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Short Term Squeals of COVID-19 Pandemic Among Children and Adolescents with Various Hematological Disorders in Egypt

Alaa A Rashad[1*], Eman El-Bostany[1], Iman Salama[2], Ghada A Abdellatif[2], Seham MM Ragab[3], Gehan L Abelhamid[4], Azza AG Tantway[5], Eman A Elghoroury[6], Nehal Abdel Hamid[1], Abeer ES Hamed[7]

[1]Department of Paediatrics, National Research Centre, Cairo, Egypt; [2]Department of Community Medicine Research, National Research Centre, Cairo, Egypt; [3]Department of Paediatric Hematology, Menofyia University, Egypt; [4]Department of Paediatric Hematology, Menia University, Egypt; [5]Department of Paediatric Hematology, Ain Shams University, Egypt; [6]Department of Chimical &Clinical Pathology, National Research Centre, Cairo, Egypt; [7]Department of Pediatric &Neonatology, National Herat Institute, Cairo, Egypt

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***Correspondence:** Alaa A Rashad. Department of Paediatrics, National Research Centre, Cairo, Egypt. E-mail: lo2lo2eleslam@hotmail.com
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Abstract

BACKGROUND: Since its emergence, COVID-19 has hugely impacted healthcare, including pediatrics. During the COVID 19 pandemic waves, the medical follows up of pediatric patients with–hematological diseases might be negatively affected in Egypt. The aim of this study is to assess the difference in COVID 19 clinical symptoms among the studied patients and healthy controls during the pandemic. Moreover, to identify the short-term effects of COVID 19 on the medical care, knowledge, behavior, and practice among children and adolescents with hematological disorders; so that the required health services can be improved and modified to those with chronic diseases in the event of any epidemic or other disasters.

METHODS: A cross–sectional case-control study was carried out on 200 children and adolescents suffering from chronic hematologic diseases during 1st wave of COVID 19 pandemic. They were attending the hematological clinics at the National Research Centre (NRC) and three University Hospitals: Ain Shams, Menia, and Menofia. A control group of 100 non-hematologic children with matched age and sex was selected.

RESULTS: As regards the history of clinical symptoms of COVID-19; patients with hematological disorders were significantly suffering from most of COVID-19 symptoms compared to controls (P <0.05). Nearly two third (64%) of the studied patients continue visiting their hematological clinics, 15.5% had difficulty in blood transfusion, 6.0% suffered from cardiac complications due to iron overload, 6.5% complained of delay of their treatment regimens, and 8.5% contacted their doctors via telemedicine. About three quarters (77.0%) had an overall good general knowledge regarding the common clinical presentations of COVID-19 symptoms and 63.0% were ready to be vaccinated, when vaccine is available. Their main sources of knowledge were TV, radio, and the internet. Change in the behavior of pediatric patients during the epidemic wave was reported. About 56% of them wash their hands with soap and water or by alcohol 70% upon entering the house, 41.0% increased their intake of fruits and vegetables, and 17.5% practiced home physical exercise. The participants studied had a phobia from rapid spread of this epidemic (29.0%) and the lack of effective treatment (27.0%), so they avoided going to school (25.0%) and avoided talking in public transportation (25.5%) during the wave time.

CONCLUSION: The COVID-19 epidemic had affected children and adolescents with hematological disease medically as the follow-up rate decreased relatively and this led to some complications. Fortunately, the knowledge and behavior towards COVID pandemic were updated among a good percent of them. The health care administration system has to be upgraded and to develop a strategy for children with chronic diseases in the time of pandemic waves.

Introduction

Coronavirus disease 2019 (COVID-19) is a viral respiratory zoonotic disease caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). It had appeared first in 2019 in Wuhan city, China. On March 2020, it was announced as a global pandemic causing paralyzation of life in many countries [1]. Due to COVID-19 pandemic, schools across 188 countries were closed by April 2020 in order to contain the spread of the virus; leaving approximately 1.6 billion students continue their education from home [2].

The global incidence of COVID-19 among children was (7.3%) as reported by the Centers for Disease Control and Prevention in July 2020 [3]. In Egypt, children were affected like other age groups, but total incidence was less than 10% [4], but the actual number of COVID-19 cases or deaths among pediatrics with hemoglobinopathy may be underreported especially in developing or under-developed nations [5].

During the pandemic, there was pressure on all medical services with efforts at multiple system levels directed to prevent exposure to COVID-19 infection around the world. This affected chronic immune-compromised pediatric patients who were afraid to seek insufficient medical care during the pandemic [6].

