

Significant Reduction in Pediatric, Population-Based Hospital Admissions Due To COVID-19 in Malta

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What is already known on this topic?

- COVID-19 typically affects children mildly when compared to adults.
- During the COVID-19 pandemic, a trend of reduced pediatric presentations to hospitals was noted among a few centers worldwide.
- One of the possible reasons for this reduction included fear of contracting the COVID-19 virus from the hospital environment.

What this study adds on this topic?

- The trend of decreased presentations was reproducible during the first year of COVID-19 on a population-based level.
- A significant drop in respiratory and communicable diseases was noted, possibly as a result of effective public health measures.
- An inverse relationship between decreasing pediatric admissions and increasing active COVID-19 cases was evident.

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ABSTRACT

Objective: This population-based, retrospective study aimed to determine whether there was a drop in pediatric admissions during the first year of COVID-19 in Malta, as reported in other centers worldwide, as well as to determine any differences in patient characteristics when compared to the previous year.

Materials and Methods: All unplanned pediatric medical admissions to Mater Dei Hospital from March 1, 2020 (a few days before the first case of COVID-19 in Malta) till February 28, 2021 (study period) and the corresponding period in 2019/20 (control period) and characteristics of patients admitted during the first 10 weeks (first wave of COVID-19) were analyzed.

Results: Pediatric admissions dropped by 57.7% during the first year of COVID-19 (1601 vs. 3789 in 2019). During the first wave of COVID-19, a higher percentage of neonates were admitted in 2020 when compared to all other ages. There was a lower prevalence of respiratory illnesses during the first wave of COVID-19 (31.6% vs. 47.5% in 2019, $P < .001$), with a higher prevalence of cases related to child abuse or adverse socio-economic circumstances (2020, 9 [3.4%] vs 1 [0.1%] in 2019, $P < .001$). Following school closures, a drop in communicable disease admissions was recorded (68 [42.2%] vs. 421 [70.3%] in 2019, $P < .001$). A negative correlation between daily pediatric admissions and active COVID-19 cases in Malta was noted ($r(68) = -0.33$, $P = .005$).

Conclusion: The drop in admissions likely represents fear of contracting COVID-19 in hospital environments, together with a decline in communicable diseases due to school closures. Guardians' concerns must be alleviated as best as possible by effective public health measures.

Keywords: COVID-19, emergency, public health, infectious disease, pediatrics, SARS-CoV-2

INTRODUCTION

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) was first reported in China in December 2019.¹ The virus spread rapidly and the World Health Organization (WHO) declared coronavirus disease 2019 (COVID-19) a pandemic on March 11, 2020.² This global public health emergency resulted in major healthcare system changes to cater for the increased workload of COVID-19 cases. Apart from restructuring and re-organization strategies, hospitals had to maintain their ability to treat patients with non-COVID conditions, as well as safeguard patients and staff from COVID-19 within the hospital environment.³ Despite efforts, a trend of reduced pediatric admissions was reported among several centers worldwide, including Italy, the United Kingdom, Ireland, and the United States of America.⁴⁻⁹

Malta is a small island in Southern Europe with a population of approximately half a million. The first case of COVID-19 in Malta was detected on March 7, and it was noted to be a pediatric case.¹⁰ Several public health measures were implemented to limit the spread of

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COVID-19 including travel restrictions, closure of non-essential shops and entertainment outlets, mandatory self-quarantine upon return from high-risk countries, and eventually, all flights were restricted to repatriation services. On March 12, 2020, childcare centers, schools, and elderly homes were closed, and on April 1, 2020, Malta declared a state of national emergency.¹⁰

Various studies have shown that children represent a minority of the population affected by COVID-19; nevertheless, they are the primary focus of every pediatrician's work.^{11,12} Mater Dei Hospital (MDH) is Malta's main regional hospital offering specialized pediatric services. Minor structural changes were undergone to accommodate isolation of patients with potential COVID-19 illness.¹³ Pediatric emergency services remained functional at full capacity amid the pandemic. A change within the department included earlier discharge (36 hours) of postpartum neonates following uncomplicated vaginal and cesarean deliveries as a method of limiting COVID-19 exposure within the hospital, as well as safeguarding bed availability amidst the pandemic. Despite minimal changes to the department and the continuation of a well-functioning pediatric service, it was felt that fewer patients were presenting and being admitted to hospital, similar to other centers worldwide as mentioned above.

