

Diagnosis of Covid-19 in Children and Nursing Approach: A Systematic Review

Çocuklarda Covid-19'un Tanılanmasında Hemşirelik Yaklaşımı: Sistematik Bir İnceleme

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ABSTRACT

Aim: This study was carried out to summarize the systematic literature review on current information about Serious acute respiratory syndrome 2 (SARS-CoV-2 or Covid-19 in children and to determine nursing approach.

Methods: Regarding the research, 156 publications were examined between 21 January and 15 November 2020. The review was conducted with the key words of "SARS-CoV-2", "coronavirus", "Covid-19", "child", "nursing", which are openly accessible on databases such as PubMed, Science Direct and the WHO.

Results: Covid-19 infection may be asymptomatic or characterized by fever and fatigue in children; they can be potential carriers of the disease. Several upper respiratory symptoms have been seen, such as nasal congestion and a runny nose. In some patients, abdominal pain, nausea, vomiting and diarrhea occurs. Fever and cough were evident in pediatric patients. As the condition progresses, dyspnea, cyanosis and other signs may arise after typically one week of the disease, along with systemic toxic signs, including restlessness or malaise, decreased appetite, poor feeding and reduced activity. Children's condition might progress quickly and turn to respiratory failure, which cannot be improved by conventional oxygen within 1-3 days. Metabolic acidosis, septic shock, irreversible bleeding and coagulation dysfunction can take place in such severe cases. However, Covid-19 may cause an inflammatory reaction in some children. Those starting with gastrointestinal symptoms may progress to severe conditions and newborns whose mothers are infected with Covid-19 could have severe complications.

Conclusion: This systematic review has shown that children generally develop mild Covid-19 disease and these infections are often acquired through community sources. Diagnosis of the disease is difficult in children and there is limited data on children with Covid-19. The disease mainly causes fever, respiratory symptoms and other flu-like manifestations in children. The signs and symptoms of the disease should be carefully monitored. Nurses should know the course and symptoms of the disease well in children and take precautions.

Keywords: 2019-nCoV, care, Covid-19, child, nursing

ÖZ

Amaç: Bu çalışma, çocuklarda ciddi akut solunum sendromu 2 (SARS-CoV-2 veya Covid-19) hakkındaki güncel literatürü sistematik olarak özetlemek ve hemşirelik yaklaşımını belirlemek amacıyla yapılmıştır.

Yöntem: Araştırmaya konu olan kısım ile ilgili olarak, 21 Ocak ve 15 Kasım 2020 tarihleri arasında 156 araştırmaya ulaşılmıştır. İnceleme PubMed, Science Direct ve WHO veri tabanlarında "SARS-CoV-2", "koronavirüs", "Covid-19", "çocuk", "hemşirelik" anahtar ke-limleri ile gerçekleştirilmiştir.

Bulgular: Covid-19 enfeksiyonu, çocuklarda asemptomatik olabilir ve hastalığın potansiyel taşıyıcıları olabilirler. Burun tıkanıklığı ve burun akıntısı gibi çeşitli üst solunum yolu semptomları görülür. Bazı hastalarda karın ağrısı, bulantı, kusma ve ishal görülür. Pediyatrik hastalarda daha çok ateş ve öksürük görülmektedir. Durum ilerledikçe, huzursuzluk veya halsizlik, iştahsızlık, zayıf beslenme ve daha az aktivite gibi sistemik toksik belirtiler birlikte tipik olarak hastalığın bir haftasından sonra dispne, siyanoz ve diğer belirtiler ortaya çıkabilir. Çocukların durumu hızlı bir şekilde ilerleyebilir ve 1-3 gün içinde geleneksel oksijenle düzilemeyen solunum yetmezliğine dönüşebilir. Metabolik asidoz, septik şok, geri döndürülemez kanama ve pıhtılaşma disfonksiyonu bu tür ağır vakalarda meydana gelebilir. Bununla birlikte, Covid-19 bazı çocuklarda inflamatuvar bir reaksiyona neden olabilir. Gastrointestinal semptomların görüldüğü çocuklarda ve anneleri Covid-19 ile enfekte olan yenidoğanlarda hastalığın ilerlemesiyle birlikte ciddi komplikasyonlar oluşabilir.

