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# Investigating olfactory disorders in children with COVID-19 disease admitted to Hazrat Masoumeh Hospital in Qom

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## Abstract:

**BACKGROUND:** One of the most important sensory disorders that usually occur after viral infections, especially human coronaviruses and rhinoviruses, is anosmia or loss of olfactory sense. The aim of the present study was to investigate olfactory disorders in children with COVID-19 disease admitted to Hazrat Masoumeh Hospital in Qom.

**MATERIALS AND METHODS:** This descriptive-analytical study was conducted on 85 children admitted to Hazrat Masoumeh Hospital in Qom by using a convenience random sampling method. Data were collected using a checklist containing demographic data. The collected data were entered SPSS 18 software and were analyzed using descriptive and analytical statistics.

**RESULTS:** In the present study, the results showed that the mean age of participants was  $6.59 \pm 3.27$  years and more patients were Iranian ( $n = 69, 87.3\%$ ), had a history of underlying disease ( $n = 51, 64.6\%$ ), had a history of vaccination ( $n = 78, 98.7\%$ ), and did not have contact with a suspected patient ( $n = 43, 54.4\%$ ). Among the signs and symptoms of the disease, only the symptoms of fever ( $n = 71, 89.9\%$ ), weakness and lethargy ( $n = 44, 55.7\%$ ), and anorexia ( $n = 44, 55.7\%$ ) were observed in most patients. Moreover,  $87.3\%$  ( $n = 69$ ) of the patients did not have olfactory. Furthermore, no association was found between age ( $P = 0.803$ ), length of hospital stay ( $P = 0.397$ ), white blood cell ( $P = 0.624$ ), lymph ( $P = 0.638$ ), Polymorphonuclear (PMN) ( $P = 0.493$ ), erythrocyte sedimentation rate ( $P = 0.507$ ), C-reactive protein ( $P = 0.085$ ), and O2sat ( $P = 0.205$ ) and olfactory disorders, but a significant relationship was found between patient weight ( $P = 0.002$ ) and olfactory disorders.

**CONCLUSION:** According to the results of the study, it can be said that in order to increase the strength of the immune system of children, especially overweight children, appropriate and planned action should be taken to prevent problems in these children.

## Keywords:

Child, corona, hospital, infection, smell

## Introduction

Coronavirus is one of the main pathogens targeting mainly human respiratory system. The previous outbreak of coronavirus includes severe acute respiratory syndrome coronavirus (SARS-CoV) and Middle East respiratory syndrome coronavirus (MERS-CoV) as the cause of severe lower respiratory tract infection in

humans, and it is considered as a major threat to general human health.<sup>[1]</sup> The disease began in China, where it left the most widespread effects. Then, it spread to many other countries. The severity of the disease ranges from asymptomatic or mild to severe. A significant proportion of patients with obvious evidence of clinical infection have severe disease.<sup>[2]</sup> Coronaviruses are a large family of coronaviruses and subtype Coronaviridae that range from the

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common cold virus to the agent of more severe diseases such as SARS, MERS, and COVID-19.<sup>[3-5]</sup> The new coronavirus 2019 is transmitted through droplets, close contact, aerosols, and possibly fecal-oral transmission, and patients during the incubation period can transmit the virus to other people.<sup>[6,7]</sup> Furthermore, the incubation period of the virus is 5 days on average with a range of 4–7 days. The time interval between exposure to the virus and manifestation of clinical symptoms is called incubation period of the virus.<sup>[8-11]</sup>

The mortality rate of coronavirus COVID-19 is changing, and the number of recovered cases is increasing. The mortality rate of the new coronavirus is significantly lower than that of the SARS coronavirus (approximately 9.6%) and the MERS coronavirus (approximately 35.2%). Furthermore, the new coronavirus is closely associated with two bat SARS-like coronaviruses, but it is less similar to SARS and MERS viruses.<sup>[12-14]</sup> The male-to-female mortality rate is 3.25–1, the median age of death is 75 years, and in some studies, it is 60 years, and the median time interval from first symptoms to death is 14 days and median time interval from initial symptoms to death in people aged 70 years and above (11.5 days) is shorter than people under the age of 70 (20 days). These results suggest that the disease may progress more rapidly in adults than in young people.<sup>[8,15,16]</sup>

