Factors associated with preventive behaviors of COVID-19 among children with congenital heart disease: Application of protection motivation theory

Zohreh Sadat Navabi, Alireza Ahmadi, Mohammad Reza Sabri, Fahimeh Bagheri Kholenjani[1], Mehdi Ghaderian, Bahar Dehghan, Chehreh Mahdavi

Abstract:

BACKGROUND: Congenital heart disease (CHD) is one of the underlying medical conditions that put children at increased risk for coronavirus. This study aimed to predict preventive behaviors of COVID-19 among children with CHD based on the protection motivation theory (PMT).

MATERIALS AND METHODS: This cross-sectional study was conducted from March 2021 to April 2021, on 240 children 3–7 years with CHD whose data had been registered in Persian Registry of Cardiovascular Disease/CHD (PROVE/CHD) System in Isfahan, Iran. The research variables were measured using an online researcher-made questionnaire that was based on PMT constructs. The collected data were analyzed using statistical tests (e.g., Pearson correlation coefficient and linear regression analysis).

RESULTS: From a total of 240 participants (mean age of 4.81 ± 1.50) in the present study, 122 (50.8%) were girls. The most common types of CHD among children participating in this study were related to atrial septal defect (ASD) (29.2%, $n = 70$) and ventricular septal defect (VSD) (26.7%, $n = 64$), respectively. Protective behaviors showed a significant correlation with all constructs of PMT. The PMT constructs explained 41.0% of the variances in protective behavior, in which the perceived reward ($\beta = 0.325$) and perceived self-efficacy ($\beta = 0.192$) was the most important, respectively.

CONCLUSION: The results of this study showed well the effectiveness of PMT on the preventive behaviors of COVID-19 in children with CHD. This theory can be used to teach preventive behaviors of COVID-19 to children with CHD in education programs.

Keywords:

Behavior, child, congenital, COVID-19, heart defects

Pediatric Cardiovascular Research Center, Cardiovascular Research Institute, Isfahan University of Medical Sciences, Isfahan, Iran
[1]Isfahan Cardiovascular Research Center, Cardiovascular Research Institute, Isfahan University of Medical Sciences, Isfahan, Iran

Address for correspondence:
Zohreh Sadat Navabi, MSc of Health Education & Health Promotion Pediatric Cardiovascular Research Center, Cardiovascular Research Institute, Isfahan University of Medical Sciences, Isfahan, Iran. E-mail: zs.navabi@gmail. com

Introduction

Coronaviruses are a large family of viruses and a subset of coronaviridae ranging from the common cold virus to the cause of more severe diseases, such as SARS, MERS, and COVID-19.[1] The novel coronavirus was first reported in December 2019 in Wuhan, China, and with the rapid spread of the virus worldwide, the disease was reported as an epidemic in 2019–2020.[2,3] According to research studies, most COVID-19 infected people experience mild to moderate respiratory illness and recover the disease without the need for special treatments, however, children, the elderly, and people with underlying medical conditions, such as cardiovascular disease, diabetes, chronic

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respiratory diseases, cancer, etc., are more likely than others to develop a severe illness.[4] There are no accurate statistics on the number of Iranian children infected with COVID-19. According to the report by World Health Organization (WHO) from December 30, 2019 to October 25, 2021, 1,890,756 children under 5 years of age and 7,058,748 older children (5–14 years) of reported global cases have been infected with coronavirus.[5] Contrary to popular belief that children are not infected with the coronavirus, the disease can thus infect children of all ages. Most of these children had been in close contact with COVID-19 infected people. More than 90% of Chinese children experienced no symptoms after becoming infected and only developed a mild disease. Meanwhile, children with underlying medical conditions, such as pulmonary or cardiovascular diseases or weakened immune systems are more likely to develop a severe illness from coronavirus.[6] Congenital heart disease (CHD) is one of the underlying diseases that put children at increased risk for coronavirus.[7] The results of research studies show that the morbidity and mortality due to coronavirus infection are higher in patients with cardiovascular diseases (congenital and acquired heart disease) than other people.[8,9]

Though few studies have assessed the clinical consequences of COVID-19 in pediatric and adult populations with CHD,[7] the patients with CHD are considered to be at high risk for COVID-19 serious clinical symptoms and complications given the important effect of coronavirus on the heart.[10] Accordingly, numerous studies have emphasized the importance of COVID-19 prevention in this population.[11] Indeed, prevention and early detection of COVID-19 infection in patients with CHD are the key point to prevent severe manifestations of the disease.[12]

