



# Psychiatric comorbidities and dehydration are more common in children admitted to the emergency department for eating disorders in the COVID-19 era

Giulia Spina<sup>1</sup> · Marco Roversi<sup>1</sup> · Maria Rosaria Marchili<sup>2</sup>  · Umberto Raucci<sup>2</sup> · Francesca Fini<sup>1</sup> · Gianluca Mirra<sup>1</sup> · Giulia Testa<sup>1</sup> · Benedetta Guarnieri<sup>1</sup> · Anna Clemente<sup>3</sup> · Antonella Diamanti<sup>4</sup> · Valeria Zanna<sup>5</sup> · Maria Chiara Castiglioni<sup>5</sup> · Stefano Vicari<sup>6,7</sup> · Antonino Reale<sup>2</sup> · Alberto Villani<sup>2</sup>

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## Abstract

**Purpose** Since the beginning of COVID-19 pandemic, social distancing and home confinement had a significant impact on children, especially on those with eating disorders (ED). The primary objective of this retrospective study was to describe and analyze the demographic and clinical profiles of children presenting with ED during the COVID-19 pandemic.

**Methods** We conducted a retrospective review of clinical charts of patients with ED younger than 18 years who accessed the emergency department of the Bambino Gesù Children’s Hospital, Rome, between March 2019 and March 2021. Of these, we reported and compared the demographic, clinical and laboratory data before and after the COVID-19 pandemic and looked for predictors of ED severity.

**Results** A total of 211 admissions for ED were recorded. The patients, mostly females (86.3%) were on average 14.1 years old. The mean weight loss on admission was 11 kg. Bradycardia was observed in 31.3% of the study sample. 16.6% of patients had an associated psychiatric disorder and 60.2% required psychotropic drugs. 68.7% of the patients required hospitalization. Respectively, 96 and 115 patients were admitted before and during the COVID-19 pandemic. The latter were hospitalized more (78.3 vs 57.3%;  $p=0.001$ ), yet for less time (19 vs 26 days;  $p=0.004$ ), had a higher mean serum creatinine (0.68 vs 0.47;  $p<0.001$ ) and were more frequently diagnosed with an associated psychiatric disorder (23.5 vs 8.3%;  $p=0.003$ ).

**Conclusion** Our study shows a significant increase of hospitalizations of children with ED during the COVID-19 pandemic, along with a shorter length of stay, more psychiatric comorbidities, and some distinctive features at the laboratory work-up, such as an increase of serum creatinine and/or a reduction of serum albumin.

**Level of evidence** III, evidence obtained from well-designed cohort or case–control analytic studies.

**Keywords** COVID-19 pandemic · Eating disorders · Anorexia nervosa · Mental health · Pediatric emergency department · Pediatrics

✉ Maria Rosaria Marchili  
mrosaria.marchili@opbg.net

<sup>1</sup> University Hospital Pediatric Department, “Bambino Gesù” Children’s Hospital, IRCCS, Tor Vergata University, Rome, Italy

<sup>2</sup> Department of Emergency, Acceptance and General Pediatrics, Bambino Gesù” Children’s Hospital, IRCCS, Rome, Italy

<sup>3</sup> Department of Maternal Infantile and Urological Sciences, “Sapienza” University of Rome, Rome, Italy

<sup>4</sup> Hepatology, Gastroenterology and Nutrition Unit, Bambino Gesù” Children Hospital, IRCCS, Rome, Italy

<sup>5</sup> Anorexia Nervosa and Eating Disorders Unit, Child Neuropsychiatry, Department of Neuroscience, Bambino Gesù” Children Hospital, IRCCS, Rome, Italy

<sup>6</sup> Head Child and Adolescent Psychiatry, Bambino Gesù” Children Hospital, IRCCS, Rome, Italy

<sup>7</sup> Child Neuropsychiatry Department of Life Sciences and Public Health, Catholic University, Rome, Italy

## Introduction

Since the onset of the COVID-19 pandemic, the introduction of never-before-experienced restrictions, such as social distancing and home confinement, has had a significant impact on children's emotional and social spheres. Preliminary studies have shown that in the COVID-19 era, there was a general increase in negative feelings in the general population, such as fear, anxiety, and sadness [1–10]. In addition, COVID-19-related isolation has resulted in an increase in mental health conditions, such as post-traumatic stress disorder [6, 11], anxiety and depression [12, 13].