In patients who have symptoms, this disease can develop over a period of 1 week or more and begins with mild symptoms that in some cases progress to shortness of breath and severe seizures. The most common complications are fever (almost universal) and cough, which may or may not be productive. Muscle pain and fatigue are also common. Patients with moderate-to-severe disease suffer from shortness of breath, a small percentage of patients reported hemoptysis, and another group of them report chest pleurisy, upper respiratory symptoms such as runny nose, sneezing, and sore throat, headache, and gastrointestinal symptoms (nausea, vomiting, and diarrhea).<sup>[17-19]</sup> Laboratory tests showed that 25% of infected patients had leukopenia and 63% had lymphocytopenia. Aspartate aminotransferase levels have elevated in 37% of patients. Myocarditis has been diagnosed in 12% of patients, and the level of troponin I in these patients has significantly increased. Disorders in chest computed tomography (CT) scan images and pulmonary infection were observed in 98% of patients.<sup>[16,20]</sup>

One of the major sensory disorders resulting from viral infections, especially human coronaviruses and rhinoviruses, is anosmia, or loss of olfactory sense, which is one of the most common concerns reported in many coronavirus patients. In a study conducted by

Giacomelli *et al.*, out of 59 patients who participated in the study, 20 (33.9%) had disorders in at least one taste or smell and 11 (18.6%) patients had disorders in identifying both and had 91% reported changes in the olfactory system before hospitalization.<sup>[21]</sup> In a study conducted by Lichien, the incidence of olfactory and taste disorders was 85.6% and 88%, respectively, and the rate of recovery of symptoms in the olfactory sense was 0.44.<sup>[22]</sup> In the study conducted by Mao *et al.*, the most common neurological symptoms in patients with COVID-19 were taste and vision disorders.<sup>[23]</sup> Furthermore, based on other studies conducted on examining the olfactory level of patients with COVID-19, a significant number of patients, both outpatients and hospitalized patients, complained about this issue and reported anosmia.<sup>[24-27]</sup> One of the groups examined in COVID-19 disease is children because, unlike adults, atypical symptoms such as anosmia are very common in them, and in some cases, they are asymptomatic. The aim of this study was to investigate olfactory disorders in children with COVID-19 disease admitted to Hazrat Masoumeh Hospital in Qom.

## Materials and Methods

### Study design and setting

This descriptive-analytical study was conducted on hospitalized children undergoing treatment due to COVID-19 in Hazrat Masoumeh Hospital in Qom in 2021.

### Study participants and sampling

They were selected by a convenience random sampling method. Based on a similar study, the required sample size was determined to be 85 people considering 5% alpha and 0.1% error level, of which 79 people participated in the study.<sup>[21]</sup> To collect information, the goals of the study were explained for children with COVID-19 and written consent was obtained from them. The inclusion criteria of the study were as follows: (1) children with COVID-19 disease who were hospitalized and treated, (2) children over 3 years old, and (3) positive polymerase chain reaction or positive CT scan. The exclusion criterion also included the children and their families who did not cooperate in conducting the research.