This population-based study was carried out to determine whether there was a significant decline in acute pediatric medical admissions during the first year of the COVID-19 pandemic in Malta, compared to the same period in the previous year. Detailed analysis of all admissions during the first COVID-19 wave in Malta was performed to determine whether any differences in characteristics (such as demographics, time of presentation from symptom onset, inpatient care of patients, and reasons for admission) were present between patients admitted in 2020 and 2019. Furthermore, we aimed to determine whether a significant correlation existed between pediatric admissions and daily COVID-19 cases in Malta during the first wave.

METHODS

Study Population

All acute (unplanned) pediatric hospital admissions from the Accident and Emergency (A&E) Department, Gozo General Hospital (hospital on a neighboring island unable to offer all specialized pediatric services) and direct admissions (including walk-ins) were included. Routine admissions of neonates following birth were not included. The period studied for admission rates was the first year of COVID-19 in Malta, spanning from March 1, 2020 to February 28, 2021. The corresponding period in 2019/2020 (March 1, 2019 to February 29, 2020) was used as a control group for comparison.

Data Collection

Anonymous data were collected from MDH health records and computer databases, including iSoft clinical manager (ICM) and the electronic case summary (ECS) database. Ethics approval was obtained from the University of Malta Research Ethics Committee (FRECMDS_1920_208), and the study was performed with a waiver of consent.

A closer analysis of the patients admitted during the first COVID-19 wave was performed, which spanned from March 1 to May 9, 2020 (10 weeks); and this was compared directly to the same period of the previous year. Data sought included age, gender, source of admission, past medical history, diagnosis upon admission, time of presentation from symptom onset, investigations performed upon and during admission (including blood-letting which was dependent on each case and may have included a complete blood count, C-reactive peptide, renal profile, electrolytes, liver profile, troponin, or blood cultures, as well as chest x-ray), length of hospital stay, intensive care admissions, and whether any medical follow-up was given. Apart from the above-mentioned data, daily active COVID-19 cases in Malta were collected from the official online dashboard maintained by the Maltese COVID-19 Public Health Response Team to delineate any correlation with daily acute pediatric admissions.¹⁴ Active COVID-19 cases were defined as patients who were within 14 days of testing positive for SARS-CoV-2 on a polymerase chain reaction (PCR) test.

During the first wave of COVID-19, following the closure of schools and nurseries due to the country's lockdown protocols, all pediatric diagnoses were divided into communicable and non-communicable disease groups. A communicable disease was defined as an infection that may be contracted from interaction with other children, including respiratory illnesses, meningitis, hand and mouth foot disease, and gastroenteritis.

Statistical Analysis

Chi-squared test and Fisher's exact test (used when more than 20% of expected values have frequencies of less than 5) were used for comparison of all categorical data. Mann-Whitney *U* test was used for comparison of continuous data after Shapiro-Wilk test determined that the data were not normally distributed. Continuous data were demonstrated as medians and interquartile ranges (IQR). Pearson's correlation coefficient was used to determine whether any significant correlations were present. Statistical analysis was performed using bespoke Microsoft Excel spreadsheets and a *P* value of less than .05 was deemed as statistically significant.

RESULTS

Admissions During First Year of COVID-19

The total number of acute pediatric medical admissions between March 1, 2020 and February 28, 2021, was 1601, when compared to 3789 during the control period (March 1, 2019 and February 29, 2020), signifying a 57.7% drop in admissions during the first year of COVID-19 (Figure 1).

