCUSSIONS

These demographic characteristics closely resembled those in the study by Wiguna, et al. [15] conducted in April and May 2020, focusing on adolescents infected with COVID-19. However, our study's slightly lower mean age may be due to using adolescent age criteria limited to 11–17 years. In particular, the mean age in the Wiguna et al. study was approximately 14 years old.

The cohort in this investigation was predominantly composed of individuals with no history of comorbidities (62.1%), different from Kapoor, et al. [18] the findings of, where a higher proportion (51.7%) had comorbidities. This variance might be attributed to the broader age range in our study, which included children from infancy to 18 years, thus capturing a more diverse demographic.

In our study, nearly half of the participants (48.3%) exhibited susceptibility to overall difficulties, with 27.6% at risk of emotional problems and 31.9% prone to behavioral issues. Furthermore, 27.6% displayed vulnerability to hyperactivity, and 48.3% were susceptible to experiencing peer-related challenges. Conversely, only a small fraction of children (6.9%) exhibited low prosocial behavior. Our findings indicate a higher prevalence of emotional and

behavioral disorders compared to those in previous studies conducted by Wiguna et al. and in Malaysia [19]. Notably, pre-pandemic research in Indonesia indicated a lower incidence of emotional and behavioral disorders, with the 2018 Basic Health Research (Riskesdas) data showing a mere 9.6% prevalence of total difficulties associated with emotional and behavioral disorders [20].

The correlation between comorbidity and emotional status is consistent with findings from [21], [22] which suggest that children with underlying health conditions might be more susceptible to higher emotional and behavioral challenges during the pandemic.

Further justification is provided by Ademhan Tural, et al. [23], who suggest that chronic illnesses such as respiratory tract infections or chronic obstructive pulmonary disease in children can elevate anxiety levels in relation to the COVID-19 pandemic. Additionally, Skalski, et al. [24] found that children without comorbidities who contracted COVID-19 typically do not develop emotional difficulties, potentially attributed to their better adaptive coping mechanisms in response to the anxiety induced by the infection. These findings suggest that children without comorbidities may face a reduced risk of experiencing emotional symptoms.

In our investigation found that children aged between 4 and 10 years displayed bigger proportion of difficulty with their peer group. This scenario may occur due to the psychosocial development theory, which suggests that children aged 4 to 10 years are placed within the industry versus inferiority phase. If children within this age stage contract COVID-19 and undergo social isolation, combined with government regulations restricting school activities, their inclination towards engaging in peer activities and accomplishing tasks may be delayed due to the pandemic, leading to peer-related problems [25]. According to Piaget's cognitive development theory, children aged 4 to 10 years are typically at the preoperational and concrete operational stages. Throughout these stages, children may exhibit limitations in logical cognitive functions, moral reasoning, and social skills [26].

Bivariate analysis also found no significant correlation between comorbidity status and various behavioral and emotional issues. These findings align with Bussières, et al. [4], who observed that children with comorbidities responded differently to the pandemic due to reduced social interactions, possibly resulting in greater comfort with the situation. Conversely, Takahashi and Honda [27] found that during the COVID-19 pandemic children experienced bigger external problems such as behavioral issues and difficulties in peer relationships compared to internal emotional symptoms.

This study found no significant gender differences in the likelihood of emotional and behavioral disorder risks. These findings differ from Mazza, et al. [28], who suggested that men tend to manifest emotional symptoms post-COVID-19 more frequently than women. Specifically, it was observed that male children were more susceptible to behavioral issues such as hyperactivity and aggression, rather than emotional concerns [19].

CONCLUSION

This research reveals a strong association between children's comorbidity status and their susceptibility to developing emotional disorders following COVID-19 infection. However, further comprehensive and long-term studies involving multiple institutions are needed to obtain a larger sample size. This will provide a deeper understanding of the relationship between comorbidity status and the mental health of children with a history of COVID-19 infection.

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CONFLICT OF INTEREST

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