Sonuç: Bu sistematik derleme sonuçları çocuklarda Covid-19 hastalığının genellikle hafif geliştiğini ve bu enfeksiyonun genellikle toplum kaynaklı edinildiğini göstermiştir. Çocuklarda hastalığın tanısı zordur ve Covid-19'lu çocuklar hakkında sınırlı sayıda veri vardır. Bu hastalık, çocuklarda temel olarak ateş, solunum semptomları ve diğer grip benzeri belirtilere neden olur. Bu yüzden, hastalığın semptom ve belirtileri dikkatle izlenmelidir. Hemşireler çocuklarda hastalığın seyrini, semptomlarını iyi bilmeli ve önlem almalıdır.

Anahtar Kelimeler: 2019-nCoV, bakım, Covid-19, çocuk, hemşirelik

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INTRODUCTION

Serious acute respiratory syndrome 2 (SARS-CoV-2 or Covid-19), which was reported in Wuhan, China in December 2019, has spread rapidly. The sequence of the causative virus was shared by Chinese scientists at the beginning of January 2020. As soon as January 30, approximately 10 000 cases were confirmed and 15 000 cases were identified as suspects [1].

The Chinese government made quick and radical decisions, by canceling many events, flights, trains and bus schedules [2]. However, the measures taken were insufficient and the outbreak spread throughout the world, from Australia to Europe. On March 11th 2020, the epidemic was declared a pandemic by the World Health Organization [3].

According to the “Weekly epidemiological update” published by the World Health Organization (WHO) on the 8th and the 15th of December 2020, the number of Covid-19 cases had exceeded 70 million cumulative cases worldwide [4,5].

Common complaints such as fever, dry cough, dyspnea and fatigue, were reported in adults and considerable death statistics were reported in the elderly population [6]. In Covid-19 case statistics, it was determined that infants and children did not stand out prominently. Children’s infections represent 10% of the Covid-19 cases. Since the beginning of the pandemic, over 1 million children, ages 0-17 years, have been infected with the Covid-19 virus in the United-States. The immature immune system have been linked to increased risk of infectious diseases, particularly respiratory viral infections in infants [7]. Current research suggests that the lowered susceptibility in children is likely due to the scarcity of the SARS-CoV-2 angiotensin-converting enzyme 2 (ACE2) receptor in the respiratory tract in children, meaning that the virus has less receptors to bind to and take hold within a child’s respiratory tract. It is also hypothesized that higher rates of prior infection with other human coronavirus in children, may provide protection against severe SARS-CoV-2 infection in this population. Child cases are mostly affected by family members or other adult individuals. Young adults and children have a high likelihood of developing Covid-19 as a result of household transmission, once a family member tests positive

to Covid-19. However, there is limited evidence of secondary infection from children to others and as a result, the role children play in the transmission pathways of Covid-19 remains unclear [8]. The clinical findings of the children are often atypical and milder [9]. Data on seriously affected pediatric patients is unknown [10]. A large proportion of the young children with the Covid-19 infection are asymptomatic, underpinning the need for ongoing surveillance to monitor Covid-19 disease epidemiology in this population, strengthening prompt laboratory identification for case isolation and clinical management.

As there are limited data on children with Covid-19, there is an urgent need to define the clinical characteristics and severity of the disease, especially in those countries that lack pediatric patient data. At present, China has made initial progress in containing the spread of Covid-19, however many countries are still suffering from the disease.

