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Coronavirus Disease 2019 (COVID-19) in adolescents: An update on current clinical and diagnostic characteristics

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Summary. The current outbreak of infections with SARS-CoV-2 is defined as Coronavirus Disease 2019 (COVID-19). The clinical symptoms of COVID-19 include fever, fatigue, cough, breathing difficulty that may lead to respiratory distress; a small population of patients may have diarrhea, nausea or vomiting. The highest infection rate occurs in adults; however, neonates, children, and adolescents can also be infected. As the outbreak continues to spread worldwide, attention has switched toward determinants of clinical manifestations and disease severity. The situation surrounding the outbreak is rapidly evolving and the information and recommendations are changing as new information becomes available. This paper summarises the current findings (April 3,2020) from a systematic literature review on the current knowledge of COVID-19 in adolescents (10-19 years according to the WHO definition) and reports the preliminary epidemiological data stated by the Italian National Institute of Health. (www.actabiomedica.it)

Key words: Coronavirus Disease 2019, COVID-19, clinical and diagnostic characteristics, children, adolescents

Background

The coronaviruses (CoVs) belong to a family of viruses that may cause various symptoms, such as cough, fever, breathing difficulty, and lung infection, mainly pneumonia (1). These viruses are common in animals worldwide, but, in a few instances, are known to infect humans (2).

Human coronaviruses (HCoVs) were first described in the 1960s in patients with common cold. Since then, a number of HCoVs have been discovered (229E, OC43, NL63, and HKU1), including SARS-CoV causing the severe acute respiratory syndrome and MERS-CoV, the Middle East respiratory syndrome; both are highly transmissible and pathogenic viruses that emerged in humans at the beginning of the 21st century (3). These HCoVs are associated with lower respiratory tract syndromes, spread from person-to-person via close contact; they have high morbidity and mortality caused by the progression to Acute Respiratory Distress Syndrome (ARDS). It was recently discovered that dromedary camels in Saudi Arabia harbor three different HCoV species, including a dominant MERS HCoV lineage that was responsible for outbreaks in the Middle East and South Korea during 2015 (2).

On 9 January 2020, a novel coronavirus, 2019-nCoV, was officially identified as the cause of an outbreak of diffuse pneumonitis in the city of Wuhan in Hubei Province, China. The epidemic has progressed very quickly in the following weeks, and an increasing number of cases have occurred daily in many countries (1).

The disease was named COVID-19 by the World Health Organization (WHO) on 11 February 2020 (4), and the virus, SARS-CoV-2 by the International Committee on Virus Taxonomy on the same day. On 11 March 2020, WHO classified the outbreak as a pandemic (5). Currently SARS-CoV-2 has now spread to all continents excluding Antarctica.

On 3 April 2020, over 1 million patients with COVID-19 have been reported globally, with approximately 212,000 cases having recovered and over 53,000 deaths, according to the data compiled by the Center for Systems Science and Engineering at Johns Hopkins University.

The US has the highest reported number of patients with COVID -19 worldwide, accounting for approximately one quarter of all global cases. After the US, Italy, Spain, Germany, China, France, Iran, and the UK have the higher number of patients. Italy still has the largest number of deaths globally, accounting for nearly one third of all global fatalities (Tables 1 and 2), but it appears that the rate of new infections has slowed in the last few days.

According to the WHO, case and contact definitions are based on the current available information and are revised daily as new information accumulates. Countries may need to adapt case definitions depending on their local epidemiological situation and other factors. All countries are encouraged to publish definitions used online and in regular situation reports, and to document periodic updates to definitions which may affect the interpretation of surveillance data.

As the outbreak continues to spread worldwide, attention has switched toward determinants of clinical manifestation and disease severity. This paper summarises the findings of a systematic literature review on the current knowledge of COVID-19 in adolescents (10-19 years, according to the WHO definition) and reports the preliminary epidemiological data on adolescents in Italy.