The social impact of confinement and isolation associated with lockdown has also recently been described in the pediatric field. According to an estimate by the Italian Ministry of Education, University, and Research (MIUR), approximately 8.5 million students remained at home during the pandemic [14]. The combination of these stressors could both exacerbate pre-existing mental health problems and cause their onset, in children and adolescents [15].

During such a sensitive time, individuals with psychiatric conditions are considered particularly vulnerable as their pre-existing conditions may be exacerbated by the effects of isolation and restrictions [1–3]. Social restrictions and the need for continuity of psychiatric treatment are thought to be linked to worsening symptoms in this group of patients [16, 17].

From these premises, patients with eating disorders (ED) may represent a population vulnerable to the effects of the COVID-19 pandemic [18, 19]. Interactions between genetic and environmental factors have been considered as crucial for ED pathogenesis, although the underlying mechanisms are still not completely recognized [20, 21].

In the most recent classification [21], ED includes the following conditions: Anorexia Nervosa (AN), characterized by excessive restriction of oral intakes associated with excessive physical activity (restrictive subtype), and periodic "binges" followed by vomiting or assumption of laxatives (binge-elimination behavior subtype); Bulimia Nervosa (BN), characterized by ingestion of large quantities of food in a short period of time ("binges"), followed by compensatory vomiting, assumption of laxatives, fasting or exercise; Non-specific ED, i.e., conditions in which the patient shows only some of the previous characteristics (avoidant/restrictive eating disorder and binge eating disorder (DAI) characterized by binges, not always followed by compensatory behaviors). Non-specific EDs can evolve into full-blown EDs. [21–24]

Currently, much has been written about the pediatric ED "epidemic" at the time of COVID-19 [25], but most articles have focused on the epidemiologic and seasonal

pattern of ED in children [26], with little or no exploration of the risk factors that lead to increased severity of this condition in children.

We conducted a study on a large pediatric cohort, with the objective of describing and analyzing the clinical profiles of children presenting with ED during the COVID-19-related lockdown, to identify epidemiological and clinical predictors of ED severity before and after the COVID-19 pandemic.

## Methods

We retrospectively reviewed the clinical charts of all patients with ED diagnoses younger than 18 years who accessed the Emergency Department of the Bambino Gesù Children's Hospital, IRCCS, Rome, between March 2019 and March 2021. ED diagnoses were defined according to DSM-5 criteria [24, 27]. During the study period, an internal protocol for the admission of ED patients was used, which was validated and in use prior to the start of the present research. In detail, the admission criteria used were as follows: BMI < 14, weight loss/week > 0.5 kg, systolic blood pressure < 90 mmHg, diastolic blood pressure < 70 mmHg, orthostatic hypotension, heart rate < 50 bpm, QTc > 450 ms, presence of arrhythmia, body temperature < 35 °C, electrolyte changes (potassium < 3.5 mmol/L, sodium < 135 mmol/L, phosphorus 0.5–0.8 mmol/L). Patients were identified through keyword searches in the hospital's electronic databases. Medical records were selected by searching for the key words "eating disorders", "anorexia nervosa". Then, cases with such discharge diagnosis, made by a child neuropsychiatrist, were manually selected through a retrospective review of their medical records.

We reported the following demographic, clinical and laboratory data: age; gender; geographic provenance, number and length of hospitalizations; stature-ponderal data, including BMI on admission and at discharge (both values and centiles); number of relapses; previous menarche; duration of amenorrhea; diagnosis of any previous psychiatric disorder; vital signs; blood gas analysis and laboratory work-up on admission; administration of intravenous fluids; enteral nutrition; drug therapy; necessity of guarding by specialized staff. All data were gathered and stored in an electronic database.