### Data collection tool and technique

To collect information, a checklist that includes patients' demographic information (race, history of underlying disease, history of vaccination, history of contact with suspected patient, signs and symptoms (fever, chills, cough, sore throat, runny nose, olfactory disorders, anorexia, weakness and lethargy, shortness of breath, sweating, edema of the hands and feet, rash, conjunctivitis, muscle pain, chest pain, headache, drowsiness, seizures, hospitalization in the intensive care unit (ICU), respiratory distress, and death), age, weight, length of hospital stay,

time of onset of symptoms, blood tests (white blood cell [WBC], lymph, PMN, erythrocyte sedimentation rate [ESR], C-reactive protein [CRP], and O<sub>2</sub>sat) was used. To evaluate the child's olfactory disorders, both children's family was asked and olfactory test with alcohol 70° scored between 1 and 10 was used (children reacted to alcohol by reacting and not reacting). The data were entered into SPSS 16.0 (Created by Norman Ney in 1968 at Stanford University in the United States) and were analyzed with the help of descriptive statistics (frequency, percentage, mean, and deviation) and analytical statistics (Chi-square and *t*-test). Patients were also reassured that information would remain confidential.

### Ethical consideration

This article was derived from a research project approved by Qom University of Medical Sciences. It was registered with the code of IR.MUQ.REC.1399.295 in the Ethics Committee of Qom University of Medical Sciences.

### Results

In the present study, the results showed that most patients were Iranian ( $n = 69, 87.3\%$ ), had a history of underlying disease ( $n = 51, 64.6\%$ ) and a history of vaccination ( $n = 78, 98.7\%$ ), and did not have contact with a suspected patient ( $n = 43, 54.4\%$ ) [Table 1]. Furthermore, the mean age of participants was  $6.59 \pm 3.27$  years, the mean weight was  $27.52 \pm 14.44$  kg, the mean hospital stay was  $6.68 \pm 4.229$  days, and the onset of symptoms was  $10.36 \pm 3.28$  days.

Among the signs and symptoms of the disease, only the symptoms of fever ( $n = 71, 89.9\%$ ), weakness and lethargy ( $n = 44, 55.7\%$ ), and anorexia ( $n = 44, 55.7\%$ ) were seen in most patients. The rest of the symptoms were not present in most patients or were less. Furthermore,  $87.3\%$  ( $n = 69$ ) of the children had no sense of smell [Table 2]. Furthermore, no association was found between age ( $P = 0.803$ ), length of hospital stay ( $P = 0.397$ ), WBC ( $P = 0.624$ ), lymph ( $P = 0.638$ ), PMN ( $P = 0.493$ ), ESR ( $P = 0.507$ ), CRP ( $P = 0.085$ ), and O<sub>2</sub>sat ( $P = 0.205$ ) and olfactory disorders, but a significant relationship was found between patient weight ( $P = 0.002$ ) and olfactory disorders [Table 3].

Finally, there was no relationship between death ( $P = 0.198$ ), hospitalization in ICU ( $P = 0.766$ ), respiratory distress ( $P = 0.556$ ), and olfactory sense [Table 4] and there was no relationship between race and olfactory sense ( $P = 0.755$ ).

### Discussion

The aim of the present study was to investigate olfactory disorders in children referred to Hazrat Masoumeh

**Table 1: Demographic characteristics of children with COVID-19**

Variable	Subgroup	Frequency (%)
Nationality	Iranian	69 (87.3)
	Afghan	8 (10.1)
	Arab	1 (1.3)
	Pakistani	1 (1.3)
History of underlying disease	No	51 (64.6)
	Yes	28 (35.4)
Vaccination history	No	78 (98.7)
	Yes	1 (1.3)
Contact a suspicious patient	No	43 (54.4)
	Yes	36 (45.6)