In general, pediatric COVID-19 patients showed a milder clinical course compared to adults, but some reported thrombosis [7]. Pediatric patients with sickle cell disorder (SCD) and COVID-19 have a low mortality rate when compared to adults; however, comparing to the general population; SCD have a relatively higher risk for acute pulmonary illness as well as viral infections [8]. On the other hand, pediatric with thalassemic diseases do not possess an increased risk of lung infections, but transfusion-related excess iron load leads to organ hypofunction and immune deficiency [9].

COVID-19 pandemic put children and adolescents in the face of the fears of spread and hazards that may follow; which may influence their emotional fear behavior [10]. This caused chronic pediatric patients with thalassemia, SCD, and cancer to turn to telemedicine for contact with their doctor [11].

The general protective rules from WHO and UNICEF recommend that adolescents and children aged between 6 and 11 years must wash their hands with soap and water or apply a disinfectant and should wear masks [12], [13], [14], [15] very specific hemoglobinopathy patient care recommendation during the outbreak of COVID-19 during the admission of patients to blood centers /units /clinics has been published by Thalassemia International Federation [16].

The aim of the current work is to assess the short term squeals of COVID 19 on medical care, knowledge, behavior, and practice among children and adolescents with hematological disorders. In addition we aim to assess the difference in the history of COVID clinical symptoms among the studied patients and healthy controls during the pandemic; so that the required health services can be improved and modified to those with chronic diseases in the event of any epidemic or other disasters.

Methods

Study design

The study was a cross-sectional study that was conducted from October to December 2021. It was carried on 200 children who aged from 7 years to 17 years who suffering from chronic hematologic diseases. A control group of 100 healthy children, age and sex matched were enrolled. A questionnaire was designed by the study team and was fulfilled during a face to face interview with the studied participants and their parents, after signing a written consent. During the interview, data was collected on general demographics (age, sex, and education), history of any clinical symptoms of COVID-19, and hematological disease follow up.

Data collection

The studied participants attended the hematological clinics of National Research Centre (NRC) and Ain Shams, Menia and Menofia University Hospitals, Egypt. COVID-19 knowledge and practices regarding the prevention and control measures were also assessed. The study was approved by the ethical committees of the NRC, Egypt.

Table 1: History of clinical symptoms of COVID-19 among the studied participants

Symptoms	Patients with hematological disorders (200) N (%)	Controls (100) N (%)	P value
Fever			
Yes	21 (10.5)	0 (0.0)	**<0.001****
No	179 (89.5)	100 (100)	
Coughing			
Yes	26 (13.0)	29 (29.0)	**<0.001****
No	174 (87.0)	71 (71.0)	
Sneezing			
Yes	29 (14.5)	33 (33.0)	**<0.001****
No	171 (85.5)	67 (67.0)	
Sour throat			
Yes	17 (8.5)	36 (36.0)	**<0.001****
No	183 (91.5)	64 (64.0)	
No smell and taste			
Yes	11 (5.5)	0 (0.0)	**0.017***
No	189 (94.5)	100 (100)	
Bone and muscle pain			
Yes	23 (11.5)	0 (0.0)	**<0.001****
No	177 (88.5)	100 (100)	
Anorexia			
Yes	23 (11.5)	29 (29.0)	**<0.001****
No	177 (88.5)	71 (71.0)	
Contact with a suspected COVID-19 case			0.434
Yes	13 (6.5)	9 (9.0)	
No	187 (93.5)	91 (91.0)	

*P <0.05, ** p <0.01.

Sampling

To the best of our knowledge at the time of sample size calculation, no published research reported about COVID-19 among Egyptians hematological pediatrics patients. The minimum required sample size calculated using Epi Info was 194 subjects. The actual sample size collected was 300 subjects.

Statistical analysis

Data analysis was done using IBM Statistical Package for the Social Sciences (SPSS) version 25.0. Qualitative data was presented in frequencies and percentages. Quantitative data was presented as mean and standard deviation. Chi-squared test was used for measuring differences. P value < 0.05 was considered significant and p < 0.01 was considered highly significant.

Results

The mean age among patients with hematological disorders was 9.0 ± 4.8 years and 57.5% of them were males. While the mean age among non-hematological participants was 9.8 ± 5.3 years and 57.0% of them were males, with no significant differences between the two groups, P > 0.05. Regarding the history of clinical symptoms of COVID-19, Table 1 shows that pediatric patients with hematological disorders were significantly suffering from most COVID-19 symptoms compared to controls (P <0.05). Table 2 shows a comparison between the three hospitals regarding the major COVID-19 symptoms among hematological infected pediatrics, all COVID-19 symptoms were significantly different (P <0.05).