On January 30, 2020, the WHO Director General declared the COVID-19 outbreak to be a public health emergency of international concern and issued a set of temporary recommendations, such as avoiding crowded places, washing hands frequently with soap and water for at least 20 s, avoiding touching the mouth, eyes, or nose with unwashed hands, using a mask and keeping a physical distance of about 1.8 m, to prevent people from getting the infection.[13]

As so far the WHO has proposed no specific therapy for COVID-19 and vaccines just prevent severe illness or death from coronavirus and no vaccine is 100% effective,[14,15] patients with CHD and their families should be educated about the signs and symptoms of COVID-19.[16] One way to protect the health of children not currently eligible for vaccination is adopting protective measures, such as repeated hand washing, the effective wearing of face masks, and social distancing.[11]

Children 3–7 years are under the control and supervision of the parents, and parental supervision over the children's behavior may encourage them to adopt healthy behaviors.[17] In between, the care provided by parents of children with CHD, especially younger children, who are vulnerable to developing coronavirus infection and are less capable of fully complying with health protocols, plays an important role in preventing and reducing the risk of developing the disease. Considering the increasingly growing prevalence of COVID-19 disease and the virus genetic mutations, it is essential to seriously consider health behaviors to prevent the occurrence of COVID-19 infection in children with underlying medical conditions.[18]

One of the theories, especially in the field of preventive behaviors and decision-making in the face of significant traumatic events is the protection motivation theory (PMT). PMT was first introduced by Rogers in 1975 to understand the effects of fear appeals on health-related attitude and behavior.[19] PMT assumes that the adoption of health behaviors to prevent health threats (different types of diseases) is an action arisen from the individual's motivation for protection.

The framework of the PMT is displayed in Figure 1.[20] This theory includes two processes: Threat appraisal and coping appraisal; and fear is the main and axial construct of this theory.[21] Threat appraisal assesses factors affecting the likelihood of performing unhealthy behaviors, including perceived vulnerability to, perceived severity of, and perceived reward for unhealthy behavior, and fear is an intermediate variable between perceived vulnerability and perceived severity. Coping appraisal assesses one's ability to cope with and avert the threatened danger and includes perceived self-efficacy, perceived response efficacy, and perceived cost. These two cognitive processes combine with each other to form the protection motivation.[13,22] Considering the importance of investigating these constructs in health planning to help parents teach preventive behaviors of COVID-19 to children with CHD, this study was conducted with the aim to investigate the PMT constructs regarding preventive behaviors of COVID-19 in children with CHD.
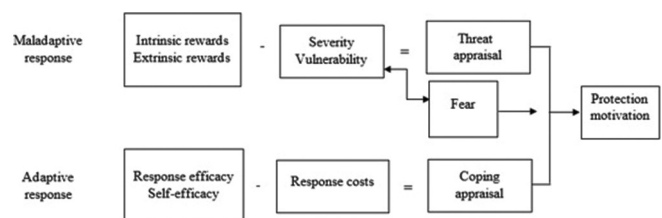

Figure 1: The framework of the protection motivation theory

Materials and Methods

Study design and setting

This cross-sectional study was conducted from March 2021 to April 2021. The study population consisted of children with CHD whose data had been registered in the Persian Registry of Cardiovascular Disease/CHD (PROVE/CHD) System in Isfahan (Iran).[23,24]

Study participants and sampling

Through initial investigation of the data registered in the PROVE/CHD System and based on the inclusion and exclusion criteria, the target population was estimated to be 350 people, out of them, a total of 240 were included in the study based on a simple randomized sampling method. First, the code of ethics was obtained from Isfahan University of Medical Sciences (IR.MUI.MED.REC.1399.926). The data of all 3–7-year-old children with CHD, who attended the three pediatric cardiologists in private offices in Isfahan and two clinics to Isfahan University of Medical Sciences (i.e., Imam Hossein (AS) Pediatric Hospital and Shahid Chamran Cardiovascular Hospital) from 2017 until now, were then extracted.

It is noteworthy that the data of the above mentioned children were registered in the PROVE/CHD System after confirming the disease by pediatric cardiologists and obtaining informed verbal and written consent from parents.

Inclusion criteria were voluntary participation of individuals in the study, 3–7-year-old children (girls and boys) with CHD whose information have been registered in the PROVE/CHD System, being residents of Isfahan province, and having access to smart cell phone or web-based software to respond to the questionnaire items.