**Table 2: Signs and symptoms of children with COVID-19**

Variable	Subgroup	Frequency (%)
Fever	No	8 (10.1)
	Yes	71 (89.9)
Chills	No	51 (64.6)
	Yes	28 (35.4)
Cough	No	40 (50.6)
	Yes	39 (49.4)
Sore throat	No	66 (83.5)
	Yes	13 (16.5)
Watery	No	76 (96.2)
	Yes	3 (3.8)
Olfactory	No	69 (87.3)
	Yes	10 (12.7)
Weakness and lethargy	No	35 (44.3)
	Yes	44 (55.7)
Anorexia	No	35 (44.3)
	Yes	44 (55.7)
Shortness of breath	No	53 (67.1)
	Yes	26 (32.9)
Sweating	No	71 (89.9)
	Yes	8 (10.1)
Human hand and foot	No	73 (92.4)
	Yes	6 (7.6)
Rush	No	57 (73.1)
	Yes	21 (26.9)
Conjunctivitis	No	60 (75.9)
	Yes	19 (24.1)
Muscle pain	No	49 (62)
	Yes	28 (35.4)
Headache	No	58 (73.4)
	Yes	21 (26.6)
Drowsiness	No	67 (84.8)
	Yes	12 (15.2)
Convulsions	No	75 (96.2)
	Yes	3 (3.8)
Hospitalization in the ICU	No	52 (65.8)
	Yes	27 (34.2)
respiratory distress	No	48 (61.5)
	Yes	30 (38.5)
Death	No	69 (87.3)
	Yes	10 (12.7)

ICU=Intensive care unit

**Table 3: Relationship between demographic variables and olfactory disorders in children with COVID-19**

Variable	Olfactory disorders	Frequency	Mean±SD	P
Age	No	69	6.62±3.28	0.803
	Yes	10	6.35±3.39	
Weight	No	58	25.56±13.10	0.002
	Yes	8	41.75±16.61	
Duration of hospitalization	No	69	6.84±4.47	0.397
	Yes	10	5.60±2.63	
WBC	No	69	105764.80±23491.02	0.624
	Yes	10	6950.34±3747.85	
Lymph	No	64	8668.32±3024.46	0.638
	Yes	10	1719.60±926.50	
Pmn	No	63	8311.83±7117.26	0.493
	Yes	10	5276.00±3182.26	
ESR	No	65	46.09±31.26	0.507
	Yes	8	38.37±26.97	
CRP	No	67	52.29±39.26	0.085
	Yes	8	27.48±23.27	
O2sat	No	62	93.12±6.46	0.205
	Yes	10	95.80±2.85	

WBC=White Blood Cells, ESR=Erythrocyte sedimentation rate, CRP=C-Reactive-Protein, Pmn=Polymorphonuclear, O2sat=Arterial oxygen saturation

**Table 4: Relationship between clinical status and olfactory disorders in children with COVID-19**

Variable	Subgroup	Olfactory, frequency (%)		P
		Does not have	Has it	
Death	No	59 (85.5)	10 (14.5)	0.198
	Yes	10 (100)	0	
Hospitalized in ICU	No	45 (86.5)	7 (13.5)	0.766
	Yes	24 (88.9)	3 (11.1)	
Respiratory distress	No	41 (85.4)	7 (14.6)	0.556
	Yes	27 (90)	3 (10)	

ICU=Intensive care unit

Hospital in Qom with a history of coronavirus. The results showed that there was no significant relationship between demographic characteristics and laboratory characteristics and olfactory disorders and only patients' weight showed a significant relationship with olfactory disorders. Two common causes of anosmia are olfactory disorders caused by viruses and chronic rhinosinusitis, the pathophysiology of which is sensory, neurological, or mixed, and less common causes of it are nasal polyps, tumors, head trauma, chemotherapy, or radiation therapy. However, the olfactory disorder induced by coronaviruses is most often caused by edema, congestion, and inflammation of chemical receptors and olfactory neuroepithelium. This olfactory disorder is rarely seen in SARS, while it is more common in COVID-19 patients.<sup>[28,29]</sup> In the present study, most children had symptoms of fever, weakness and lethargy, and anorexia, which was consistent with results of other studies.<sup>[30-32]</sup> Most studies have referred to the mentioned symptoms. Hence, it is necessary to pay more attention to these symptoms for faster diagnosis of the disease and

further quarantine and appropriate treatment for faster recovery of children and prevention of transmission of the disease to others.