Table 2: History of clinical symptoms of COVID-19 among the participants studied from the 3 hospitals

Symptoms	Cairo (30) N (%)	Menofia (120) N (%)	Menia (50) N (%)	Total 200 N (%)	P value
Fever					
Yes	5 (16.7)	16 (13.3)	0 (0.0)	21 (10.5)	**0.017***
No	25 (83.3)	104 (86.7)	50 (100.0)	179 (89.5)	
Coughing					
Yes	7 (23.3)	18(15.0)	1 (2.0)	26 (13.0)	**0.014***
No	23 (76.7)	102 (85.0)	49 (98.0)	174 (87.0)	
Sneezing					
Yes	7 (23.3)	21 (17.5)	1 (2.0)	29 (14.5)	**0.011***
No	23 (76.7)	99 (82.5)	49 (98.0)	171 (85.5)	
Sour throat					
Yes	5 (16.7)	12 (10)	0 (0.0)	17 (8.5)	**0.023***
No	25 (83.3)	108 (90.0)	50 (100.0)	183 (91.5)	
No smell and taste					
Yes	4 (13.3)	7 (5.8)	0 (0.0)	11 (5.5)	**0.039***
No	26 (86.7)	113 (94.2)	50 (100.0)	189 (94.5)	
Bone and muscle pain					
Yes	4 (13.3)	19 (15.8)	0 (0.0)	23 (11.5)	**0.012***
No	26 (86.7)	101 (84.2)	50 (100.0)	177 (88.5)	
Anorexia					
Yes	4 (13.3)	19 (15.8)	0 (0.0)	23 (11.5)	**0.012***
No	26 (86.7)	101 (84.2)	50 (100.0)	177 (88.5)	
Contact with a suspected COVID-19 case					
Yes	7 (23.3)	6 (5.0)	0 (0.0)	13 (6.5)	**<0.001****
No	23 (76.7)	114 (95.0)	50 (100.0)	187 (93.5)	

*P <0.05, ** p <0.01.

Table 3 illustrates the short term squeals of COVID pandemic on the follow-up of children and adolescents who suffer from chronic hematologic diseases. Regular follow up with the blood clinic was decreased to 64.0%, while receiving the blood transfusion and medicine were interrupted among 15.5% and 6.5% respectively with significant differences between the three studied hospitals (P <0.05). About, 8.5% of the studied patients reported communication with their doctors through WhatsApp during the pandemic with significant difference between the three hospitals (P =0.04).

Table 4 shows the knowledge of the studied patients towards COVID-19 infection. About 77.0% of the studied patients were aware of the general symptoms of COVID 19 (fever, tired, and cough, sneezing, sore throat, and diarrhea). Difficulty in breathing that needs hospitalization was known by 81.0% of them. While 69.0% knew that infected pediatrics with COVID-19 may not have any apparent symptoms (p <0.05).

Table 3: Comparison between the 3 hospitals regarding hematological disease follow up among the participants studied from the 3 hospitals

Follow up	Cairo (30) N (%)	Menofia (120) N (%)	Menia (50) N (%)	Total 200 N (%)	P value
Affecting your visit blood clinic					
Yes	22 (73.3)	79 (65.8)	28 (56.0)	128 (64.0)	0.270
No	9 (30.0)	41 (34.2)	22 (44.0)	72 (36.0)	
Frequency of visiting blood clinic					
Weekly	3 (10.0)	15 (12.5)	12 (24.0)	30(15.0)	
Monthly	23 (76.7)	79 (65.8)	26 (52.0)	128 (64.0)	0.320
Decreased due to fear from Corona	4 (13.3)	26 (21.7)	12 (24.0)	42 (21.0)	
High blood pressure					
Yes	2 (6.7)	12 (10.0)	3 (6.0)	17 (8.5)	0.420
No	28 (93.3)	108 (90.0)	47 (94.0)	183 (91.5)	
Cardiac problems					
Yes	2 (6.7)	2 4(20.0)	0 (0.0)	26 (13.0)	**0.01****
No	28 (93.3)	96 (80.0)	50 (100.0)	174 (87.0)	
Skin problems					
Yes	0 (0.0)	9 (7.5)	7 (14.0)	16 (8.3)	0.200
No	30 (100.0)	111 (92.5)	43 (86.0)	184 (92.0)	
Muscle and joint weakness					
Yes	5 (16.7)	17 (15. 0)	0 (0.0)	22 (11.0)	**0.040***
No	26 (86.7)	102 (85.0)	50 (100.0)	178 (89.0)	
Hospital admission					
Yes	4 (13.3)	14 (11.7)	5 (10.0)	23 (11.5)	0.870
No	26 (86.7)	106 (88.3)	45 (90.0)	177 (88.5)	
Blood transfusion affection					
Yes	18 (60.0)	52 (43.3)	12 (24.0)	82 (41.0)	**0.020***
No	12 (40.0)	68 (56.7)	38 (76.0)	118 (59.0)	
Drug intake affection					
Yes	7 (23.3)	5 (4.2)	1 (2.0)	13 (6.5)	**<0.001****
No	23 (76.7)	115(95.8)	49 (98.0)	187 (93.5)	
Contact doctor via WhatsApp					
Yes	4 (13.3)	13 (10.8)	0 (0.0)	17 (8.5)	**0.040***
No	26 (86.7)	107 (89.2)	50 (100.0)	183 (91.5)	