Nurses play a key role in pandemics as they are at the forefront of the fight against the disease. With their professional training, they can manage crises and make decisions. Pediatric nurses interact with children and parents of all ages and the provide effective health care to children and their families. They are accustomed to approaching parents and patients with evidence-based nursing information and alleviating the lack of information. Pediatric nurses can be advocates by increasing awareness of the need for clinical management and diagnosis, for children and parents affected by Covid-19. Children diagnosed with Covid-19 in this process may be anxious and nurses are able to be honest with children and reassure them [11]. Accurate and appropriate information about the process should be provided. The child should be protected against destructive news appearing on social media, television or heard on the radio [12]. Pediatric nurses can promote children’s wellbeing by administering care, educating patients and families, as well as leading campaigns to increase awareness for Covid-19. This study was carried out to summarize the systematic literature review on current information about coronavirus disease 2019 (Covid-19) in children and ascertain nursing approaches.

MATERIAL AND METHOD

Design

This research is a literature review for the identification of the Covid-19 outbreak in children.

Research method and outcome

Regarding the research, 236 publications were accessed between 21 January and 15 November 2020. Covid-19 prevention plans and guides published by featured centers were also included in these studies. As they were unrelated or concerning adults (n = 51), out of the health field (n = 38) and duplicates (n = 43), 92 studies were excluded from the study. Of the remainder, 64 were accepted to this review and analyzed in detail. The review was conducted with the keywords of "SARS-CoV-2", "coronavirus", "Covid-19", "child", "nursing", which are openly accessible on databases such as PubMed, Science Direct and the WHO (Figure 1).

Methodological evaluation

Due to the importance of the subject, no methodological evaluation was made and all publications that could be accessed were included. Descriptive studies, case reports, letters, WHO reports and guides of institutions were all examined.

Data

In this research, the definition of Covid-19 in children and the nursing approach were synthesized according to the subject. Two reviewers conducted the search (AS, ST, and ES). ES compiled all articles identified through a literature search. Two reviewers (AS, and ST) independently screened the title. All of the articles published about children were examined for use.

RESULTS

Etiology

Covid-19 is a new human coronavirus alongside 229E, NL63, OC43, HKU1, MERS-CoV and SARS-CoV. Covid-19 is a pleomorphic single-strand RNA virus with a diameter of 60-140 nm, circular or elliptical. There is an 86.9% to 89% genome similarity to bat-SL-CoVZC45 coronavirus

occurring in bats. The physicochemical feature of Covid-19 has not been clarified yet [13].

Epidemiology

People of all ages are sensitive to Covid-19. The elderly and those with chronic diseases are more likely to turn into serious cases and it was found that children have a better prognosis. According to the data reported by China's Center for Disease Control on 11 February 2020, 44,672 cases were confirmed. Of these, 416 (0.9%) were found to be 0-10 year-olds and 549 (1.2%) were between 10-19 years old [14]. In a meta-analysis where 65 studies from 11 different countries were analyzed, a total of 1,214 children with RT-PCR confirmed Covid-19 infection (further mentioned as Covid-19 cases) were included. It was stated that 474 Covid-19 cases from China, 720 from the United States of America and Canada, eight from the United Kingdom, five from Iran, two from Malaysia, and one each from Vietnam, Lebanon, Iraq, France and Germany. Of 1,214 Covid-19 cases, age-distribution data were available for 1,135 (93%) cases. The age of 1,135 Covid-19 cases ranged from zero days to less than five years and 596 (53%) were less than one year (infant). Among the 596 Covid-19 infant cases, five (1%) were newborns [7]. However, the proportion of severe and critical cases was 10.6% under 1 year of age, compared to 7.3, 4.2, 4.1, and 3.0% among the 1-5, 6-10, 11-15, and > 15-year subsets, suggesting that infants may be at higher risk of severe respiratory failure than initially thought. It is not known why the disease is less common in children. A possible reason may be that children have less outdoor activity and travel. Another reason may be that children have a more active immune system and a healthier respiratory system. Perhaps children are also less exposed to cigarette smoke and air pollution [15].