Patients were divided into two subgroups and compared according to the access date, setting March 8, 2020 as the start of the COVID-19-related lockdown in Italy. In particular, ED diagnoses from March 9, 2019 to March 8, 2020 (pre-COVID-19 era) and from March 9, 2020 to March 8, 2021 (COVID-19 era) were considered. For patients admitted more than once, we reported and analyzed the first admission to the emergency department only. However, any access of these patients within the period of the study was

defined as “relapse” and reported. Finally, we performed a binary logistic regression adopting the cutoff of admission before or after the COVID-19 outbreak as the dependent variable and all variables significant and/or interesting from the univariate analysis as the independent variables to identify potential factors reflecting ED severity.

The software IBM SPSS version 23.0 was used for statistical analysis. Continuous normally distributed variables were expressed as means and standard deviations and analyzed with the Student’s *t* test. Continuous non-normally distributed variables were expressed as medians and ranges and analyzed with the Mann–Whitney *U* test. Categorical variables were expressed as proportions and percentages and analyzed with the Chi-squared test or Fisher’s exact test (when appropriate). A *p* value less than 0.05 was considered statistically significant.

Ethical approval was granted by the Research Ethics Board at the Bambino Gesù Children’s Hospital, IRCCS, Rome, Italy.

## Results

The characteristics of the study sample are outlined in Table 1. A total of 211 ED-related admissions were recorded during the study period. Patients included were on average 14.1 ( $\pm 2.5$ ) years old (range 5.3–17.9), mostly females (86.3%). 81% of patients came from the Lazio region. 68.7% of the patients were hospitalized, for a mean period of 22 ( $\pm 14$ ) days. The mean weight loss on admission was 11 ( $\pm 8$ ) kg, with a corresponding mean BMI of 15.8 ( $\pm 2.5$ ) and median BMI percentile of 3.3 (range 0.2–14.5). About 8.5% of the patients relapsed during the study period. Bradycardia was observed in 31.3% of the study sample. Notably, 16.6% of patients were diagnosed with a psychiatric disorder other than ED, but 60.2% of the study sample required administration of psychotropic drugs, mostly aripiprazole (51.2%) and sertraline (25.6%). Most patients required intravenous fluids during hospitalization (63%), with a minority requiring enteral nutrition (23.2%, 14.2% of which continuous) due to severe cachexia.

The comparison of the clinical characteristics of the study sample before and during the COVID-19 pandemic is outlined in Table 2.

Figure 1 shows the trend in pediatric admissions by ED over the two periods. Of all patients, 96 and 115 were admitted before and during the COVID-19 pandemic, respectively. More patients required hospitalization during the COVID-19 era than before (78.3 vs 57.3%;  $p=0.001$ ), although they were significantly hospitalized for less time ( $19 \pm 12$  vs  $26 \pm 17$  days;  $p=0.004$ ). However, no significant differences in terms of weight loss or BMI were observed between the two groups. Although not significant, a longer