*P <0.05, ** p <0.01.

The pandemic COVID-19's precautionary measures among the studied participants is shown in Table 5. Isolation if infected was pursued by 72.5% and washing hands with soap and water or using alcohol 70% when returning home was done by 56.5%. Most of the hematological children and adolescents (85.5%) bought face-masks. 47.5% wore their masks when leaving the house and 77.0% in public places while infected. The Infection changed their food habits of hematological patients in light of this disease. Their consumption of fruits, vegetables and Vit C increased by 41.0% and 25.5% respectively. Online marketing had been increased by 12% during the pandemic. Around two thirds of them (61.5%) helped in feeding isolated patients with COVID-19. Only 17.5% of infected teens were physically active at home with significant difference between the three hospitals (p <0.05). Table (5) also shows that one quarter of the pediatric patients with hematological disorders were feared from COVID-19 pandemic, so they stopped attending school, avoided talking in public transportations, and avoided overcrowded public transportations at the time of COVID-19's peak. While 15% avoided overcrowded supermarkets at that time. More than one third of the studied participants were

following COVID-19 news through a TV, radio or the internet (39.5%). Two thirds of them were ready to be vaccinated (63%) with significant difference between the three hospitals (p <0.05).

Table 4: Knowledge towards mode of transmission of COVID-19 infection among the studied participants from the 3 hospitals

Variables	Cairo (30) N (%)	Menofia (120) N (%)	Menia (50) N (%)	Total (200) N (%)	P value
Transmit by respiratory droplets					
Yes	27 (90.0)	103 (85.8)	42 (84.0)	172 (86.0)	0.841
No	2 (6.7)	6 (5.0)	4 (8.0)	12 (6.0)	
Do not know	1 (3.3)	11 (9.2)	4 (8.0)	16 (8.0)	
Transmit by touching infected surfaces					
Yes	26 (86.6)	101 (84.2)	38 (76.0)	165 (82.5)	0.290
No	2 (6.7)	8 (6.6)	9 (18.0)	19 (9.5)	
Do not know	2 (6.7)	11 (9.2)	3 (6.0%)	16 (8.0)	
Infected patients without any apparent symptoms					
Yes	25 (83.3)	86 (71.7)	27 (54.0)	138 (69.0)	**0.009****
No	2 (6.7)	15 (12.5)	16 (32.0)	33 (16.5)	
Do not know	3 (10.0)	19 (15.8)	7 (14.0)	29 (14.5)	
Symptoms as fever, tired, and cough					
Yes	26 (86.6)	94 (78.3)	34 (68.0)	154 (77.0)	**0.005****
No	2 (6.7)	14 (11.7)	16 (32.0)	32 (16.0)	
Do not know	2 (6.7)	12 (10.0)	0 (0.0)	14 (7.0)	
Symptoms as sneezing, sore throat, and diarrhea					
Yes	23 (76.6)	97 (80.9)	34 (68.0)	154 (77)	**0.003****
No	2 (6.7)	13 (10.8)	16 (32.0)	31 (15.5)	
Do not know	5 (16.7)	10 (8.3)	0 (0.0)	15 (7.5)	
80% of patients recover without treatment					
Yes	17 (56.7)	78 (65.8)	30 (60.0)	125 (62.5)	0.189
No	3 (10.0)	18 (15.0)	12 (24.0)	33 (16.5)	
Do not know	11 (36.7)	23 (19.2)	8 (16.0)	41 (21.0)	
Most serous symptom is difficult breathing which need hospitalization					
Yes	26 (86.6)	101 (84.2)	35 (70.0)	162 (81.0)	**0.006****
No	2 (6.7)	6 (5.0)	12 (24.0)	20 (10.0)	
Do not know	2 (6.7)	13 (11.8)	3 (6.0)	18 (9.0)	

*P <0.05, ** p <0.01.