Transmission route and physiopathology

Covid-19 infection is transmitted between people as a result of contact, droplet delivery (by caregivers, family members, visitors) and nosocomial infections [16]. It has been reported that the Covid-19 pathogen can be found in the stool and it is also thought that children carry this pathogen longer in their stools [17]. It was found that the incubation stage of the disease is between

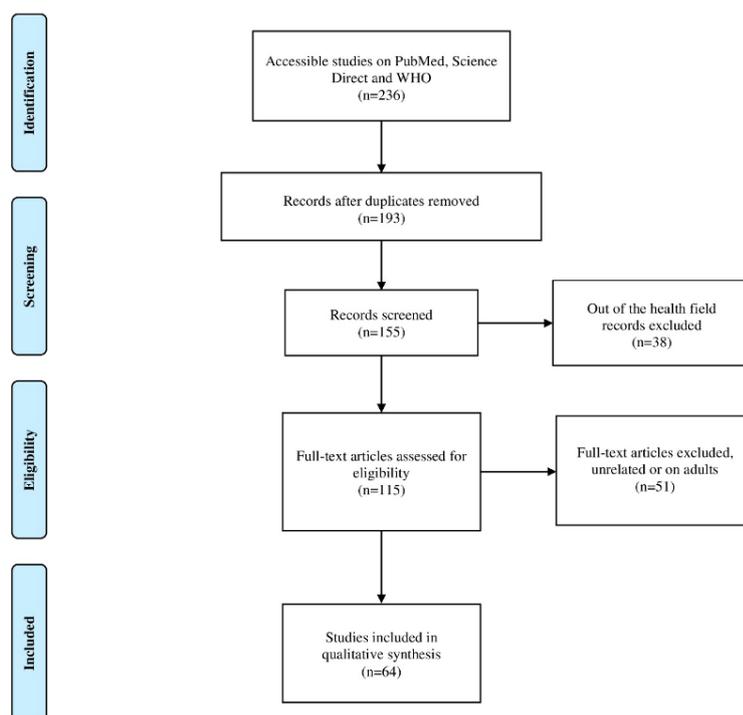


Figure 1. Flow diagram of the studies included in the review.

7-14 days [18], and mostly changes between 3-7 days [19]. The binding of a receptor expressed by host cells is the first step of viral infection, followed by cell membrane fusion. Lung epithelial cells are thought to be the primary target of the virus. Thus, it has been reported that human-to-human transmissions of SARS-CoV occur by the binding between the receptor-binding domain of virus spikes and the cellular receptor, which has been identified as an angiotensin-converting enzyme 2 (ACE2) receptor. Importantly, the sequence of the Covid-19 spiked receptor binding domain is similar to that of the SARS-CoV. This data reveals that entry into host cells is most likely through the ACE2 receptor [20].

Symptoms and Signs

According to data obtained from adults with Covid-19, fever, dry cough, dyspnea, muscle pain, fatigue and leukopenia problems occur. In acute cases, severe respiratory distress, septic shock, metabolic acidosis and coagulation disorders, were observed a week after the onset of the disease [21].

Covid-19 infection may be asymptomatic or characterized by fever, dry cough and fatigue in children. Several upper respiratory symptoms

have been observed, such as cough, nasal congestion and runny nose. In some patients, abdominal pain, nausea, vomiting and diarrhea occurs. Most infected children have mild clinical signs and the prognosis is good. Many pediatric patients recover 1-2 weeks after the onset of the disease [9].

The characteristics of the symptoms of pediatric patients as reported by some select studies are provided in Table 1 [10,21–29]. It was determined that fever and cough were evident in pediatric patients (Table 1). In chest computerized tomography (CT) studies, pediatric patients showed signs of glass opacities and thickened lung tissue [30].