**Table 1** clinical characteristics of study sample<sup>a</sup>

Total	211
Age (years)	14.1 $\pm$ 2.5 (5.3–17.9)
Females–no. (%)	182/211 (86.3)
Hospitalized–no. (%)	145/211 (68.7)
Hospitalization (days)	22 $\pm$ 14 (1–70)
Weight on admission (kg)	39 $\pm$ 9 (13–76)
Height on admission (m)	1.57 $\pm$ 0.1 (1.2–1.8)
Weight loss on admission (kg)	11 $\pm$ 8 (0.5–40)
Weight loss to admission (months)	6 $\pm$ 5.5 (0–36)
BMI on admission (value)	15.8 $\pm$ 2.5 (10.6–25.8)
BMI on admission (percentile)–median (IQR)	2.6 (0.1–16.6)
BMI at discharge (value)	16.0 $\pm$ 2.1 (12–25)
BMI at discharge (percentile)–median (IQR)	3.3 (0.2–14.5)
Follow-up (months)–median (range)	1 (0–30)
Multiple ED admissions–no. (%)	18/211 (8.5)
Relapse–no. (%)	31/211 (14.7)
Amenorrhea (months)–median (range)	5.4 (1.1–56.6)
Psychiatric disorder <sup>b</sup> –no. (%)	35/211 (16.6)
Vital signs	
Heart rate (bpm)	66 $\pm$ 20 (33–130)
Bradycardic–no. (%)	46/211 (31.3)
Systolic blood pressure (mmHg)	105 $\pm$ 14 (69–167)
Diastolic blood pressure (mmHg)	66 $\pm$ 9 (42–94)
Respiratory rate (rpm)	17 $\pm$ 3 (12–28)
Oxygen saturation (%)	99 $\pm$ 0.4 (99–100)
Blood gas analysis	
pH (value)	7.36 $\pm$ 0.4 (7.26–7.52)
Base excess (value)	1.4 $\pm$ 4.1 (– 13 to + 13)
Lactate (mmol/l)	1.2 $\pm$ 0.5 (0.6–3.7)
Laboratory work-up	
Azotemia (mg/dl)	13 $\pm$ 5.7 (2–40)
Creatinine (mg/dl)	0.59 $\pm$ 0.32 (0.03–1.38)
Hb (g/dl)	13.5 $\pm$ 1.1 (9.1–15.6)
Albumin (g/dl)	4.8 $\pm$ 0.39 (3.8–5.9)
Management	
Intravenous fluids	133/211 (63)
Enteral nutrition (EN)–no. (%)	49/211 (23.2)
Continuous EN–no. (%)	30/211 (14.2)
Psychotropic drug therapy–no. (%)	127/211 (60.2)
Aripiprazole–no. (%)	108 (51.2)
Sertraline–no. (%)	54 (25.6)
Fluoxetine–no. (%)	22 (10.4)
Delorazepam–no. (%)	12 (5.7)
Diazepam–no. (%)	5 (2.4)
Lithium–no. (%)	5 (2.4)
Alprazolam–no. (%)	4 (1.9)
Olanzapine–no. (%)	4 (1.9)
Risperidone–no. (%)	4 (1.9)
Amitriptyline–no. (%)	1 (0.5)
Guarding–no. (%)	3 (1.4)

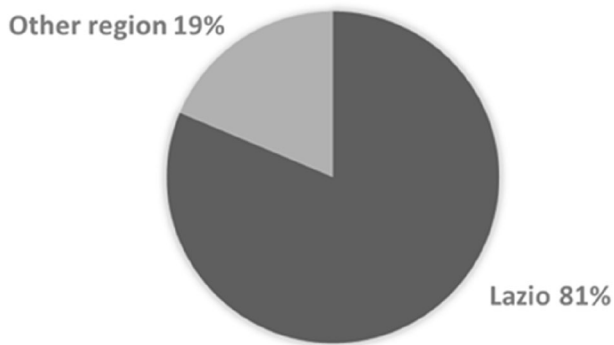
<sup>a</sup>All variables are expressed as means  $\pm$  SD and range (in brackets), if not otherwise specified