Detailed Analysis of First COVID-19 Wave

Analysis of admissions during the first COVID-19 wave (March 1 to May 9, 2020) and the corresponding period in 2019 revealed a drop of 63.5% admissions, with 266 patients admitted over the 10 weeks in 2020, while 729 patients were admitted during the same period in 2019. There was no significant difference between gender presentations. When compared to all other ages, a higher percentage of neonate (aged 0-28 days) admissions in 2020 (24 [9%]) compared to 2019 (28 [3.8%]) (*P* = .001) was noted, while a lower percentage of infants (1 month to 2 years) were admitted in 2020 (133 [50%]) vs. 2019 (424 [58.2%]), with no other significant differences among children and

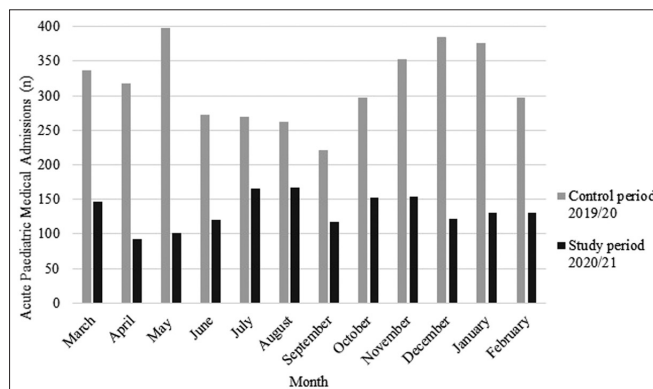


Figure 1. Histogram demonstrating monthly acute pediatric medical admissions during the study (March 1, 2020 to February 28, 2021) and control period (March 1, 2019 to February 29, 2020).

adolescent admissions (Table 1). Among the neonate admissions, it was noted that jaundice as a cause of admission was significantly more frequent in 2019 (11 [39.3%] vs. 2020 2 [8.3%], $P = .043$), while feeding-related admissions (including inability to establish feeding, hypoglycemia, and failure to thrive) were similar (2019, 2 [7.1%] vs. 2020, 3 [12.5%], $P = .554$). On comparing admission source, a greater percentage of patients were admitted through the A&E department in 2019 (696, 95.5% vs. 241, 90.6% in 2020, $P = .004$), while a higher proportion was admitted as direct admissions in 2020 (21, 7.9% vs. 23, 3.2% in 2019, $P = .001$) (Table 1).

In 2019, 346 (47.5%) pediatric cases were admitted with respiratory and allergy pathologies, compared to 84 (31.6%) cases in 2020 ($P < .001$) (Table 1). Four patients were admitted while positive for SARS-CoV-2; however, all cases were considered as mild, not requiring intensive care. There was a higher percentage of admissions related to child abuse and adverse socio-economic circumstances (child abuse was defined as any act, or failure to act, by a guardian or caregiver that may result in actual or potential harm to the child; a case related to adverse socio-economic circumstances was defined as any inadequate social or economic situation resulting in the admission of a child) in 2020 (9, 3.4% vs. 1, 0.1% in 2019, $P < .001$). From the 9 social cases, 5 were related to guardians who tested positive for SARS-CoV-2 and were subsequently unable to adequately care for their children. Furthermore, on dividing all admissions into communicable (infectious) and non-communicable (non-infectious) cases following the closure of schools and nurseries in the country, significantly more communicable cases were admitted in 2019 (421, 70.3%) compared to 2020 (68, 42.2%) ($P < .001$) (Table 1). No other significant differences were noted among the other reasons for admission.

There were no significant differences between the cohorts with regards to past medical history, median length of stay, median time of onset of symptoms to hospital presentation, number of discharges against medical advice, and number of patients needing intensive care in the intensive therapy (ITU) or neonatal pediatric intensive care unit (NPICU) or planned follow-ups (Tables 2 and 3). The percentage of chest x-rays performed either on presentation or during admission was higher in the

2019 cohort (2019, 48.4% vs. 2020, 30.8%, $P < .001$) (Table 3). Three in-patients (0.4%) passed away in 2019, while no deaths were recorded in 2020 ($P = .569$).