Information sources and search strategy

Literature was identified by searching the following online databases: PubMed, Google scholar, medRxiv, bioRxiv, WHO**,** Centres for Disease Prevention and Control (CDC), European Centre for Disease Prevention and Control, Italian National Institute of

Table 1. Countries in regions of Americas, Western Pacific, Eastern Mediterranean reporting laboratory-confirmed COVID-19 cases and deaths (From: WHO situation report – 74 - Data as of 3 April 2020; modified).

Reporting Country/ Territory/Area†	Total confirmed cases‡	Total confirmed new cases	Total deaths	Total new deaths
Region of America				
United States of America 213600	26298	4793	947	
Canada	10114	1109	127	22
Western pacific Region				
China	82802	78	3331	4
Republic of Korea 10062	86	174	5	
Australia	5224	248	223	2
Eastern Mediterranean Region				
Iran (Islamic Republic of)	50468	2875	3160	124
Pakistan	2450	159	35	4
Saudi Arabia	1885	165	21	5
United Arab Emirates	1024	210	8	0
Qatar	949	114	3	1
Egypt	865	86	58	6
Oman	252	21	2	1

Legend: ‡Case classifications are based on WHO case definitions for COVID-19. Note: Total new cases and deaths refer to the last day of observation, 3 April 2020.

Table 2. Countries of European Region with reported laboratory-confirmed COVID-19 cases and deaths (From: WHO situation report – 74 - Data as of 3 April 2020; modified).

Reporting Country/ Territory/Area†	Total confirmed cases‡	Total confirmed new cases	Total deaths	Total new deaths
Italy	115242	4668	13917	760
Spain	110238	8102	10003	950
Germany	79696	6174	1017	145
France	58327	2066	4490	471
The United Kingdom	33722	4244	2921	389
Switzerland	18844	1774	536	158
Turkey	18135	2456	356	79
Belgium	15348	1384	1011	183
Netherlands	14697	1083	1339	166
Greece	1514	139	53	3

Legend: ‡Case classifications are based on WHO case definitions for COVID-19. Note: Total new cases and deaths refer to the last day of observation, 3 April 2020.

Health (ISS), Centre for Evidence-Based Medicine (CEBM), Worldometer, and health authorities. The searches concluded on 3 April 2020. The following search terms were used: "2019 novel coronavirus, 2019-nCoV, Wuhan coronavirus, Wuhan pneumonia, Covid-19 in children and adolescents". Articles were screened by title, abstract, and full text. Google searches were also used to provide access to government and international institutes. In our review we preferentially included the relevant peer-reviewed scientific publications written in English.

What we know so far in adults with SARS-CoV-2 infection

a. Incubation period and transmission dynamics:

The mean incubation period is brief, reported as 5.2 days, with the 95th percentile of the distribution at 12.5 days (95% confidence interval: 9.2–18) (6). Overall, these estimates will be refined as more data become available.

Available evidence indicates that human transmission of SARS-CoV-2 occurs via close contact with respiratory droplets produced when a person exhales, sneezes, or coughs, or via contact with fomites. The virus has been detected in blood, saliva, tears, and conjunctival secretions (7-10). SARS-CoV-2 RNA was also detected in stool specimens but according to WHO-China report, fecal-oral transmission did not appear to be a significant factor in the spread of infection (Report of the WHO-China Joint Mission on Coronavirus Disease 2019,COVID-2019. February 16-24, 2020).

All ages are susceptible to this viral infection (11,12). High viral loads have been detected in nasal and throat swabs soon after symptoms onset; it is thought that the viral shedding pattern may be similar to that of patients with influenza.

Pharyngeal viral shedding is high during the first week when symptoms are mild or prodromal, peaking on day 4, suggesting an active virus replication in the upper respiratory tract tissues. Other studies have also shown a higher viral load in the nasal cavity as compared to the throat, with no difference in viral burden between symptomatic and asymptomatic people. Patients can be infectious for as long as the symptoms last and even after clinical recovery (13,14). Up to now, no cases of transmission via the faecal–oral route have been reported for SARS-CoV-2, which might suggest that infection via this route is unlikely.