<sup>b</sup>Other than ED

**Table 2** Clinical characteristics of study sample (comparison)<sup>a</sup>

	Pre-COVID-19 (N=96)	Post-COVID-19 (N=115)	p value
Age (years)	13.6±2.6	14.5±2.4	0.010
Females–no. (%)	81 (84.4)	101 (87.8)	0.468
Hospitalized–no. (%)	55 (57.3)	90 (78.3)	0.001
Hospitalization (days)	26±17	19±12	0.004
Weight on admission (kg)	39±9	39±9	0.885
Height on admission (m)	1.57±0.12	1.57±0.09	0.785
Weight loss on admission (kg)	11.1±7.4	11.6±8.2	0.677
Weight loss to admission (months)	5.5±5.6	6.4±5.5	0.283
BMI on admission (value)	15.8±2.3	15.7±2.5	0.676
BMI on admission (percentile)–median (IQR)	4.8 (0.1–17.9)	1.3 (0.1–13.9)	0.075
BMI at discharge (value)	15.9±1.8	16.0±2.2	0.814
BMI at discharge (percentile)–median (IQR)	6.6 (0.1–19.8)	2.5 (0.2–11.7)	0.333
Multiple ED admissions–no. (%)	8 (8.3)	10 (8.7)	–
Relapse–no. (%)	13 (13.5)	18 (15.7)	0.666
Menarche–no. (%)	33 (34.4)	53 (46.1)	0.085
Amenorrhea (months)–median (range)	4.6 (2–11)	6.2 (1–57)	0.100
Psychiatric disorder <sup>b</sup> –no. (%)	8 (8.3)	27 (23.5)	0.003
<b>Vital signs</b>			
Heart rate (bpm)	68±18	66±22	0.502
Bradycardic–no. (%)	17 (17.7)	29 (25.2)	0.188
Systolic blood pressure (mmHg)	105±14	105±14	0.952
Diastolic blood pressure (mmHg)	64±8	67±10	0.137
Respiratory Rate (rpm)	19±3	16±3	<0.001
Oxygen saturation (%)	100±0	99±0.4	–
<b>Blood gas analysis</b>			
pH (value)	7.35±0.04	7.36±0.05	0.069
Base excess (value)	0.62±3.9	1.9±4.3	0.079
Lactate (mmol/l)	1.1±0.4	1.3±0.6	0.354
<b>Laboratory work-up</b>			
Azotemia (mg/dl)	13±4.7	14±6.3	0.478
Creatinine (mg/dl)	0.47±0.37	0.68±0.26	<0.001
Hb (g/dl)	13.6±0.9	13.4±1.2	0.499
Albumin (g/dl)	4.9±0.4	4.7±0.4	0.001
<b>Management</b>			
Intravenous fluids	50 (52.1)	83 (72.2)	0.004
Enteral nutrition (EN)–no. (%)	17 (17.7)	32 (27.8)	0.083
Drug therapy–no. (%)	45 (46.9)	82 (71.3)	<0.001
Aripiprazole–no. (%)	42 (43.7)	66 (57.4)	0.048
Sertraline–no. (%)	19 (19.8)	35 (30.4)	0.078
Fluoxetine–no. (%)	11 (11.5)	11 (9.6)	0.654
Delorazepam–no. (%)	1 (1.04)	4 (3.5)	0.379
Diazepam–no. (%)	6 (6.3)	6 (5.2)	0.747
Lithium–no. (%)	1 (1.04)	2 (1.7)	1.000
Alprazolam–no. (%)	3 (3.1)	2 (1.7)	0.661
Olanzapine–no. (%)	1 (1.04)	3 (2.6)	0.628
Risperidone–no. (%)	1 (1.04)	3 (2.6)	0.628
Amitriptyline–no. (%)	0 (0)	1 (8.7)	1.000
Guarding–no. (%)	7 (7.3)	6 (5.2)	0.533

<sup>a</sup>All variables are expressed as means±SD, if not otherwise specified<sup>b</sup>Other than ED



**Fig. 1** Geographic distribution of the studied population

median time of amenorrhea was described in those who complained of it during the COVID-19 pandemic ( $6.2$  vs  $4.6$  months;  $p=0.100$ ). When comparing the vital signs between the two groups, a statistically significant lower respiratory rate was detected in the COVID-19 cohort ( $19 \pm 3$  vs  $16 \pm 3$ ;  $p < 0.001$ ). No statistical significance was documented in terms of heart rate, bradycardia and other vital signs reported. Interestingly, the post-COVID-19 group had a higher mean serum creatinine ( $0.68 \pm 0.26$  vs  $0.47 \pm 0.37$  mg/dl;  $p < 0.001$ ) and a lower mean serum albumin ( $4.7 \pm 0.4$  vs  $4.9 \pm 0.4$  g/dl;  $p=0.001$ ) than the patients with ED admitted before the COVID-19 pandemic. A significantly higher number of patients were diagnosed with a psychiatric disorder other than ED during the COVID-19 pandemic ( $23.5$  vs  $8.3\%$ ;  $p=0.003$ ), consequently more often requiring pharmacological treatment ( $71.3$  vs  $46.9\%$ ;  $p=0.048$ ). Aripiprazole ( $57.4\%$ ), sertraline ( $30.4\%$ ) and fluoxetine ( $9.6\%$ ) were the most commonly prescribed drugs in this subgroup. Moreover, patients admitted during the COVID-19 pandemic more often required intravenous fluids ( $72.2$  vs  $52.1\%$ ;  $p=0.004$ ).