Knowledge and behavior of the studied participants at the time of the COVID-19 pandemic are shown in Table 6. Most of the hematological patients (82.5%) knew that the COVID-19 virus was highly infectious. The most important reason for the spread of COVID-19 was the person's behavior (49%), and the COVID-19 virus could cause death to the infected patient (60.5%) with a significant difference between the three hospitals (p <0.05).

Only 22.5% knew that it can be cured. The most annoying things that frightened them were the rapid spread of the COVID-19 virus (29%), there was no effective treatment or vaccine (27%), and severe pain when infected (26%).

Discussion

Medical effect of COVID-19 epidemic on Egyptian hematological pediatric patients

The lockdown of COVID-19 epidemic has affected routine care for hematological pediatric patients in our country. Similarly, in Pakistan, Iran, Bangladesh and India, thalassemic pediatric patients were missing their follow up sessions with rising cases of COVID-19 [17], [18],[19], [20]. In Swedish pediatric oncology and hematology patients, the prevalence of regularity follow-up of patient was low in the beginning of epidemics 2020, then the number of clinic visitor was increased in 2021 [21].

Table 5: Practices concerning COVID-19 among the studied participants from the 3 hospitals

Variables	Cairo (30) N (%)	Menofia (120) N (%)	Menia (50) N (%)	Total (200) N (%)	P value
Clean house with chlorine more than before					
Always	13 (43.3)	59 (49.2)	31 (62.0)	103 (51.5)	0.452
Sometimes	15 (50.0)	56 (46.6)	18 (36.0)	89 (44.5)	
No	2 (6.7)	5 (4.2)	1 (2.0)	8 (4.0)	
Wear mask when go out from the house					
Always	5 (16.7)	60 (50.0)	30 (60.0)	95 (47.5)	**0.013***
Sometimes	20 (66.6)	53 (44.2)	15 (30.0)	88 (44.0)	
No	5 (16.7)	7 (5.8)	5 (10.0)	17 (8.5)	
Wash hands with soap and water or by alcohol 70% when return to home					
Always	9 (30.0)	67 (55.8)	37 (74.0)	113 (56.5)	**0.002****
Sometimes	20 (66.7)	45 (37.5)	12 (24.0)	77 (38.5)	
No	1 (3.3)	8 (6.7)	1 (2.0)	10 (5.0)	
Keep social distancing for at least 1m					
Always	7 (23.3)	53 (44.2)	19 (38.0)	79 (39.5)	0.055
Sometimes	22 (73.3)	52 (43.3)	24 (48.0)	98 (49.0)	
No	1 (3.3)	15 (12.5)	7 (14.0)	23 (11.5)	
Cover mouth and nose by tissue or your clothes during sneezing or coughing					
Always	17 (56.7)	65 (54.2)	37 (74.0)	119 (59.5)	0.153
Sometimes	9 (30.0)	45 (37.5)	11 (22.0)	65 (32.5)	
No	4 (13.3)	10 (8.3)	2 (4.0)	16 (8.0)	
Practice physical exercise at home					
Always	3 (10.0)	24 (20.0)	8 (16.0)	35 (17.5)	**<0.001****
Sometimes	10 (32.3)	68 (56.7)	1 (2.0)	79 (39.5)	
No	17 (56.7)	28 (23.3)	41 (82.0)	86 (43.0)	
Stop usage of crowded public transportation					
Always	2 (6.7)	26 (21.7)	18 (36.0)	46 (23.0)	**<0.001****
Sometimes	13 (43.3)	66 (55.0)	9 (18.0)	88 (44.0)	
No	15 (50.0)	28 (23.3)	23 (46.0)	66 (33.0)	
Follow COVID-19 news in TV, radio, or internet					
Always	9 (30.0)	42 (35.0)	28 (56.0)	79 (39.5)	**0.012***
Sometimes	17 (56.7)	53 (44.2)	21 (42.0)	91 (45.5)	
No	4 (13.3)	25 (20.8)	1 (2.0)	30 (15.0)	
Will be vaccinated					
Yes	25 (83.3)	59 (49.2)	42 (84.0)	126 (63.0)	**<0.001****
No	5 (16.7)	61 (50.8)	8 (16.0)	74 (37.0)	
Will be isolated if infected					
Yes	23 (76.7)	77 (64.2)	45 (90.0)	145 (72.5)	**0.003****
No	8 (26.7)	43 (35.8)	5 (10.0)	75 (37.5)	
Wear mask in public places if infected					
Yes	26 (86.7)	80 (66.7)	48 (96.0)	154 (77.0)	**<0.001****
No	4 (13.3)	40 (33.3)	2 (4.0)	46 (23.0)	
Go to school or college if you have exam and COVID-19 symptoms					
Yes	19 (63.3)	27 (22.5)	10 (20.0)	56 (28.0)	**<0.001****
No	11 (36.7)	93 (77.5)	40 (80.0)	144 (72.0)	
Go to school or college if no. of COVID-19 cases increased					
Yes	18 (60.0)	21 (17.5)	11 (22.0)	50 (25.0)	**<0.001****
No	12 (40.0)	99 (82.5)	39 (78.0)	150 (75.0)	
If sit in a clinic near person with cough					
- nothing	2 (6.7)	4 (3.3)	2 (4.0)	8 (4.0)	
- move away	9 (30.0)	40 (33.3)	32 (64.0)	81 (40.5)	**0.007****
- ask him to leave	9 (30.0)	47 (39.2)	13 (26.0)	69 (34.5)	
- leave the place and wash face & hands	10 (33.3)	29 (24.2)	3 (6.0)	42 (21.0)	