Correlation Analysis

There was a weak negative correlation between daily acute pediatric medical admissions and the number of active COVID-19 cases in Malta ($r(68) = -0.33$, $P = .005$) (Table 4).

DISCUSSION

Children have been noted to be affected mildly by COVID-19, with symptoms such as fever, cough, sore throat, and sneezing.^{12,15} Historically, children are frequently exposed to non-COVID-19 strains of coronavirus, and emerging studies have suggested that this may provide some cross-protection against COVID-19.^{16,17} Although the pediatric population demographic does not seem to have been impacted by COVID-19 as severely as the adult population, there are growing concerns regarding the reported reduction in pediatric admissions. In northeast Italy, a 76% decrease in pediatric patients presenting to the A&E department was noted when comparing pre- and post-lockdown periods.⁴ Similar results were described in the United Kingdom, Ireland, and the United States.⁶⁻⁸

The reasons for the decline in pediatric presentations and admissions may be multifactorial. Firstly, a potentially strong contributor may be the fear of the COVID-19 transmission within hospital environments, a worrying trend also reported among the adult population.^{7,9,18} The pandemic seems to have caused a cultural shift within families, with guardians isolating themselves and their children. Secondly, a sharp decline in common seasonal viral infections may have played a key role in reducing pediatric illnesses. Schools, childcare centers, and nurseries in Malta closed their doors on March 13, 2020, after the ninth local case of COVID-19 was detected. According to the United Nations Educational, Science and Cultural Organization, 194 countries had enforced school closure by the April 1, 2020, in an effort to limit transmission and control the pandemic.¹⁹ The closure of schools together with social distancing measures and isolation within the community would have inadvertently limited child-to-child transmission of the usual common communicable diseases, which frequently lead to acute respiratory presentations and hospital admissions.^{4,20} Furthermore, substantial air quality improvement during lockdown was reported in certain studies, and this may have resulted in improved asthma control and a decline in exacerbations.²¹

Apart from a reduction in pediatric admissions, a delay in presentation to hospitals was also reported, with guardians admitting to avoid hospital contact due to fear of contracting COVID-19.^{5,22} Similar concerns were recorded in the United Kingdom, with detrimental implications for delayed presentations to critically ill children.²³ In our study, a delay in presentation of patients during the first wave of COVID-19 was noted; however, this did not reach statistical significance.

Parental stress has increased due to unprecedented family isolation, growing unemployment, and the pandemic itself.^{24,25} This rise in parental stress may lead to an increase in child abuse and neglect, and indeed, this was found in our study.²⁶ Concern