Laboratory and imaging

In the clinical findings of children infected with Covid-19 that have been described, diagnosis is made with swabs from sputum or secretions. However, Reverse Transcription Polymerase Chain Reaction (RT-PCR) assay can detect Covid-19 cases in the blood, where the C-reactive protein (CRP) is high. Creatine kinase, aspartate aminotransferase, alanine aminotransferase, lactate dehydrogenase, creatinine can be increased in the presence of Covid-19 [31].

Table 1. Symptoms of children infected with Covid-19.

Author(s)	Age (%)	Value	Gender (%)	Fever (%)	Nasal Congestion (%)	Cough (%)	Dyspnea (%)	Abdominal Pain (%)	Vomiting (%)	Diarrhea (%)	Fatigue (%)	Headache (%)
Sun et al. [10]	0-3 years	8	6 (75) males 2 (25) females	6 (75)	Not specified	6 (75)	Not specified	Not specified	4 (50)	3 (37.5)	1 (12.5)	1 (12.5)
Zheng et al. [21]	0-3 years (40)	10	14 (56) males 11 (44) females	13 (52)	2 (8)	11 (44)	2 (8)	2 (8)	2 (8)	3 (12)	Not specified	Not specified
	3-6 years (24)	6										
	≥6 years (36)	9										
Qui et al. [22]	≤5 years	10	23 (64) males	13 (36)	1 (3)	7 (19)	1 (3)	Not specified	1 (3)	1 (3)	Not specified	3 (8)
	>5	28	13 (36) females									
Le et al. [23]	3 months old	1 (case report)	Female	Yes	Yes	No	No	No	No	No	Yes	-
Ji et al. [24]	15 years old	1 (case report)	Male	Yes	Yes	No	No	No	No	No	No	No
	9 years old	1 (case report)	Male	No	No	No	No	No	No	Yes	No	No
Cui et al. [25]	5 years old	1 (case report)	Female	Not specified	Yes	Yes	Yes	Not specified	Not specified	Not specified	Not specified	Not Specified
Wang et al. [26]	1 month -7 years	31	Not specified	20 (65)	Rare	14 (45)	Not specified	Not specified	Rare	3 (10)	3 (10)	Rare
	<1 year	31 (18)	104 (60) males 67 (40) females	71 (42.5)	9 (5.3)	8 (48.5)	4 (2.3)	Not specified	11 (6.4)	15 (8.8)	13 (7.6)	Not specified
	1-5 years	40 (23)										
	6-10 years	58 (34)										
	11-15 years	42 (25)										
Xu et al. [28]	2 months old-15 years old	9	5 (55) males 4 (45) females	6 (66)	2 (22)	4 (44)	Not specified	Not specified	Not specified	2 (22)	Not specified	Not Specified
Liu et al. [29]	1-11 months' old	9	2 (22) males 7 (78) females	4 (44)	1 (11)	2 (22)	Not specified	Not specified	Not specified	Not specified	Not specified	Not Specified

It has been determined that some tests taken from swab or blood were negative, but that there was the presence of opacity and thickening in the chest CT. Repeat tests have reported cases that negative results are actually positive. Therefore, chest CT has a vital importance as it is very sensitive and effective in detecting signs of pneumonia [30].

Culture analysis can be used in diagnosis because of stool transmission. Nucleic acid testing from respiratory samples or serum are effective in detecting the virus and results can usually be

obtained in 4-6 hours [17,31].

It is difficult to diagnose in children with mild or atypical findings. Different imaging and laboratory tests should be applied to children who are suspected [28].

Treatment

The evidence in terms of care for Covid-19 is ever-changing and there exists no substantive evidence about treatment, at this point in time. However, some interventions are recommended.