Detailed epidemiological information based on a larger sample of COVID-19 patients is needed to determine the infectious period of SARS-CoV-2, as well as whether transmission can occur from asymptomatic individuals during the incubation period ("pre- symptomatic" period). However, such sources of infection cannot be effectively identified due to the

absence of symptoms. So far, research evidence is lacking, although there are a few studies suggesting that pre-symptomatic or asymptomatic carriers may cause viral transmission (12,15).

Asymptomatic carriers can also be a source to propagate the outbreak (16). A study in Singapore identified 6.4% of patients among seven clusters of cases in which presymptomatic transmission was likely to have occurred 1 to 3 days before symptom onset (17). These patients are not easy to detect when initially infected but might have abnormal symptoms later.

In a small number of case reports and studies, a familial cluster of infection associated with SARS-CoV-2 has been reported, indicating possible person-to-person transmission during the incubation period (18,19).

The best evidence so far comes from the Diamond Princess cruise ship, which was quarantined with all passengers and crew members repeatedly tested and closely monitored. A modelling study found that approximately 700 people with confirmed infection (18%) were asymptomatic (20).

Pregnant women and their fetuses represent a high-risk population during disease outbreaks.

Until 23 March 2020, the outcomes of 55 pregnant women infected with SARS-Cov-2 and 46 neonates have been reported with no definite evidence of vertical transmission (21).

Prenatal complications may include premature labor and fetal distress.

However, vertical transmission cannot be ruled out. There have been reports of infection in neonates born to mothers with COVID-19 (22), and virus-specific antibodies have also been detected in neonatal serum samples (23).Therefore, it is crucial to screen pregnant women and implement strict infection control measures, quarantine of infected mothers, and close monitoring of neonates at risk of COVID-19.

In conclusion, several properties of this virus make prevention difficult namely: the non-specific features of the disease, the infectivity before onset of symptoms during the incubation period, the transmission from asymptomatic people, the long incubation period, the tropism for mucosal surfaces such as the conjunctiva, the prolonged duration of the illness and the transmission after clinical recovery.

b. Clinical manifestations

Many reports provide descriptions of the clinical signs associated with COVID-19 in Wuhan and other cities in China. The clinical symptoms range from mild cough and fatigue to severe acute respiratory distress and respiratory failure. In adults, the main prevalent clinical manifestations include: sore throat, cough, high fever, tachypnea/dyspnea, and chest tightness/pain. The presence of fever is significantly higher in adults compared to children.

In adults and adolescents with severe pneumonia the respiratory rate is >30 breaths/minute and the SpO_2 is ≤93% on room air. The leading cause of death in patients with COVID-19 is respiratory failure from acute respiratory distress syndrome (6,13,14,24).

c. Diagnostic tests

A wide range of diagnostic tests are commercially available for SARS-CoV-2, some of which have received authorization for use by various national regulatory agencies. Countries have implemented different testing strategies, reflecting the availability of equipments, diagnostic reagents, and capability of their national health system.

The CDC recommends collection of a nasopharyngeal swab specimen to test for SARS-CoV-2 (25). A positive test generally confirms the diagnosis of COVID-19, although false-positive results may occur. Negative RT-PCR tests on nasopharyngeal specimen swabs despite CT findings suggestive of viral pneumonia have been reported in some patients who ultimately tested positive for SARS-CoV-2 (26).

d. Imaging

Based on the findings of chest radiographs in 1,099 respiratory distress syndrome (ARDS) in COVID-19 patients, only 14.7% had abnormal findings (27). In contrast, 840 (76.4%) had abnormal and diverse chest CT images, in which ground-glass opacity (GGO) was the most common abnormality (65.5%), followed by local patchy shadowing (48.7%), and interstitial abnormalities (17.0%). In addition, 50.1% patients had bilateral patchy shadowing (27). As the disease progress, follow-up CT scans may show enlargement and consolidation of single GGO, an enlarged fibrous stripe, and solid nodules.