*P <0.05, ** p <0.01.

In the current study, clinic visits have decreased with the fear of the infection and the emergence of telemedicine as an alternative method for non-critical cases among the studied participants.

Table 6: attitude at the time of COVID-19 pandemic among the participants studied from the 3 hospitals

Variables	Cairo (30) N (%)	Menofia (120) N (%)	Menia (50) N (%)	Total (200) N (%)	P value
High possibility to be infected with COVID-19 virus					**<0.001****
Yes	28 (93.3)	89 (74.2)	48 (96.0)	165 (82.5)	
No	2 (6.7)	31 (25.8)	2 (4.0)	35 (17.5)	
Infection with COVID-19 virus causes death					
Yes	29 (96.7)	90 (75.0)	2 (4.0)	121 (60.5)	**<0.001****
No	1 (3.3)	30 (25.0)	48 (96.0)	79 (39.5)	
Person behavior causes transmission of COVID-19 virus					
Yes 50%	18 (60.0)	70 (58.4)	2 (4.0)	90 (45.0)	**<0.001****
Yes 100%	11 (36.7)	40 (33.3)	47 (94.0)	98 (49.0)	
No	1 (3.3)	10 (8.3)	1 (2.0)	12 (6.0)	
Most annoying thing:					
• Rapid spread	5 (18.5)	36 (31.9)	17 (56.7)	58 (29.0)	
• Cause death and prevent from praying	5 (18.5)	16 (14.2)	9 (30.0)	30 (15.0)	
• No effective treatment or vaccine	8 (29.6)	46 (40.7)	0 (0.0)	54 (27.0)	**<0.001****
• Patient may be infectious without symptoms	0 (0.0)	6 (5.3)	0 (0.0)	6 (3.0)	
• Patient feels severe pain	12 (66.6)	16 (8.0)	24 (13.3)	52 (26.0)	

*P <0.05, ** p <0.01.

In Egypt, blood-banks had shortages during the epidemics and this reflected to the blood transfusions sessions among pediatric Transfusion-Dependent Thalassemia (TDT). Several international organizations suggested that blood donation showed be delayed for 21 days after a potential exposure to a laboratory-confirmed COVID-19 patient [22]. Similarly, blood transfusion services for transfusion-dependent hematological pediatric patients were reported insufficient during epidemics in studies from: Pakistan, India and Saudi Arabia [17], [20], [23]. On the other hand, in Turkey, the blood needs could be provided well during the COVID-19 epidemic among thalassemic pediatric patients [24] and SCD pediatric patients in Brazil, USA, and UK [25], [26]. Recruiting voluntary donors is a big challenge in developing countries due to a lack of awareness.

Our study reported cardiac complications among hematological pediatric patients which was secondary to iron overload and inadequate chelation therapy. Vilela et al [25] in Brazil stated that pediatric SCD patients with COVID-19 needed more intensive care due to vaso-occlusive crisis (VOC) and acute chest syndrome (ACS). In UK, Whittaker et al [27] studied 58 children with Kawasaki like disease associated with COVID-19, only one of them had sickle cell trait. A national survey conducted during the year 2020 across the French reference centers for hemoglobinopathies identified four COVID-19 hematological pediatric patients but without sever complications [28]. Studies in Oman and USA, reported that SCD pediatric patients recovered from COVID infection without complications [29], [30]. Pediatric with hematological disorders are considered to be at high risk and prone to complications depending on the presence of co-morbidities, the degree of iron overload and a history of splenectomy.