Most disease cases have a history of life in the epidemic region or contact with individuals who have travelled there [32]. This situation should not be ignored. General management comprises in homeostasis maintenance, close follow-up of blood work and chest radiography, and initialization of respiratory support if required [33]. Contact and droplet isolation measures should be applied to suspected or infected patients, in single rooms [34]. There is no definitive evidence whether breastfeeding can cause Covid-19 infection, however, it has been stated that infected mothers should not breastfeed their infants until they recover [33]. Liquid and electrolyte balance should be maintained, routine blood tests should be performed and chest radiography should be reviewed regularly [35]. Respiratory support should be administered with non-invasive oxygen therapy or invasive ventilation [18]. Oxygen, like other drugs, should be applied only in a specific and appropriate concentration [36]. In the drug treatment of Covid-19, some antiviral drugs whose effectiveness is not fully known have nonetheless been recommended [37]. The effectiveness of these drugs in children continues to be investigated [38]. In newborns, high dose nitric oxide inhalation, surfactant and high frequency ventilation are recommended, in respiratory distress [39]. Glucocorticoids or immunoglobulins can be administered intravenously to newborns who show no improvement [40]. Interferon nebulization and gamma globulin infusion have been reported to be successful in treatment [41].

Nursing Approach

Virus mutations and germ diversity have created many pandemics in the world [42]. Contagion is high, as most of the epidemic diseases are unpredictable. In the process of obtaining information about an epidemic, healthcare professionals need to work in coordination [43]. Edmonson et al. stated the importance of nursing interventions in global outbreaks [12]. Nurses make an important contribution to the prevention, intervention and management of diseases and they offer expert perspectives in implementing emergency response plans in outbreaks. Their understanding and expertise regarding care delivery models, complex systems, resources, infection prevention and control principles, in

addition to biopsychosocial human needs, make them valuable assets as leaders and members of the interprofessional healthcare community and in legislative advocacy preparedness.

On March 11th 2020, the World Health Organization (WHO) declared Covid-19 as a pandemic [44]. Since the start of Covid-19, a race against time has begun to treat and care for patients. During this period, doctors, nurses and all health workers have worked with great devotion. In the process, patients have presented with requirements such as oxygen and mechanical ventilation, intensive care and drug therapy. Nurses play a key role in the success of these procedures [36]. They successfully provide both basic care to these patients and the delivery of the psychosocial process. Therefore, it is a great challenge for nurses to fight Covid-19, but their ongoing work in the pandemic is making nursing history.

It was determined that Covid-19, an RNA virus, is highly contagious and that 2-3 more people from an infected patient can be infected [45]. Many studies have proven that Covid-19 can be transmitted from person to person in hospital and family settings [17,32]. Control measures have been reported to be of vital importance in the early stage of the outbreak [13]. Preventive treatments have an important role to control and avoid the spread of respiratory disease, especially in children and this prevention may not be easy to achieve, as preventive measures can be difficult to define. Patients and their families may not be aware that hospitals are either restricting or not allowing visitors to hospitals for all patients, and not only for those hospitalized with Covid-19. This fact may have significant implications for the type of care that patients who are at an elevated risk of mortality wish to receive, and this should be clearly communicated, ensuring patients and loved ones/family can be well informed regarding signs and symptoms of deterioration, as well as how to self-monitor the patients' condition on a daily basis. Nurses can provide information sessions for residents on Covid-19 to inform them about the virus, the disease it causes, and how to protect themselves from infection.

Available data indicates that the incubation period of Covid-19 varies from 1 to 14 days. This is a

serious risk, however it is possible to prevent the spread of the outbreak by preventing contact with infected cases [19]. Medical staffs are at particular high risk of acquiring newly emerging infectious diseases while treating patients. Such risks arise during the first encounter with a patient, at the onset of an outbreak, when faced with a large number of patients. Nurse should wear personal protective equipment when caring for infected/suspicious cases [46]. They should also take appropriate insulation measures [34]. Disposable equipment should be used as much as possible. If devices need to be reused, they should be sterilized or disinfected after each patient and should be disposed of appropriately [47].