The CHD children with mental and behavioral disorders, Down syndrome, Turner syndrome, noncardiac anomalies, and other chronic comorbidities, such as asthma, diabetes, kidney diseases, etc., were excluded from the study.

Considering the outbreak of COVID-19 in Iran and the need to comply with health protocols, the researcher made a phone call to the families of these children from Isfahan Pediatric Cardiovascular Research Center. In addition to explaining the objectives of the study to parents and putting emphasis on maintaining confidentiality of information received and full observance of ethical principles in research, the researcher obtained verbal consent from them. The parents were then provided with an explanation on how to complete the questionnaire. Depending on the age group of the population under study, the parents answered the questions about their child using the online questionnaire of the preventive behaviors of COVID-19 in 3–7-year-old children with CHD.

Data collection tool and technique

The research variables were measured using a researcher-made questionnaire designed based on the PMT constructs. The questionnaire consisted of two sections: Demographic characteristics and the PMT constructs. The demographic information included age, gender, birth order, education level, father's and mother's job, type of CHD disease, etc., The PMT constructs were assessed using 68 items and 9 main constructs: (1) Perceived vulnerability (6 items, $\alpha = 0.95$), (2) Perceived severity (7 items, $\alpha = 0.75$), (3) Fear (8 items, $\alpha = 0.90$), (4) Perceived response cost (7 items, $\alpha = 0.91$), (5) Perceived reward (5 items, $\alpha = 0.91$), (6) Response self-efficacy (7 items, $\alpha = 0.96$), (7) Protection motivation (8 items, $\alpha=0.89$), (8) Perceived self-efficacy (12 items, $\alpha = 0.89$), and (9) Behavior (8 items, $\alpha = 0.75$). The PMT questions were scored on a 5-point Likert scale ranging from 1 (absolutely disagree) to 5 (absolutely agree) and behavior questions were scored on a 5-point scale ranging from 1 (never) to 5 (always) [Table 1].

Content validity ratio (CVR) and content validity index (CVI) were used to determine the validity of the instrument. After designing questions based on references, authoritative scientific articles and the latest WHO protocols, the questionnaire was reviewed and approved by 10 expert faculty members (including 8 health education specialists and 2 pediatric cardiologists). CVI and CVR of the designed scale ranged from 0.80 to 1.00.

The reliability of the instrument was examined using Cronbach's alpha coefficient through a pilot study on 35 children aged 3–7 years under conditions similar to the target population. The reliability of the questionnaire was investigated by calculating internal consistency.

Data analysis

Finally, the collected data were analyzed using SPSS software (Version 24.0, IBM Corporation, Armonk, NY, USA), descriptive statistical tests, and inferential statistics including Pearson correlation coefficient and linear regression analysis. The KolmogorovSmirnov test was used to test the normality of the data and $P < 0.05$ was considered significant.

Results

The mean age of the participants in the study was 4.81 ± 1.50 years. About 50.8% of the participants ($n = 122$) were girls. Approximately,

Table 1: Some illustrative items of the questionnaire

PMT constructs	Questions	Scale
Perceived vulnerability	That my child becomes ill with COVID-19 depends greatly on his/her chance and destiny	Absolutely agree to absolutely disagree
Perceived severity	It may cause serious damage to his/her heart and lungs if my child becomes infected with coronavirus	Absolutely agree to absolutely disagree
Fear	I feel anxious or scared when I think my child may become infected with COVID-19 virus	Absolutely agree to absolutely disagree
Perceived response cost	It is very difficult to convince my child to use a mask outdoors	Absolutely agree to absolutely disagree
Perceived reward	My child does not put single-use masks in crowded public places because he/she can breathe easier	Absolutely agree to absolutely disagree
Response self-efficacy	Keeping a physical distance (at least 2 m) from others outdoors and indoors protects my child from becoming infected with coronavirus	Absolutely agree to absolutely disagree
Protection motivation	I am going to wash my child's hands (at least for 20 s) with soap and water after entering the house	Absolutely agree to absolutely disagree
Perceived self-efficacy	I can teach my child not to put his/her dirty hands on his/her face and eyes or to use a clean handkerchief	Absolutely agree to absolutely disagree
Behavior	I have restricted my child's outdoor activities since the outbreak of coronavirus until now, and we have only left the house when necessary	Never, rarely, sometimes, frequently, always

PMT=Protection motivation theory

48.8% of the participants (*n* = 117) lived in families of 4 persons, and 45.8% (*n* = 110) were firstborn children. About 40.4% of mothers and 37.9% of fathers held a high school diploma. About 83.3% (*n* = 200) of the mothers were housewives and 40.9% (*n* = 98) of the fathers were self-employed. The most common types of CHD among children participating in this study were related to atrial septal defect (ASD) (29.2%, *n* = 70) and ventricular septal defect (VSD) (26.7%, *n* = 64), respectively [Table 2].