Furthermore, there was no relationship between the child's age, length of hospital stay, specific blood tests, and olfactory disorders, which was consistent with similar studies conducted in this regard.<sup>[25,33,34]</sup> However, there was a significant relationship between the child's weight and olfactory disorder. It suggests that olfactory disorders occur in people regardless of the patient's condition. The present study also showed that there was no relationship between death of the patient, hospitalization in the ICU, respiratory distress of the patient, and olfactory disorder. Furthermore, in a study conducted by Hornuss *et al.*, the results showed that none of the patients in the control group had evidence of anosmia and only 45.12% of the patients had hyposmia. In the group of patients with COVID-19, 40% of the patients also had evidence of anosmia, indicating a significant relationship between COVID-19 and olfactory disorder in these patients.<sup>[35]</sup>

Furthermore, in another similar study, most patients had olfactory and taste disorders and there was a significant relationship between these disorders. Olfactory disorder was among the symptoms manifested earlier than other symptoms. Furthermore, the results of recovery scores obtained in patients with anosmia were significantly lower compared to normal and hyposmia people. Furthermore, 18.2% of the patients had no nasal congestion or runny nose and 79.7% of them had hyposmia and anosmia.<sup>[22]</sup> In a case study conducted by Feobo *et al.*, the results showed that olfactory and taste disorders were observed in the patients, followed by sore throat, runny nose, headache, and cough, and this olfactory and taste disorder continued for some time. Furthermore, in this study, olfactory and taste disorders were first observed and then the rest of symptoms appeared.<sup>[25]</sup> In the study conducted by Valendio *et al.*, olfactory disorder was first observed, followed by blood disorders, muscle pain, and respiratory problems, and these olfactory and taste disorders persisted in the patient for some time after recovery.<sup>[26]</sup> As soon as olfactory and taste disorders appear in these patients, we should immediately remove the patient and quarantine him or her and refer to medical centers for appropriate treatment and specialized tests to prevent the progression of the disease. This disease is a major threat to the health and safety of the world and its spread should be prevented immediately. The spread of the disease depends on the interaction between the virus and the patient's immune system. The disease may recover in some people without symptoms and without any specific action, or it may be transmitted to others, but among those who have been infected with it, about one in six patients will



experience severe disease and shortness of breath and other disorders.<sup>[36]</sup>

One of the strengths of this study is lack of such a study in the studied province, and this study is the first study conducted on COVID-19 patients in this province on both adults and children, especially on these signs and symptoms of the disease. One of the weaknesses of this study is lack of proper cooperation between mothers and children for olfactory disorders test. In this regard, we tried as much as possible to give the necessary explanations to the mothers and their families about the goals of the research and to get their consent and we tried to give prize for children to satisfy them for taking test.

## Conclusion

Based on the results of the study, in the case of taste and olfactory disorders along with other problems in our children, we should be sensitive to these children, quarantine them, and provide appropriate treatment for these patients to prevent transmission of this disease to other people.

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Nil.

## Conflicts of interest

There are no conflicts of interest.