Generally, two types of abnormal radiographic presentations are seen in children and adolescents: multiple opacities and patchy opacities (28). In the Liao et al study (29), only 7 (50.0%) adolescent patients showed ground-glass opacity at chest CT scanning, compared with 22 (68.8%) young adults.

e. Laboratory findings

Rodriguez-Morales et al (30) performed a systematic literature review with meta-analysis, using three databases to assess clinical, laboratory, imaging features, and outcomes of COVID-19 confirmed cases. 660 articles were retrieved for the time frame (1/1/2020-2/23/2020). After screening, 27 articles were selected for full-text assessment, 19 being finally included for qualitative and quantitative analyses. Decreased albumin (75.8%), high C-reactive protein (58.3%), high lactate dehydrogenase (LDH) (57.0%), lymphopenia (43.1%), and high erythrocyte sedimentation rate (ESR) (41.8%), were the most prevalent laboratory findings.

In short, confirmation of infection requires nucleic acid testing of respiratory tract samples (e.g., throat swabs). However, nasopharyngeal specimens may miss some infections and a deeper specimen may need. Alternatively, repeated testing can be used because, over time, the likelihood of the SARS-CoV-2 present in the nasopharynx increases. Serologic tests, once generally available, should be able to identify patients who have either current or previous infection but a negative PCR test. Clinical diagnosis may be made based on symptoms, exposure, and chest imaging. Chest CT may plays a key role in detection or diagnosis of COVID-19 infection with some typical CT features while the initial RT-PCR result is negative. Consequently, at present, exposure history, clinical manifestations, chest CT features and laboratory results, should be taken in consideration to diagnose COVID-19 infection.

Clinical characteristics of SARS-CoV-2 infection in adolescents

At present, information regarding the epidemiology and clinical features caused by COVID-19 in adolescents are scarce in the literature. As a first step, we reviewed the epidemiological characteristics of 2019-nCoV. From February-April 2020, the reported prevalence of infection in adolescents in China (31), Korea (32,33), USA (children and adolescents <18 years) (34), and Italy (35) was equal to 1%, 4%, 1.7%, and 0.87 %, respectively.

Tables 3 and 4, and figure 1 illustrate the available data in adolescents compared to children (0-9 years) in China (31) and Italy (Ruggiero L, data calculated from ref 35). Notably, a higher number of positive cases were reported in the North of Italy (36).

In the Chinese report, the time period from the peak of the symptom-onset-based epidemic curve (around January 24) to the peak of the diagnosis-based epidemic curve (February 4) was about 10 days (31). The proportion of Chinese children who developed severe or critical COVID-19 illness with breathlessness, acute respiratory distress syndrome (ARDS), and shock was much lower (6%) than among Chinese adults (19%).

In the United States, among 2,572 COVID-19 cases in children aged <18 years, nearly one third, 813 cases (32%) occurred in children, aged 15–17 years, and 682 (27%) in children aged 10–14 years (37). No admissions in intensive care units or deaths were reported in patients younger than 19 years up to 3 April 2020.

Table 3. Number of patients, deaths, and fatality rate reported in confirmed COVID-19 patients in Mainland China as of 11 February, 2020 (From: The Novel Coronavirus Pneumonia Emergency Response Epidemiology Team. The Epidemiological Characteristics of an Outbreak of 2019 Novel Coronavirus Diseases (COVID-19) — China, 2020. China CDC Weekly.2020; www.ne.jp/asahi/kishimoto /clinic/ cash/COVID-19)

Baseline Characteristics	Confirmed Cases, N (%)	Deaths, N(%)	Case Fatality Rate, %
Age, years			
0-9	416 (0.9)	-	-
10-19	549 (1.2)	1 (0.1)	0.2
20-29	3,619 (8.1)	7 (0.7)	0.2