Table 1. Characteristics of Patient Admissions During the First COVID-19 Wave

	2019	2020	P
Gender, n (%)			
Female	318 (43.6)	133 (50)	.074
Male	411 (56.4)	133 (50)	
Age groups, n (%)	2019	2020	
0 to 28 days (1 month)	28 (3.8)	24 (9.0)	.001
All other ages	701 (96.2)	242 (91.0)	
1 month to 2 years	424 (58.2)	133 (50.0)	.022
All other ages	305 (41.8)	133 (50.0)	
2 to 12 years	222 (30.5)	83 (31.2)	.820
All other ages	507 (69.5)	183 (68.8)	
12 to 16 years	55 (7.5)	26 (9.8)	.255
All other ages	674 (92.5)	240 (90.2)	
Source of admission, n (%)			
A&E	696 (95.5)	241 (90.6)	.004
All others	33 (4.5)	25 (9.4)	
GGH	0 (0)	1 (0.4)	.267*
All others	729 (100)	265 (99.6)	
Direct admission	23 (3.2)	21 (7.9)	.001
All others	706 (96.8)	245 (92.1)	
Ward attender/walk-In	10 (1.4)	3 (1.1)	1.000*
All others	719 (98.6)	263 (98.9)	
Past medical history, n (%)			
Preterm	29 (4.0)	11 (4.1)	.911
Not preterm	700 (96.0)	255 (95.9)	
Congenital heart disease	21 (2.9)	7 (2.6)	.833
No congenital heart disease	708 (97.1)	259 (97.4)	
Cerebral palsy	10 (1.4)	3 (1.1)	.764
No cerebral palsy	719 (98.6)	263 (98.9)	
Epilepsy	17 (2.3)	9 (3.4)	.357
No epilepsy	712 (97.7)	257 (96.6)	
Psychiatric history	11 (1.5)	6 (2.3)	.421
No psychiatric history	718 (98.5)	260 (97.7)	
Trisomy 21	12 (1.6)	1 (0.4)	.118
Non-trisomy 21	717 (98.4)	265 (99.6)	
Malignancy	3 (0.4)	1 (0.4)	1.000*
No malignancy	726 (99.6)	265 (99.6)	
Asthma/wheeze	59 (8.1)	14 (5.3)	.130
No asthma/wheeze	670 (91.9)	252 (94.7)	
Reason for admission, n (%)			
Cardiology	19 (2.6)	12 (4.5)	.126
All others	710 (97.4)	254 (95.5)	
Respiratory and allergy	346 (47.5)	84 (31.6)	<.001
All others	383 (52.5)	182 (68.4)	
Gastroenterology	88 (12.1)	40 (15.0)	.216
All others	641 (87.9)	226 (85.0)	
Endocrinology	12 (1.6)	6 (2.3)	.523
All others	717 (98.4)	260 (97.7)	
Neurology	77 (10.6)	35 (13.2)	.252
All others	652 (89.4)	231 (86.8)	
Nephrology	22 (3.0)	13 (4.9)	.157
All others	707 (97.0)	253 (95.1)	
Dermatology	15 (2.1)	4 (1.5)	.572
All others	714 (97.9)	262 (98.5)	

	2019	2020	P
Neonatology	38 (5.2)	21 (7.9)	.113
All others	691 (94.8)	245 (9.2)	
Hematology and oncology	8 (1.1)	4 (1.5)	.743*
All others	721 (98.9)	262 (98.5)	
Infectious disease	82 (11.2)	27 (10.2)	.624
All others	647 (88.8)	239 (89.8)	
Child abuse and social cases	1 (0.1)	9 (3.4)	<.001
All others	728 (99.9)	257 (96.6)	
Others ^a	21 (2.9)	11 (4.1)	.321
All others	708 (97.1)	255 (95.9)	
Infectivity post-school closures, n (%)			
Communicable	421 (70.3)	68 (42.2)	<.001
Non-communicable	178 (29.7)	93 (57.8)	

COVID-19, coronavirus disease 2019; NS, not significant; A&E, accident and emergency; GGH, Gozo General Hospital. *Fisher's exact test. All other analyses were performed using Chi-squared test. ^aIncludes psychiatric admissions and non-specific or unknown diagnoses.

has indeed been expressed regarding falling rates of child protection referrals during the pandemic.²⁷ Further concern has been shown regarding vulnerable patients, including neonates, oncology patients, and patients with mental health illness, who may not be accessing necessary medical assistance.²⁸ Apart from concern regarding hesitancy to seek medical care, neonatologists have expressed concerns regarding early hospital discharges after birth aimed at reducing the hospital burden during the pandemic. The main issues highlighted included the lack of sufficient time to establish feeding and to evaluate jaundice.^{29,30} In our study, it was observed that the number of neonate admissions in 2019 and 2020 were similar; however, upon comparing with all other age groups, a higher percentage of neonates were admitted in 2020. This could signify a lower threshold for guardians of neonates to seek urgent hospital care when compared to guardians of older children. Apart from this, the strategy to discharge neonates earlier than previously in 2020 did not result in a rise in jaundice and feeding-related admissions in 2020.