The mean and standard deviation of the variables are presented in Table 3. Based on the results of the Pearson correlation coefficient test, a significant correlation is observed between the constructs perceived severity (*r* = 0.151, *P* = 0.01), perceived vulnerability (*r* = 0.281, *P* < 0.001), response efficacy (*r* = 0.420, *P* < 0.001), perceived self-efficacy (*r* = 0.469, *P* < 0.001), response cost (*r* = 0.348, *P* < 0.001), fear (*r* = 0.332, *P* < 0.001), perceived reward (*r* = 0.488, *P* < 0.001), protection motivation (*r* = 0.446, *P* < 0.001) and protective behavior against COVID-19 [Table 4].

Based on the results of the linear regression test, overall, the PMT constructs predicted 61.5% of the variance of protection motivation (*F* = 53.05, *P* < 0.001), and a significant relationship was observed with regard to response efficacy, perceived self-efficacy, response cost, fear, and perceived reward. Among these constructs, the predictive role of the perceived self-efficacy was stronger (β = 0.448). The constructs of the PMT could predict behavior by 41.0% (*F* = 23.01, *P* < 0.001). A significant relationship is observed in case of the perceived severity, response efficacy, perceived self-efficacy, response cost, fear, and perceived reward, and the perceived reward (β = 0.325) was a stronger predictor. Moreover, the protection motivation

construct predicted 19.9% of variance in protective behavior (*F* = 59.21, *P* < 0.001) [Table 5].

Discussion

Current evidence shows that similar to adults, children with diabetes, obesity, chronic lung disease or asthma, immunosuppression, and CHD can be at increased risk for severe illness from COVID-19.[11,16]

The results from the conducted studies show that cyanotic congenital heart patients, such as Tetralogy of Fallot and tricuspid valve atresia, as well as patients with pulmonary hypertension and Eisenmenger syndrome, are at higher risk for serious illness from COVID-19. The presence of structural defects in patients with CHD does not necessarily increase the risk of mortality or morbidity of the disease in individuals.[25]

The best way to prevent the 3–7-year-old children, who are not currently eligible for vaccination, from getting the coronavirus is involving parents in teaching children and taking preventive measures against the disease. Therefore, providing the required training to children who need help and guidance from parents to perform many of their activities depends on increasing parents' awareness and understanding of the principles of coronavirus prevention, adherence to health protocols, and their preventive behaviors for their children. Several studies have been conducted on the effectiveness of models, including PMT, to study and intervene with the prevention and protection-related behaviors, whose results show the impressionability of this theory.[26,27]

By increasing the parents' sensitivity to children's vulnerability, increasing the fear of getting coronavirus, and expressing the importance of taking protective

Table 2: Sociodemographic characteristics of the participants (*n*=240)

Variables	Categories	Frequency, *n* (%)
Age (years), mean±SD		4.81±1.50
Gender	Girl	122 (50.8)
	Boy	118 (49.2)
Number of family members	Three	78 (32.5)
	Four	117 (48.8)
	Five	39 (16.2)
	Six	6 (2.5)
Birth order	One	110 (45.8)
	Two	93 (38.8)
	Three	21 (8.8)
	Four	16 (6.6)
Mother's education	Elementary school	13 (5.4)
	High school	22 (9.2)
	Diploma	97 (40.4)
	Associate degree	20 (8.3)
	Bachelor's degree or higher	88 (36.7)
Father's education	Elementary school	11 (4.6)
	High school	49 (20.4)
	Diploma	91 (37.9)
	Associate degree	23 (9.6)
	Bachelor's degree or higher	66 (27.5)
Mother's occupation	Housewife	200 (83.3)
	Employed	40 (16.7)
Father's occupation	Laborer	65 (27.0)
	Employee	41 (17.0)
	Self-employed	98 (40.9)
	Engineer	23 (9.6)
	Military	10 (4.2)
	Retired	3 (1.3)
Type of CHD	ASD	70 (29.2)
	VSD	64 (26.7)
	AVSD	41 (17.1)
	AS	20 (8.3)
	PDA	18 (7.5)
	PS	14 (5.9)
	ToF	9 (3.7)
	TGA	2 (0.8)
	CoA	2 (0.8)