Table 4. Number of COVID-19 cases and deaths reported in children (0-9 years) and adolescents (10-19 years) compared to the total number of confirmed infections and deaths reported in all Italian regions. [Adapted from: Italian National Institute of Health (ISS) bulletin data - 2 April, 2020 and 3 April, 2020 - appendix; modified]

Region	AGE 0-9 years Number of cases	Deaths N	AGE 10-19 years Number of cases	Deaths No.	Total number of confirmed infections	Total number of deaths
Piemonte	35	0	29	0	8,133	874
Val D'Aosta	9	0	7	0	498	26
Lombardia	205	0	170	0	46,071	7,600
Trentino-Alto Adige	32	0	48	0	3,791	299
Veneto	90	0	164	0	10,192	547
Friuli Venezia Giulia	12	0	33	0	1,594	125
Liguria	16	0	18	0	2,311	428
Emilia Romagna	73	0	131	0	14,741	1,720
Toscana	56	0	66	0	3,968	163
Umbria	22	0	20	0	806	34
Marche	20	0	29	0	3,815	209
Lazio	35	0	48	0	3,088	147
Abruzzo	16	0	41	0	1,447	29
Molise	1	0	7	0	159	11
Campania	17	0	30	0	1,394	73
Puglia	21	0	34	0	2,077	145
Basilicata	2	0	4	0	76	9
Calabria	12	0	21	0	556	28
Sicilia	12	0	23	0	1,047	50
Sardegna	7	0	8	0	635	33
Total	**693**	**0**	**931**	**0**	**106, 399**	**12, 550**

Note: The case definition considers any person with laboratory confirmation of virus causing COVID-19 infection as a confirmed case, irrespective of clinical signs and symptoms.

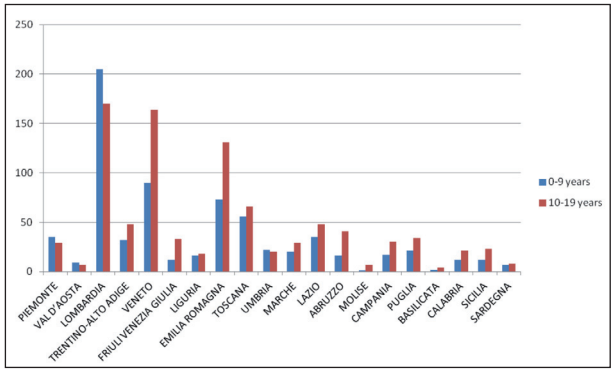

Figure 1. Total number of COVID-19 cases diagnosed in children (0-9 years) and adolescents (10-19 years) as reported by the Italian Reference Laboratories. [From: Italian National Institute of Health (ISS) bulletin data - 2 April, 2020 and 3 April, 2020 - appendix; modified]
Note: The case definition considers any person with laboratory confirmation of virus causing COVID-19 infection as a confirmed case, irrespective of clinical signs and symptoms.

Compared to the adult population, Cai et al. (38) observed a longer period of incubation in adolescents with a mean of 6.5 days (range 2-10 days) from the time of exposure to symptoms. Ludvigsson (39), in a systematic literature review, reported that the transmission could emerge rapidly between younger patients and their family members or close contacts.

A detailed study on epidemiology, transmission patterns, and clinical characteristics in adolescents and young adults with COVID-19 has been recently published (40-42). In general, common symptoms on admission were similar to those in adults, namely: dry cough (81.0%), fever (69.1%), and expectoration (38.1%). Lung auscultation may reveal rales and crackles. The less common symptoms included headache, fatigue, sore throat, chest pain, anorexia, myalgia, dizziness, diarrhoea, nausea, and shortness of breath (40-42).