Covid-19 infection is mostly asymptomatic in children [48]. However, the existence of another condition in children can exacerbate symptoms and pediatric patients whose condition has deteriorated should be treated in intensive care. Loutfy et al. reported that approximately 20% of their patients required intensive care during the SARS outbreak [49]. Pediatric patients may need respiratory support with either non-invasive oxygen therapy or invasive ventilation during a Covid-19 infection [18]. In the case of respiratory distress that occurs despite nasal catheter or mask oxygenation, heated humidified high-flow nasal cannula (HHHFNC), non-invasive ventilation, such as continuous positive airway pressure (CPAP), or non-invasive high-frequency ventilation, can be used. An emergency transfer situation plan has been prepared to ensure the safe transfer of newborns with suspect and definite Covid-19 [50]. Special vehicles should be used to transfer infected patients and strict protection for staff of transportation and disinfection for the vehicles, are of vital importance [51]. After the transfer is complete, ambulances, transfer equipment and personnel disinfection are recommended.

Infectious diseases can easily spread if proper medical care is not provided and it can cause harmful effects. Providing emergency management in an infectious disease requires professionalism in nursing. It is not known what kind of problems the outbreak will cause in children in the future, though it has been suggested that the long-term effects of Covid-19 on children will be worse than the initial phase of pandemic [52]. Although children have a

low risk of disease, the daily life of families may be greatly affected: isolation measures applied to the family or child cause stress and they may also be concerned about the infection. They may be afraid of what could happen if they or another family member got sick with Covid-19 and nurses can ensure family members and children have access to psychosocial support.

Children with special health needs, chronic conditions and weakened immune system require special health precautions during coronavirus pandemics. Their routines and social environments may change; they may be kept away from their friends and loved ones. Nurses should be honest and help give confidence to these children. A comfortable environment should be created for them to feel safe. Honest answers, appropriate for the age of development, should be given to them in a calm fashion. Being open and sharing information can reduce anxiety, confusion and false perceptions [11]. The anxiety of a child who has lost a relative should be met with understanding. Stress management can be achieved through relaxation methods and breathing exercises and children should be protected from negative publications related the outbreak on social media, television, newspaper and radio. Adults should limit children's exposure to these media as they may misinterpret what they hear and be particularly afraid that they do not understand.

Limitations of Study : Some publications were in Chinese and treatment options have not been clarified yet and these were important limitations in our study. In addition, analyzing the research with limited examples can be considered another limitation.

Conclusion:

The Covid-19 pandemic has spread rapidly and it can be fatal in elderly patients and those with chronic diseases. There is limited data on children with Covid-19 and although those with Covid-19 have had milder clinical symptoms and better clinical outcomes, the incubation period of this highly contagious virus for children has been shown to be longer than that of adults. There is an urgent need to define the clinical characteristics and severity of the disease, especially in those

countries that lack pediatric patient data. The pandemic of Covid-19 has had a milder course in children, therefore the diagnosis of the disease has been difficult in this population. The signs and symptoms of the disease should be carefully monitored as treatment options have not yet been clarified.

Nurses are at the forefront with their professional training. They have an important role in the prevention and control of the disease. They should be well aware of the course and symptoms of the disease in regards to children and take precautions. They are a sensitive age group, they require special care and nurses should support and protect them. Separation from family members could increase the risk of psychiatric disorders in children with Covid-19 [53]. Offering honest responses appropriate for the child's developmental age can reduce their anxiety, confusion, and misperceptions. In the face of Covid-19, entire families can fall into great panic, and a hospitalization may lead them to suffer from separation anxiety. Pediatric nurses can provide family members with psychological support, Covid-19 related knowledge and methods of channeling children's negative emotions and answering their questions. Coordinated efforts are required to promote the physical and psychological well-being of vulnerable populations, including pediatric Covid-19 patients and their families, during the pandemic and the considerable uncertainties of the future. Excessive interventions can be useful during an emergency when the dynamics related to the way the virus spreads are still not fully known, but urgent considerations and studies are needed to understand which of these interventions are truly effective and useful for these patients and their families. It is hoped that these suggestions could help other countries to identify possible preventive and therapeutic strategies.

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