CHD=Congenital heart disease, ASD=Atrial septal defect, VSD=Ventricular septal defect, AVSD=Atrioventricular septal defect, AS=Aortic stenosis, PDA=Patent ductus arteriosus, PS=Pulmonary stenosis, ToF=Tetralogy of Fallot, TGA=Transposition of the great arteries, CoA=Coarctation of the aorta, SD=Standard deviation

Table 3: Mean, standard deviation, and range of scores and percentage of mean from maximum obtainable score for protection motivation theory constructs (*n*=240)

Variables	Mean±SD	Range of scores	Mean percentage (%)
Perceived vulnerability	31.24±3.89	7-35	89.2
Perceived severity	23.67±3.19	6-30	78.9
Perceived reward	11.04±3.61	5-25	46.1
Response self-efficacy	29.15±4.02	7-35	83.2
Perceived self-efficacy	51.90±6.65	12-60	86.5
Perceived response cost	22.82±5.68	7-35	65.2
Fear	34.22±5.67	8-40	85.5
Protection motivation	35.65±4.15	8-40	89.1
COVID-19 preventive behaviors	33.82±4.61	8-40	84.5

SD=Standard deviation

to the COVID-19 prevention in children, the more the parents had intention, and finally, preventive behaviors to protect their children against coronavirus. Moreover, a significant negative correlation was observed between the perceived reward and the preventive behavior of COVID-19, indicating that the more the maladaptive behaviors perceived rewards, the less is the person's intention to perform adaptive behavior and the less the person shows protection motivation and protective behavior. The study results are similar to those obtained by Xiao *et al.* that indicated a correlation between the independent variables and preventive behavior against schistosomiasis in rural students.[29] According to Bagherzadeh *et al.*'s findings, there was a positive correlation between reward and preventive behavior. It seems that this difference was due to differences in study subjects and sociodemographic characteristics of the study subjects. The study by Bagherzadeh *et al.* considered the preventive behavior of COVID-19 in elementary school students' parents, while the present study considered preventive behaviors of COVID-19 in children with CHD.[28]

Based on the results of regression analysis, the PMT constructs predicted 61.5% of protection motivation (intention) in parents of children with CHD to perform preventive behaviors of coronavirus. In this study, the response efficacy, perceived self-efficacy, response cost, fear, and perceived reward predicted the protection motivation, and the predictive role of the perceived self-efficacy was the strongest among other constructs, indicating that the parents who have higher levels of self-efficacy with regard to preventing their children from getting COVID-19 will have a higher intention and motivation to perform preventive behaviors. This study is similar to Bagherzadeh *et al.*'s study that aimed to investigate preventive health behaviors against COVID-19 in elementary school students' parents. They found that all variables in PMT predicated 94% of the

behaviors for children, it is likely that the intention to take preventive behaviors of COVID-19 in children increases. The results of similar studies show that perceived severity and perceived susceptibility are related to the risk of contracting a specific disease, and they can motivate individuals toward disease prevention.[28]

The present study showed that there is a significant correlation between all constructs of PMT and behavior. The higher the threat severity, response cost, response effectiveness, self-efficacy, and parents' fear with regard

Table 4: Pearson correlation coefficients among the constructs of protection motivation theory (n=240)

Variables	1	2	3	4	5	6	7	8	9
Perceived vulnerability	1								
Perceived severity	0.393**	1							
Perceived reward	−0.265**	−0.420**	1						
Response self-efficacy	0.434**	0.191**	−0.260**	1					
Perceived self-efficacy	0.482**	0.383**	−0.409**	0.575**	1				
Response cost	0.530**	0.191**	−0.412**	0.228**	0.220**	1			
Fear	0.588**	0.256**	0.235*	0.317**	0.449**	0.057	1		
Protection motivation	0.504**	0.350**	0.457**	0.536**	0.536**	0.950	0.507**	1	
Behaviors	0.281**	0.151*	−0.488**	0.420**	0.469**	0.348**	0.332**	0.446**	1

*Correlation is significant at the 0.05 level, **Correlation is significant at the 0.01 level

Table 5: Linear regression analysis to predict the COVID-19 preventive behaviors based on the constructs of the protection motivation theory (n=240)

