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# Risk factors associated with length of hospital stay in children and adolescents with coronavirus disease 2019 in Egypt

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## Abstract

### Background

With the growing incidence of children with coronavirus disease 2019 (COVID-19), the hospitalization rate in this age category has been increasing. This study aimed to assess the length of hospital stay (LOS) among children with COVID-19 and examine potential risk factors.

### Patients and methods

We retrospectively collected data on 50 consecutive children and adolescents with mild to moderate COVID-19 who were discharged after treatment from one hospital in Egypt during July 2020. Betas (*Bs*) and their 95% confidence intervals (CIs) for the association of patients' sociodemographic and clinical characteristics with their LOS were computed using unadjusted and multivariable-adjusted linear regression models.

### Results

The average LOS was 8.3 days (median 9 days). Presenting with fever, cough, and ground-glass opacity in radiograph was associated with longer LOS in the unadjusted model with *Bs* (95% CIs): 4.30 (1.07, 7.52), 3.50 (0.34, 6.66), and 5.55 (2.72, 8.37), respectively. In the multivariable-adjusted model, only ground-glass opacity in radiograph remained statistically associated with longer LOS (*B* = 4.75, 95% CI: 0.31, 9.20).

### Conclusion

Children and adolescents with COVID-19 stayed in the hospital for a relatively short period. Selected clinical and radiological findings may be associated with longer LOS.

**Keywords:** Adolescents, children, coronavirus disease 2019, length of hospital stay

## INTRODUCTION

On the 11<sup>th</sup> of March 2020, the WHO declared the novel coronavirus disease 2019 (COVID-19) a pandemic [1]. As on the morning of the 4<sup>th</sup> of October 2020, a total of 34 804 348 confirmed cases and 1 030 738 related deaths have been reported [2]. Children of all ages are susceptible to COVID-19, though with generally less severe symptoms compared with those of adult patients. Still, they can potentially contribute to the spread of COVID-19 [3–5].

The dramatic rise in COVID-19-infected patients has represented a challenge to health care systems worldwide and raised serious concerns about the potential effects of the COVID-19 pandemic

on the low-income and middle-income countries (LMICs) in particular [6]. Given the limited infection control precautions, hospital capacity, and public health resources [7], the response to the COVID-19 pandemic in LMICs would be frail. Despite the situation in health care settings offering health services to

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children with COVID-19 would be better than those offering similar services to adult patients owing to the relatively milder manifestations of children, the huge influx of children with COVID-19 can overwhelm the health care system capacity especially in LMICs.

Thus, assessing the available health care services as opposed to the influx of patients with COVID-19 whether children or adults is mandatory to determine the demand for hospital services whether during this pandemic or next waves of infection. To precisely detect the need for hospital services, it is crucial to assess how long each patient will require hospitalization, that is, length of hospital stay (LOS). Previous reports from China and other countries examined the average LOS among patients with COVID-19 [8–16]; however, most of these studies focused on adult patients rather than children and did not figure out the associations with LOS.

We, therefore, conducted this study to retrospectively assess the average LOS among children with COVID-19 in one Egyptian hospital and examine possible risk factors for longer LOS. As Egypt is among the LMICs that were severely stricken by the COVID-19 [2], we assume that the results of this study may help in detecting the duration of hospital bed demands in health care settings hosting children with COVID-19 in the country and consequently would allow more accurate decision making.

## PATIENTS AND METHODS

### Patients

In this study, we retrospectively collected data on 50 consecutive children and adolescents aged less than or equal to 18 years with mild to moderate COVID-19 and were discharged after treatment from Imbaba Fever Hospital in Egypt throughout July 2020. All patients were diagnosed with COVID-19 using the reverse transcription PCR of nasopharyngeal swab samples that were performed per the protocol established by the WHO [17].

### Assessment of risk factors and the length of hospital stay

The following sociodemographic and clinical data were collected from the hospital records: age (years), sex (male or female), residence (urban or rural), exposure to a patient with COVID-19 (yes or no), presenting with fever (yes or no), tachycardia (yes or no), tachypnea (yes or no), cough (yes or no), rhinitis (yes or no), diarrhea (yes or no), vomiting (yes or no), radiograph findings (ground-glass opacity, atypical opacity, or clear), and blood levels of hemoglobin, platelets, total white blood cells, neutrophils, and lymphocytes. All these variables were investigated as possible risk factors for longer LOS. On the contrary, LOS, the outcome, was defined as the period between the date of admission and the date of discharge after testing negative for COVID-19 using reverse transcription PCR in two consecutive swabs.