## References

1. Rothan HA, Byrareddy SN. The epidemiology and pathogenesis of coronavirus disease (COVID-19) outbreak. *J Autoimmun* 2020;109:102433.
2. Zhu N, Zhang D, Wang W, Li X, Yang B, Song J, et al. A novel coronavirus from patients with pneumonia in China, 2019. *N Engl J Med* 2020;382:727-33.
3. Desforges M, Le Coupanec A, Dubeau P, Bourgooin A, Lajoie L, Dubé M, et al. Human coronaviruses and other respiratory viruses: Underestimated opportunistic pathogens of the central nervous system? *Viruses* 2019;12:14.
4. Casiglia E, Tikhonoff V, Virdis A, Masi S, Barbagallo CM, Bombelli M, et al. Serum uric acid and fatal myocardial infarction: Detection of prognostic cut-off values: The URRAH (Uric Acid Right for Heart Health) study. *J Hypertens* 2020;38:412-9.
5. Helu-Brown P, Barrio C. Latinx mental health in the Mexican consulate: Addressing barriers through social good. *Res Soc Work Pract* 2020;30:151-62.
6. Wu F, Zhao S, Yu B, Chen YM, Wang W, Song ZG, et al. A new coronavirus associated with human respiratory disease in China. *Nature* 2020;579:265-9.
7. Zhou P, Yang XL, Wang XG, Hu B, Zhang L, Zhang W, et al. A pneumonia outbreak associated with a new coronavirus of probable bat origin. *Nature* 2020;579:270-3.
8. Li Q, Guan X, Wu P, Wang X, Zhou L, Tong Y, et al. Early transmission dynamics in wuhan, china, of novel coronavirus-infected pneumonia. *N Engl J Med* 2020;382:1199-207.
9. Tavakoli A, Vahdat K, Keshavarz M. Novel coronavirus disease 2019 (COVID-19): An emerging infectious disease in the 21<sup>st</sup> century. *ISMJ* 2020;22:432-50.
10. Kofi Ayittey F, Dzuvor C, Kormla Ayittey M, Bennita Chiwero N, Habib A. Updates on Wuhan 2019 novel coronavirus epidemic. *J Med Virol* 2020;92:403-7.
11. Wu JT, Leung K, Leung GM. Nowcasting and forecasting the potential domestic and international spread of the 2019-nCoV outbreak originating in Wuhan, China: A modelling study. *Lancet* 2020;395:689-97.
12. Wu A, Peng Y, Huang B, Ding X, Wang X, Niu P, et al. Genome composition and divergence of the novel coronavirus (2019-nCoV) originating in China. *Cell Host Microbe* 2020;27:325-8.
13. Sun P, Qie S, Liu Z, Ren J, Xi JJ. Clinical characteristics of 50466 patients with 2019-nCoV infection. *medRxiv* 2020;92:612-7.
14. Xu J, Zhao S, Teng T, Abdalla AE, Zhu W, Xie L, et al. Systematic comparison of two animal-to-human transmitted human coronavirus comparison of two animal-to-human transmitted human coronaviruses: SARS-CoV-2 and SARS-CoV. *Viruses* 2020;12:244.
15. Wang W, Tang J, Wei F. Updated understanding of the outbreak of 2019 novel coronavirus (2019-nCoV) in Wuhan, China. *J Med Virol* 2020;92:441-7.
16. Huang C, Wang Y, Li X, Ren L, Zhao J, Hu Y, et al. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. *Lancet* 2020;395:497-506.
17. Yang X, Yu Y, Xu J, Shu H, Xia J, Liu H, et al. Clinical course and outcomes of critically ill patients with SARS-CoV-2 pneumonia in Wuhan, China: A single-centered, retrospective, observational study. *Lancet Respir Med* 2020;8:475-81.
18. Chen N, Zhou M, Dong X, Qu J, Gong F, Han Y, et al. Epidemiological and clinical characteristics of 99 cases of 2019 novel coronavirus pneumonia in Wuhan, China: A descriptive study. *Lancet* 2020;395:507-13.
19. Chan JF, Yuan S, Kok KH, To KK, Chu H, Yang J, et al. A familial cluster of pneumonia associated with the 2019 novel coronavirus indicating person-to-person transmission: A study of a family cluster. *Lancet* 2020;395:514-23.
20. Wu P, Hao X, Lau EH, Wong JY, Leung KS, Wu JT, et al. Real-time tentative assessment of the epidemiological characteristics of novel coronavirus infections in Wuhan, China, as at 22 January 2020. *Euro Surveill* 2020;25:200-8. [doi: 10.2807/1560-7917.ES.2020.25.3.2000044].
21. Giacomelli A, Pezzati L, Conti F, Bernacchia D, Siano M, Oreni L, et al. Self-reported olfactory and taste disorders in patients with severe acute respiratory coronavirus 2 infection: A cross-sectional study. *Clin Infect Dis* 2020;71:889-90.
22. Lechien JR, Chiesa-Estomba CM, De Siati DR, Horoi M, Le Bon SD, Rodriguez A, et al. Olfactory and gustatory dysfunctions as a clinical presentation of mild-to-moderate forms of the coronavirus disease (COVID-19): A multicenter European study. *Eur Arch Otorhinolaryngol* 2020;277:2251-61.
23. Mao L, Jin H, Wang M, Hu Y, Chen S, He Q, et al. Neurologic manifestations of hospitalized patients with coronavirus disease 2019 in Wuhan, China. *JAMA Neurol* 2020;77:683-90.
24. Klopfenstein T, Kadiane-Oussou NJ, Toko L, Royer PY, Lepiller Q, Gendrin V, et al. Features of anosmia in COVID-19. *Med Mal Infect* 2020;50:436-9.
25. Mak PQ, Chung KS, Wong JS, Shek CC, Kwan MY. Anosmia and ageusia: Not an uncommon presentation of COVID-19 infection in children and adolescents. *Pediatr Infect Dis J* 2020;39:e199-200.
26. Marhaeni W, Wijaya AB, Kusumaningtyas P, Mapianto RS. Thalassaemic Child Presenting with Anosmia due to COVID-19.