Independent variables	β	SE	Beta	t	P*	Adjusted R^2 (%)	Dependent variables
Constant	14.740	2.493		5.912	<0.001	0.615	Protection motivation
Perceived vulnerability	0.075	0.060	0.070	1.259	0.209		
Perceived severity	0.014	0.063	0.011	0.230	0.818		
Response self-efficacy	0.176	0.054	0.170	3.278	0.001		
Perceived self-efficacy	0.280	0.036	0.448	7.870	<0.001		
Response cost	−0.098	0.034	−0.134	−2.882	0.004		
Fear	0.107	0.039	0.147	2.776	0.006		
Perceived reward	−0.261	0.058	−0.227	−4.502	<0.001		
Constant	16.182	2.309		7.009	<0.001	0.199	COVID-19 preventive behaviors
Protection motivation	0.495	0.064	0.446	7.695	<0.001		
Constant	23.987	3.426		7.002	<0.001	0.410	COVID-19 preventive behaviors
Perceived vulnerability	−0.027	0.082	−0.023	−0.333	0.739		
Perceived severity	−0.234	0.086	−0.162	−2.715	0.007		
Response self-efficacy	0.193	0.074	0.169	2.619	0.009		
Perceived self-efficacy	0.133	0.049	0.192	2.726	0.007		
Response cost	0.142	0.047	0.175	3.050	0.003		
Fear	0.147	0.053	0.180	2.759	0.006		
Perceived reward	−0.415	0.080	−0.325	−5.217	<0.001		

*Significant at 0.05 level. SE=Standard error

variance in preventive behavior.[28] The present study is also in agreement with the study by Bashirian *et al*., conducted with the aim to assess factors associated with preventive behaviors of COVID-19 among hospital staff. They reported that intention score was associated with an increase of 0.72 in behavior score.[30] In the present study, the protection motivation (intention) construct could predict 19.9% of the protective behaviors against coronavirus in the parents of children with CHD. As the results of regression analysis show, the PMT constructs predict 41.0% of the protective behavior of the parents of children with CHD.

The prediction of behavior by PMT constructs was reported to be 33.3% in the study by Ezati Rad *et al*. that aimed to predict COVID-19 preventive behaviors in Hormozgan, Iran,[20] and the prediction of behavior rate was estimated to be 58.8% in the study by Sadeghi *et al*. that aimed to investigate the predictive factors of protective behaviors against COVID-19 among bank employees.[31]

In this study, except for the perceived sensitivity construct, other constructs contributed to the prediction of protective behavior, and the predictive role of the perceived reward was the greatest among others. This indicates that parents do not teach the preventive behaviors of COVID-19 to their children unless they believe that the COVID-19 disease is serious and dangerous for children. Overall, perceived reward, self-efficacy, and fear were the most important constructs in this study. For intention and performing preventive behaviors of coronavirus, parents may require higher reward, self-efficacy, and fear of disease. As the parents further fear their children being infected with COVID-19, the benefits of performing preventive behaviors of COVID-19 are further perceived and the self-efficacy and performing preventive behaviors of coronavirus increase in consequence.

For protection motivation to occur in an individual, the perceived severity must overcome the maladaptive response rewards (not protecting self), and perceived

self-efficacy and perceived response efficacy must cope with the adaptive response cost (protecting self), and the fear of getting coronavirus must lead to protection motivation (intention) and performing preventive behavior.[32,33]

Strengths and limitations

Among the strengths of this study were the investigation of children with CHD as one of the high risk groups for COVID-19, limited research on this group of patients, as well as the presence of both genders of participants, and using the PMT-based instrument whose efficacy in preventive behaviors of COVID-19 has been proven.

Among the limitations of the present study we can refer to the self-report questionnaire and online completion of the questionnaire by parents that may affect the reliability of the data. One of the problems with online questionnaires was the need for parents to be members of different social networks. In this study, attempts were made to send the link of an online questionnaire to parents via different social networks, such as WhatsApp, Telegram, and Instagram, or using text messages so that they can complete the questionnaire using android smart phones. To answer any questions parents may have about the questionnaire, the researcher kept in touch with parents through social media and using text messages during the study. To reduce the error of incomplete data in questionnaires, an option was enabled in the questionnaire design so that only the data provided by people who answered all the questions would be finalized.

Conclusion

The findings of the present study show well the effectiveness of PMT on the preventive behaviors of COVID 19 in children with CHD. Given the current situation in the country and the impossibility of holding face-to-face training classes, this theory can be used to teach preventive behaviors of COVID-19 to children with CHD. Accordingly, developing educational programs and PMT-based intervention techniques is suggested with emphasis on the use of social media to change attitudes, increase perceived sensitivity, increase self-efficacy and response efficacy and reduce perceived costs to improve the intentions and behavior of parents of children with CHD.

Conflicts of interest

There are no conflicts of interest.

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