COVID-19 has placed an excessive strain on hospitals globally, undoubtedly also impacting pediatric services. This may interrupt the important care and treatment that the pediatric population requires. Several pediatric bodies, including the Royal College of Paediatrics and Child Health (RCPCH), have provided guidelines that aim to safeguard the pediatric population. The College stressed that all medical professionals involved in the care of children should continue to base their decisions in the best interest of the child.^{31,32} Protocols have similarly been implemented by the local pediatric department in Malta. The global emergency may offer a unique opportunity for us to re-evaluate how we deliver health-care to the pediatric population and allow us to introduce innovative ways of care as we eventually return to a pre-COVID-19 state.³³

Table 2. Median Length of Hospital Stay and Time of Onset of Symptoms to Hospital Presentation During the First COVID-19 Wave

	2019	2020	P
Median (IQR) length of stay (days)	3 (2)	3 (2)	.128
Median (IQR) time of onset of symptoms to hospital presentation (hours)	48 (96)	72 (96)	.389

COVID-19, coronavirus disease 2019; NS, not significant. Analysis performed using Mann-Whitney U test.

Table 3. Further Comparison of Characteristics During the First COVID-19 Wave

	2019	2020	P
CXR performed, n (%)			
Yes	353 (48.4)	82 (30.8)	<.001
No	376 (51.6)	184 (69.2)	
Bloods taken, n (%)	2019	2020	
Yes	623 (85.5)	224 (84.2)	.624
No	106 (14.5)	42 (15.8)	
Follow-up given, n (%)			
Yes	423 (58.0)	150 (56.4)	.644
No	306 (42.0)	116 (43.6)	
DAMA from ward, n (%)			
Yes	11 (1.5)	3 (1.1)	.770*
No	718 (98.5)	263 (98.9)	
ITU/NPICU admission, n (%)			
Yes	8 (1.1)	1 (0.4)	.458*
No	721 (98.9)	265 (99.6)	

COVID-19, coronavirus disease 2019; CXR, chest x-ray; DAMA, discharge against medical advice; ITU, intensive treatment unit; NPICU, neonatal pediatric intensive care unit; NS, not significant. *Fisher's exact test. All other analyses were performed using chi-squared test.

Table 4. Correlation Between Number of Admissions Versus Daily Active COVID 19 Cases During the First COVID-19 Wave

Daily Admissions 2020 Versus	Active COVID-19 Cases Malta
n	70
r	-0.33
df	68
P	.005

COVID-19, coronavirus disease 2019; NS, not significant.

CONCLUSION

This study has revealed a significant drop in acute pediatric medical admissions on a national level during the first year of COVID-19. There was a significant drop in communicable and respiratory cases, with an increase in cases related to child abuse and adverse socio-economic circumstances cases during the first wave of COVID-19. These findings can be partly explained by the fear of COVID-19 transmission among medical care environments. This theory was re-enforced following the finding of a negative correlation between admissions and rising active COVID-19 cases. Another theory could be the closure of schools and lockdowns resulting in less child-to-child interaction and transmission of disease. Although the number of neonate admissions was similar in both years, a higher percentage of neonates were admitted in 2020 when compared to all other age groups which could represent a lower threshold for guardians of neonates to seek urgent care. The number of neonate admissions related to jaundice and

feeding-related issues was not increased in 2020, despite earlier discharge of uncomplicated postpartum neonates.

Although social distancing is strongly advised to safeguard children's health, public health must continue to re-assure guardians that emergency services are available and not compromised during these tough times.

Ethics Committee Approval: This study was approved by Research Ethics committee of the University of Malta, (Approval No: FRECMDS_1920_208).

Informed Consent: Consent was waived in view of the retrospective nature of the study.

Peer Review: Externally peer-reviewed.

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Conflict of Interest: The authors have no conflict of interest to declare.

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