The multivariate analysis conducted on the significant variables from the univariate analysis and adjusted for age and gender proved that a shorter hospitalization, the diagnosis of a psychiatric disorder and an increased value of serum creatinine were significantly associated with admission for ED during the COVID-19 pandemic (Table 3). Figure 2 shows ED epidemiological trends during the study period.

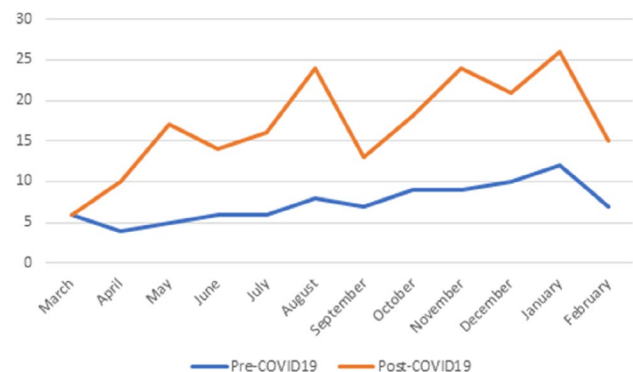
## Discussion

Our findings show a more acute and severe ED onset than in the recent past. Notably, a higher proportion of hospitalization was recorded during the COVID-19 era. Spettigue et al. also reported a higher percentage of patients requiring hospitalization during the COVID-19 pandemic:  $84.2\%$  compared to a previous  $62.1\%$  [28]. A higher rate of psychiatric

**Table 3** Binary Logistic Regression (dependent variable: pre-/post-COVID admission)

	Beta	C.I. (95%)	<i>p</i> value
Age (years)	1.157	0.881–1.520	0.295
Gender (males)	0.207	0.014–3.070	0.252
Hospitalization (days)	0.955	0.919–0.993	0.020
Psychiatric disorder (yes/no)	0.089	0.009–0.880	0.039
Weight loss on admission (kg)	0.953	0.885–1.027	0.210
BMI on admission (percentile)	0.999	0.975–1.024	0.941
Creatinine (mg/dl)	11.440	1.942–67.378	0.007
Albumin (md/dl)	0.309	0.072–1.332	0.115

disorder comorbidities and use of psychotropic drugs were detected in the COVID-19 cohort, reflecting a more complex illness. Nonetheless, the length of hospitalization was shorter during the COVID-19 pandemic rather than before. This may be due both to a more aggressive inpatient treatment of the underlying psychiatric condition as well as to the development of a solid and multi-disciplinary outpatient management of these patients, prompted by the sanitarian emergency as shown in recent reports [29]. Interestingly, patients with ED onset during the COVID-19 pandemic showed a significantly lower respiratory rate compared to the previous period. A slower respiratory rate could indicate greater severity and represent impending respiratory failure from diaphragmatic weakness. Although dehydration and electrolyte disorders are often detected in ED patients [21], blood gas analysis did not yield significant results when comparing the two subgroups. Conversely, we found a significantly higher serum creatinine and lower serum albumin in the latter group, compatible with a hyper-catabolic metabolism typical of ED patients with rapid weight loss. However, a lower serum albumin may also indicate better hydration rather than poor nutritional status. Nonetheless, more fluid was needed in the COVID-19 cohort to correct



**Fig. 2** Epidemiological trend of the population comparing in the two study periods

the greater dehydration in these subjects but not the rate of administration.

No significant differences to the previous year were noted in terms of weight or BMI at admission and duration of weight or BMI loss in patients admitted during the COVID-19 pandemic, suggesting to consider different parameters to evaluate ED onset severity. This is congruous to recent studies suggesting clinicians to consider different parameters to define AN severity avoiding BMI values alone [30].