As far as we know, anosmia/hyposmia or ageusia/ dysgeusia has not been reported in adolescents. The American Academy of Otolaryngology - Head and Neck Surgery (March 2020, internet publication) has proposed adding anosmia and dysgeusia to the list of screening items for potential infection in adults and recommends that clinicians consider testing and self-isolation of these patients in the absence of other respiratory diseases such as rhino sinusitis or allergic rhinitis.

Over 90% of patients were asymptomatic, or with mild, or moderate clinical symptoms (40). However, whether the limited number of COVID-19 in children is due to lower susceptibility or milder presentation leading to missed detection remains unknown (40). The mild nature of COVID-19 in pediatric cases is likely to be multifactorial. Cai et al. (38) reported that while COVID-19 viral shedding in respiratory specimens lasts longer in children than adults, and was also observed in the stool specimens, the virus was not detected in serum samples. The absence of viremia has likely contributed to the lack of severe illness in children cases (38).

Severe or critical illness was reported in 7.3% of children aged 1 to 5 years, 4.2% in children aged 6 to 10, 4.1% in the 11 to 15 age group, and 3.0% in adolescents 16 years and older. One 14-year-old child in this cohort died (39). Compared with young adults, no severe cases and higher odds of asymptomatic cases (14.3% vs 6.3%) were observed in adolescent patients (41).

Patients with chronic diseases are at greater risk of infection. Data on the management of comorbidities in patients with COVID-19 is limited (43) and should be tailored to the patient's chronic disease (44,45).

There are no vaccines available and there is little evidence to date on the effectiveness of potential therapeutic agents. Management strategies for children and adolescents are absent because of the limited number of patients in this age group with COVID-19. Therefore, treatment has been focused on symptomatic and respiratory support (oxygen inhalation, fluid management, and the use of broad-spectrum antibiotics to cover secondary bacterial infection). Apart from the above, the use of interferon-a nebulization, anti-viral drugs (such as, remdesivir lopinavir/ritonavir), and chloroquine have been reported (46-48).

In summary, compared with elderly patients, adolescent and young adult COVID-19 patients have a longer incubation period, a shorter serial interval, higher odds of being asymptomatic and a lower mortality rate. Larger epidemiologic studies are needed to confirm the lower susceptibility and milder clinical presentation of COVID-19 in adolescents. The commonest clinical and laboratory findings in adolescents with COVID-19 are summarized in table 5.

Conclusions

The WHO, on 30 January 2020, declared that the new coronavirus SARS-CoV-2 outbreak is a public health emergency of international concern. Pediatric COVID-19 cases, including adolescents, are rapidly increasing around the world. Early recognition and rapid diagnosis are essential to prevent transmission and provide supportive care in a timely manner.

The CDC is working closely with state and local health partners to develop and disseminate information to the public on general prevention of respiratory illness, including the 2019-nCoV. This includes everyday preventive actions such as: washing hands, cover-

Table 5. Summary of the commonest clinical and laboratory findings in adolescents with COVID-19 infection (From references: 38-42).

1.	The incubation period of COVID-19 in adolescents and young adults is longer than in older patients.
2.	Compared to young adults, adolescents were less likely to be overweight/obesity, to smoke and drink alcohol.
3.	No severe cases and higher odds of asymptomatic cases (14.3% vs 6.3%) were observed in adolescent patients
4.	The adolescent and young adult patients with COVID-19 have different patterns of symptoms and lower incidence of abnormal laboratory findings. The inflammatory markers of C-reactive protein (CRP) and procalcitonin (PCT) were elevated in 13.6% and 10.6% of cases, respectively.
5.	Ground-glass opacity at chest CT scanning was found in 50% of adolescents compared with 68.8% of young adults.
6.	Compared to young adults, adolescent patients received less oxygen inhalation therapy and had lower number of days with persistent fever.
7.	Lower number of adolescents developed severe complications. Extended follow-up is needed to provide more detailed information on the potential risk factors interfering with clinical outcomes.

ing the mouth and nose when coughing or sneezing, and staying home when ill. Thus, everybody should follow the national guidelines around screening, testing, containment, care and practice social distancing. Additional information and resources for this outbreak are available on the CDC website (https://www.cdc.gov/coronavirus/2019-ncov/ index.html).