Treatment of blood diseases like iron chelation was affected by COVID-19 epidemic among the studied Egyptian hematological pediatric patients due to the stoppage of the treatment during febrile period and to less extent from a shortage of medicines in the market at the time of the epidemic. It must be emphasized that it is recommended for all transfusion-dependent thalassemia major patients to stop iron chelation therapy when the patient feels febrile until the fever has resolved, and the cause of fever has been medically assessed [31].

In India and Afghanistan, during COVID-19 epidemic, children with thalassemia faced lack of vital iron chelation drugs [20], [21], [22], [23], [24], [25], [26], [27], [28], [29], [30], [31], [32]. At a time, researchers in Iran directed their research on the importance of the antiviral effect of hydroxyurea (HU) indicated in SCD pediatric patients with COVID [8]. Other authors in Iran and Italy studied the importance of iron chelation drug were shown to reduce iron availability in the serum and body tissue, preventing lung injury and fibrosis following COVID-19 infection [33], [34].

Symptoms of COVID-19 were mild to moderate among 23 studied Egyptian hematological pediatric patients admitted to inpatient with full recovered. As our results, researchers in Cyprus, Southeast Asia, and Italy found that pediatrics with thalassemia had mild clinical presentation of SARS-CoV-2 infection [35], [36]. While, Atmakusuma founded that there was some area with a higher COVID-19 symptoms in pediatric thalassemia if compared with general population [35]. Jean-Mgnarfd [28] concluded that COVID-19 in thalassemia young patients was associated with a high rate of hospitalization and complications. Moreover, Sundberg et al [21] stated that pediatric oncology and hematology patients may be at increased risk of severe COVID-19 due to their underlying disease or treatment. SCD pediatric patients had either asymptomatic or presented with mild symptoms of COVID. However, sickle cell disease was classified as a risk factor for severe COVID-19 disease in both adults and pediatric patients [25]. Differences in morbidity and mortality of COVID-19 among hematological pediatric patients might be affected by several factors, such as organ dysfunction due to chronic complication, inadequate therapy, and unavailability of specialized COVID-19 referral hospital for such patients.

Telemedicine has become an emerging issue during the pandemic period, but only 8.5% hematological pediatric patients and their families in the current study would prefer to rely on it. The biggest problem facing telemedicine was irregularity blood transfusion schedules which may expose the patients to many complications due to drop and postpone their session. On other hand, in USA and UK, 92% children

with sickle cell disease used telehealth [26]. Similarly, in India, kumar et al [37] found more than 75.0% of hematological pediatrics patients interested in telemedicine. However, Arian et al [38] in Iran, reported another view during the COVID-19 pandemic, most pediatrics with thalassemia and their parents shifted their care from the hospital's outpatient settings to physician offices or requested a home visit.

Knowledge towards COVID-19 among Egyptian hematological pediatric patients

The majority of our Egyptian pediatric patients in this study had overall good general knowledge regarding the common clinical presentations and the hazards complications like difficult breathing and hospitalization. Elsakka & Shehata et al [39], [40] concluded that Egyptian children and adolescents are knowledgeable about basic COVID-19 information, but other Egyptian researchers found lower levels of awareness associated with the rural residence and low socio-economic standard [40], [41]. In Norway, information about COVID-19 was not sufficient to some adolescents especially about quarantine rules and who belonged to high-risk groups [42]. Our research subjects were chronic immune-compromised patients, thus, their interest in knowing COVID-19 information is more than their peers of the same age who were non-chronic patients.

More than one third of the studied participants knew COVID-19-related information by following TV, radio, and internet. One Jordanian paper added the school to television and social media as sources of information on COVID-19 [43]. The majority of adolescents in Norway used the Facebook App and online newspapers for COVID-19 news but the family information was rated as the main source of information [42].

About two third of the studied participants were agreed to be vaccinated with COVID-19 vaccine. Globally, equitable access to safe and effective vaccines for all age groups is critical to ending the COVID-19 pandemic [43], [44], [45], [46].

Anxiety behavior towards COVID-19 among Egyptian hematological pediatric patients

We observed phobia among the hematological pediatric patients studied from rapid spread of COVID-19 and this is reflected in their behavior as they avoided talking in public transportation and even did not go to school at a time of epidemic wave.