On the other hand, the multivariate analysis showed that a shorter hospitalization, a psychiatric comorbidity and an increased serum creatinine were significantly associated with admission for ED during the COVID-19 pandemic, even when adjusting for BMI and weight on admission, age and gender, thus confirming the association with these factors.

Our study confirms the onset of an “epidemic within the pandemic” [31], characterized by an increased severity of ED during the COVID-19 era, which is congruous with other reports [25, 26]. As depicted in Fig. 2, the epidemiological trend of ED admissions during the COVID-19 pandemic shows an overall increase compared to the previous pre-COVID-19 year, with peaks and troughs of incidence that may be linked to emergency measures adopted by the Italian government, such as school closures (the first of which was announced on February 23, 2020) and their consequences: distance learning, home confinement, lifestyle changes [32]. Another putative cause of this increase is the temporary discontinuation of local public and private health services, which in turn can be blamed for the progression of the disease and the admission of more severely compromised patients.

## Strengths and limitations

Our study has three main limitations. First, the retrospective design prevented the identification of risk factors for ED onset during the COVID-19 pandemic. Second, we could not exclude that some patients admitted during the COVID-19 era developed the disease long before this period, as in some cases, the onset of the disease can be traced back up to 6 months before the hospital admission. However, our study shows that the COVID-19 pandemic may have played a role in exacerbating the disease to the point of requiring hospital admission, rather than outpatient management. Third, some significant as well as some non-significant results may have been caused by the small sample size, rather than from an actual size effect. However, even if further multi-center research is required to clearly highlight how COVID-19 triggers and affects pediatric ED, we believe our paper provides some innovative information to add to the literature on ED onset in children.

## Conclusion

Congruently with the literature, COVID-19 has been associated with worsening of mental health and development of psychiatric disorders. This study described a significant increase of ED patients during the COVID-19 pandemic among children. In particular, the presence of a psychiatric comorbidity, as well as an increase of serum creatinine and/or reduction of albumin level, should be considered as potential severity indices of ED. Families and pediatricians should be aware of the mental risk connected with the pandemic and be able to monitor and promptly detect any signs or symptoms of ED. To this regard, the development of structures where social and educational sharing can occur even in times of pandemics, may be crucial to address the complex psychological needs of teenagers. Nonetheless, more multi-center studies are required to evaluate these factors and long-term consequences of the pandemic and its related restrictions on children’s health.

## What is already known on this subject?

There have been reports describing the influence of COVID-19 pandemic on eating disorders with an increase of patients affected in the pediatric age.

## What this study adds?

This study highlights the increase of eating disorders during COVID-19 pandemic. It is of actual interest for readers, in the field of pediatrics eating disorders and in emergency settings, especially when the patients are conducted in the emergency department. We think that our results could be of great usefulness also for a broader audience of pediatricians and other specialists involved in children’s care.

**Author contributions** All authors conceived the study concept. GS, MR, MRM, UR and AV designed the study, were major contributors in writing the manuscript, contributed to the interpretation of the data, reviewed and revised the manuscript; MR performed statistical analysis; FF, GM, GT, BG, AC allowed for the acquisition of data, reviewed and revised the manuscript; AD, VZ, SV, AR and AV contributed to interpretation of data, reviewed and critically revised the manuscript for important intellectual content; AV coordinated the study, revised it critically for important intellectual content; All Authors approved the final manuscript as submitted and agreed to be accountable for all aspects of the work.

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**Data availability** The datasets are available from the corresponding author on reasonable request.

**Code availability** The source codes are available from the corresponding author on reasonable request.

## Declarations

**Conflict of interest** The authors have no conflicts of interest to disclose.

**Ethical approval** This retrospective chart review study involving human participants was in accordance with the ethical standards of the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. Ethical approval was granted by the Research Ethics Board at the Bambino Gesù Children's Hospital, IRCCS, Rome, Italy.

**Consent to participate** The requirement for informed consent was waived because the study was retrospective.

**Consent for publication** The requirement for informed consent was waived because the study was retrospective.

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