- Indian J Pediatr 2020;87:750.
27. Han AY, Mukdad L, Long JL, Lopez IA. Anosmia in COVID-19: Mechanisms and Significance. *Chem Senses* 2020;6:423-8:bjaa040.
  28. Xu X, Yu C, Qu J, Zhang L, Jiang S, Huang D, *et al.* Imaging and clinical features of patients with 2019 novel coronavirus SARS-CoV-2. *Eur J Nucl Med Mol Imaging* 2020;47:1275-80.
  29. Lei Z, Cao H, Jie Y, Huang Z, Guo X, Chen J, *et al.* A cross-sectional comparison of epidemiological and clinical features of patients with coronavirus disease (COVID-19) in Wuhan and outside Wuhan, China. *Travel Med Infect Dis* 2020;35:101664.
  30. Assaker R, Colas AE, Julien-Marsollier F, Bruneau B, Marsac L, Greff B, *et al.* Presenting symptoms of COVID-19 in children: A meta-analysis of published studies. *Br J Anaesth* 2020;125:e330-2.
  31. Xiong XL, Wong KK, Chi SQ, Zhou AF, Tang JQ, Zhou LS, *et al.* Comparative study of the clinical characteristics and epidemiological trend of 244 COVID-19 infected children with or without GI symptoms. *Gut* 2021;70:436-8.
  32. Xiong X, Wong KK, Chi S, Zhou A, Tang J, Zhou L, *et al.* Are COVID-19 infected children with gastrointestinal symptoms different from those without symptoms? A comparative study of the clinical characteristics and epidemiological trend of 244 pediatric cases from Wuhan. *medRxiv* 2020;5:842-8.
  33. Buonsenso D, Parri N, De Rose C, Valentini P; Gemelli-pediatric COVID-19 team. Toward a clinically based classification of disease severity for paediatric COVID-19. *Lancet Infect Dis* 2021;21:22.
  34. Mantovani A, Rinaldi E, Zusi C, Beatrice G, Saccomani MD, Dalbeni A. Coronavirus disease 2019 (COVID-19) in children and/or adolescents: A meta-analysis. *Pediatr Res* 2021;89:733-7.
  35. Hornuss D, Lange B, Schröter N, Rieg S, Kern WV, Wagner D. Anosmia in COVID-19 patients. *Clin Microbiol Infect* 2020;26:1426-7.
  36. Tao J, Song Z, Yang L, Huang C, Feng A, Man X. Emergency management of 2019 novel coronavirus: Implications for the dermatology department. *Br J Dermatol* 2020;182:e195.