One study among Iranian teenage patients with thalassemia and COVID-19 reported a strong reduction in social functioning and felt lonely [38]. On the other hand, SCD pediatric patients included in one study in Turkey were not suffered from elevated anxiety behavior in relation to general population. They explained this by that SCD did not appear in the media or in public service ads as a risky chronic condition (like hypertension and diabetes) during the COVID-19 outbreak in Turkey [47].

Several published studies conducted in China, Canada, Germany, US, and Australia had assessed adolescent mental health in response to the COVID-19 pandemic [48], [49], [50], [51], [52], [53], [54], [55], [56], [57], [58] which collectively showed that the prevalence of mental illness was elevated and the most important types of mental illness were anxiety, depression, feelings of isolation, and loneliness which were affected their overall behavior attitude. Also, a lack of social connection has negative consequences on social and cognitive development, as well as disruption to learning and education had been reported [49], [59], [60]. But on another study in Norway, some adolescents were not concerned about becoming infected with COVID-19 although they well- informed about it [42].

Precautionary measures and change in COVID-Eating (COV-EAT) and physical activity of Egyptian hematological pediatric patients towards COVID-19

Egyptian hematological pediatric patients had positive practice towards COVID-19 they adhered to the precautionary measures as isolation of infected patient, wearing a mask, and washing hands with soap and water or by alcohol 70% when return to home. Shehata et al [40] reported a good practice from Egyptian school students as they were keen on hand washing directly when coming from outside, followed the instructions of staying at home, and they had worn face-mask when going outside home.

A Chinese study was conducted on primary school children found satisfactory practice of hand-washing as well as had a proper practice of mask wearing [61], other studies in USA and Turkey found these positive practice in more than 90% of adolescents [62], [63]. But on the other hand, percentage of adolescents who showed poor knowledge on COVID-19, had negative attitudes toward protective measures and reported being engaged in risky practices related to infection spread [43].

Subsequently to the lockdown of COVID-19 epidemic, the daily routines lifestyle as physical activity and food habits had been changed. Near to one fifth of the studied participants practiced physical exercise at home during the time of lockdown of COVID-19. Most studies (57 studies) that were done on the effects of COVID-19 lockdown on children and teens physical activity reported a decrease in physical activity, both in duration and frequency [64]. Four studies in Canada, British Columbia, Sweden, and Hong Kong identified an increase in physical activity [65-68], whereas six studies in Italy, Croatia, Poland, Australia, Pakistan, and Ireland could detect no significant difference in physical activity before and during the pandemic [69], [70], [71[], [72], [73], [74].

COV-EAT was the term given to the nature and type of eating at the time of the epidemic were different from pre-epidemic food habit. More than a third of the hematological pediatric patients studied increased intake of fruits and vegetables during the time of lockdown. In Italy, a study found an increase in vegetable, fresh fruit and legume intake in children and adolescent food (19%) [75]. While other researches on dietary pattern of children and adolescent during COVID-19 in Egypt, Greek, India, and Kuwait studies showed increased consumption of salty snacks, and total snacks associated with increasing in body weight also there was decreased in physical activity [76], [77], [78], [79]. A study in Brazil showed that the social isolation affected the eating habits of children and adolescents presented as consumption of un-healthy food, especially those among the lower class [80].

The participants studied had chronic blood diseases and this reflected on parents' concerns, selecting healthy food that strengthened the immune system and prevented their children from outdoors eating as well as encouraged them to increasing physical exercise.

Strengths and limitations

The scarcity of studies on COVID-19 with hematological disorders in children and adolescent patients did not allow comparison of all findings of this study, however, the current study , as far as we know, is the first study to explore the collateral effects of the COVID-19 pandemic on hematological pediatric patients in Egypt and provides an initial overview about COVID-19 with hematological disorders in pediatrics and indicates the importance of policies that appeal to chronic pediatric patients. Also, this study revealed a good amount of awareness among Egyptian pediatric hematological patients toward the symptoms of COVID-19 epidemic, as well as the positivity of their behaviors and practices to protect themselves and prevent the spreading of the epidemic.

Conclusion

The COVID-19 epidemic has affected Egyptian children and adolescents with hematological disease medically as the follow-up rate decreased relatively and this led to some complications. Also, COVID-19 affects their knowledge and behaviors for protecting themselves and to prevent the spreading of the epidemic.

Recommendations

COVID-19 was a rapidly emerging pandemic that threatens chronic pediatric hematological patients, but so far; studies that have been conducted on the association between hemoglobin disorders and COVID-19 are still inadequate. Future multi-center studies are recommended, with larger sample sizes and SCD-modifying therapies on COVID-19 outcome. Up to that time, the general protocols are to be maintained strictly for hematological patients while some protocols are specifically recommended for them.

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