### Ethical considerations

The study was approved by the General Organization for Teaching Hospitals and Institutes in Egypt. Verbal assent was

obtained from the included children and adolescents before their guardians signed their informed consent. The study was conducted according to the Declaration of Helsinki and the guidelines for Good Clinical Practice.

### Statistical analyses

The Statistical Package for Social Science (SPSS), version 22.0 (IBM SPSS Statistics for Windows; IBM Corporation, Armonk, New York, USA) was used for data analysis. In Table 1, we conducted descriptive analyses in the form of frequencies and percent for categorical data and means with corresponding SDs for numeric data. In Table 2, linear regression was used to detect the association of patients' sociodemographic and clinical characteristics with their LOS in the form of unadjusted Betas (*B*s) and their corresponding 95% confidence intervals (CIs). Variables that showed statistically significant associations in the unadjusted models were included in a multivariable-adjusted model.

## RESULTS

The age of the included children ranged between 1 and 18 years (mean  $\pm$  SD: 13.07  $\pm$  4.89 years). Of them, 56.0% were males and 76.0% were living in urban areas. Most of children presented with fever (82.0%), cough (80.0%),

**Table 1: Sociodemographic and clinical characteristics of children and adolescents with coronavirus disease 2019 in Egypt**

Characteristics	<i>n</i> = 50 [ <i>n</i> (%)]
Age (years) (mean $\pm$ SD)	13.07 $\pm$ 4.89
Sex	
Male	28 (56.0)
Female	22 (44.0)
Residence	
Urban	38 (76.0)
Rural	12 (24.0)
Exposure to COVID-19-infected patient	27 (54.0)
Fever	41 (82.0)
Tachycardia	17 (34.0)
Tachypnea	15 (30.0)
Cough	40 (80.0)
Rhinitis	35 (70.0)
Diarrhea	8 (16.0)
Vomiting	3 (6.0)
Radiograph	
Ground-glass opacity	31 (62.0)
Atypical opacity	8 (16.0)
Clear	11 (22.0)
Hemoglobin (g/dl) (mean $\pm$ SD)	12.49 $\pm$ 1.53
Platelets (10 $\times$ 9/l) (mean $\pm$ SD)	250.07 $\pm$ 54.62
WBCs (10 $\times$ 9/l) (mean $\pm$ SD)	5.83 $\pm$ 2.45
Neutrophils (10 $\times$ 9/l) (mean $\pm$ SD)	3.42 $\pm$ 2.07
Lymphocytes (10 $\times$ 9/l) (mean $\pm$ SD)	2.73 $\pm$ 0.83
NLR (mean $\pm$ SD)	1.66 $\pm$ 2.40
Length of hospital stay (days) (mean $\pm$ SD)	8.30 $\pm$ 4.62
Deaths	0

COVID-19, coronavirus disease 2019; NLR, neutrophils to lymphocytes ratio; WBC, white blood cell.

**Table 2: Sociodemographic and clinical associated factors with LOS among children and adolescents with coronavirus disease 2019 in Egypt**

Characteristics	Unadjusted <i>B</i> (95% CI)	<i>P</i>	Multivariable-adjusted <i>B</i> (95% CI)	<i>P</i>
Age	-0.05 (-0.32, 0.23)	0.736	-	-
Male	-0.11 (-2.79, 2.56)	0.932	-	-
Rural residence	-0.07 (-3.17, 3.04)	0.966	-	-
Exposure to COVID-19-infected patient	-1.38 (-4.01, 1.26)	0.298	-	-
Fever	<b>4.30 (1.07, 7.52)</b>	0.010	3.09 (-1.44, 7.62)	0.176
Tachycardia	2.67 (-0.03, 5.36)	0.052	-	-
Tachypnea	2.33 (-0.48, 5.15)	0.102	-	-
Cough	<b>3.50 (0.34, 6.66)</b>	0.031	1.10 (-3.21, 5.42)	0.610
Rhinitis	2.24 (-0.59, 5.06)	0.118	-	-
Diarrhea	0.83 (-2.78, 4.45)	0.645	-	-
Vomiting	-2.45 (-7.99, 3.10)	0.379	-	-
Ground-glass opacity (radiograph)	<b>5.55 (2.72, 8.37)</b>	<b>&lt;0.001</b>	<b>4.75 (0.31, 9.20)</b>	<b>0.037</b>
Atypical opacity (radiograph)	1.27 (-0.54, 3.09)	0.157	-	-
Hemoglobin	0.13 (-2.33, 2.59)	0.910	-	-
Platelets	0.05 (-0.02, 0.11)	0.146	-	-
WBCs	-0.17 (-1.28, 0.93)	0.748	-	-
Neutrophils	-0.20 (-1.87, 1.47)	0.798	-	-
Lymphocytes	1.93 (-2.09, 5.96)	0.319	-	-
NLR	-0.50 (-1.90, 0.91)	0.461	-	-