Considering that all age groups are susceptible to SARS-CoV-2 infection, it is of critical importance also, that the youngest subjects, who may be asymptomatic or have milder symptoms, should comply with the self-isolation procedures in order to prevent virus diffusion. Additionally, personal protective equipment (PPE) is crucial when care providers look after an infected person.

As more is learned about this novel virus and outbreak, more data will emerge to facilitate the diagnostic and preventive measures for containing and minimizing the COVID-19 infection. At present, we suggest that in the presence of active community transmission, subjects presenting with a fever of unknown aetiology or with a fever in the presence of common cold or pneumonia symptoms should be tested for COVID-19, and influenza A and B viruses to rule out possible co-infection considering the seasonal overlap between influenza and COVID-19.

In helping to prevent influenza, all persons aged ≥ 6 months should receive influenza vaccine annually (49).

According to the United Nations Educational, Social and Cultural Organization (UNESCO), 107 countries have implemented nationwide school closures, impacting over 861,7 million children and youths. At this moment, we do not have strong evidence to guide decisions on duration of school closures and how duration may affect public health. Extending school closure will support the overall effectiveness of social distancing and thus aid in lowering the peak of the epidemic curve. However, prolonged periods of school closures and movement restriction may lead to additional emotional unrest and anxieties (47). Education, social support mechanisms and access to health services need to be maintained, with parents and/or guardians playing a key role (50,51).

Further relevant aspects should be also taken in consideration (Table 6).

Table 6. The United Nations Population Fund recommendations (UNFPA: www.unfpa.org/ sites/default/files/resource; modified)

1.	Many vulnerable young people are at greater risk of contracting COVID-19, such as young migrants, young refugees, homeless young people, those in detention, and young people living in crowded areas and in poverty.
2.	If caregivers are infected, quarantined, or die, protection and psychosocial issues for adolescents need to be addressed.
3.	With prolonged stress on the health system to address COVID-19, a disruption of the normal delivery of sexual and reproductive health services and information to young people will need to be addressed.
4.	The need for mental health services and counselling is paramount, as many people, including young people, who are facing high levels of anxiety and stress related to COVID-19.
5.	Adolescents and youths, especially adolescent girls and young women, who already tend to face very high levels of domestic and intimate partner violence, may experience even higher levels of violence driven by quarantine and isolation.

This review has numerous limitations; few articles are focusing on the clinical features of COVID-19 in adolescents. Some clinical and epidemiologic risk factor data might be incomplete, as they were collected by multiple teams under protocols that, by necessity, changed as the situation progressed. Data on outcomes, including hospitalization, were missing and this likely resulted in an underestimation of outcomes. No comprehensive data are available on the impact of COVID-19 on adolescents with an underlying condition, especially those with respiratory system morbidity, but it is reasonable to consider that they might be at increased risk for severe disease.

In conclusion, all clinicians should keep themselves updated about recent developments including global spread of the disease. We encourage coordinated efforts between national and international health agencies to develop effective surveys in this age group.

Dedication

We express our sincere condolences to the patients and their families who had COVID-19 around the world. We greatly respect the efforts of all the hospital employees and their families, who are working tirelessly during this outbreak, and the collaborative partnership at all levels of individuals in the

public and private sectors of the Nations for their care, support, and love to the patients.

Up to 10 April, 2020, many doctors and nurses have been died after caring for patients with COVID-19 infection, and of those 108 doctors and 28 nurses were in Italy. Their dedication and example will remain forever in our memory.

Conflict of interest: Each author declares that he or she has no commercial associations (e.g. consultancies, stock ownership, equity interest, patent/licensing arrangement etc.) that might pose a conflict of interest in connection with the submitted article

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