CI, confidence interval; COVID-19, coronavirus disease 2019; NLR, neutrophils to lymphocytes ratio; WBC, white blood cell. *P* less than 0.05 was considered statistically significant.

pharyngitis (80.0%), and rhinitis (70.0%). Slightly less than two-thirds (62.0%) of children showed ground-glass opacity in their radiographs. Patients’ LOS ranged between 1 and 21 days [mean ± SD: 8.30 ± 4.62 days, median (interquartile range): 9.00 (3.00, 11.25) days] with no deaths recorded (Table 1).

Among the studied sociodemographic and clinical characteristics, fever, cough, and ground-glass opacity in radiograph were associated with longer LOS in the unadjusted model, with *Bs* (95% CIs) of 4.30 (1.07, 7.52), 3.50 (0.34, 6.66), and 5.55 (2.72, 8.37), respectively. In the multivariable-adjusted model, only ground-glass opacity in radiograph remained statistically associated with longer LOS (*B* = 4.75, 95% CI: 0.31, 9.20) (Table 2).

## DISCUSSION

This study indicated that the average LOS in children and adolescents with COVID-19 was 8.3 days (median 9 days). Adolescents and children who presented with fever, cough, and ground-glass opacity in radiograph stayed in the hospital for 4.3, 3.5, and 5.6 more days than children with no fever, no cough, and clear radiograph. After including the three risk factors in one multivariable regression model, only ground-glass opacity in radiograph remained associated with longer LOS with extra 4.8 days in comparison with clear radiograph.

It is obvious that children and adolescents with COVID-19 in this study stayed for a relatively shorter period compared with adults with COVID-19 or even children with COVID-19 in other countries. For example, in a systematic review of

52 studies, mostly conducted on adult patients, the median LOS ranged between 4 and 53 days. On the contrary, a study conducted on 36 children (mean age: 8.3 years) with mild to moderate COVID-19 stated the average of LOS as 14 days [4]. However, it should be noted that comparing our LOS with that in other studies has to be taken cautiously given the striking differences in the sociodemographic characteristics, COVID-19 severity, and treatment protocols across study populations. Further, in absence of a national wide-scale screening and given the mild to absent symptoms of COVID-19 among children, it is hard to determine the precise time of contacting the infection that could be days away from hospital admission which may factiously minimize LOS.

Previous reports, however on adult patients, showed other risk factors for longer LOS attributed to COVID-19. In one study conducted on 99 patients from one hospital in Wuhan, China, having lymphopenia was the only associated factor with longer LOS, whereas clinical and other laboratory findings did not relate to LOS [14]. Another study on 75 patients with COVID-19 in a tertiary care hospital in Zhejiang, China, showed that cough and tachypnea predicted longer LOS [18]. In Vietnam, a study conducted on 133 hospitalized patients with COVID-19 concluded that older patients were more likely to stay for longer periods [19].

This is one of the earliest studies that determined the associations with LOS among children and adolescents with COVID-19 in a developing country; however, many limitations should be addressed. First, data on patients were collected retrospectively, therefore, a causal association was hard to

be implied. Second, retrieving data from hospital records might have affected the quality of data given the immature system of medical documentation in most hospitals in Egypt. Moreover, not all laboratory examinations were performed in all included children. Third, the relatively small number of the study population limited our ability to stratify the results by age categories, yet the age of children and adolescents in this study did not seem to affect LOS.

## CONCLUSION

In conclusion, this study showed that some clinical presentations such as fever and cough and radiological findings such as ground-glass opacity in radiograph could be associated with longer LOS among children and adolescents with COVID-19.

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Nil.

## Conflicts of interest

There are no conflicts of interest.

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