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The risk of children's malnutrition amid COVID-19 pandemic: A literature review

Risiko malnutrisi pada anak pada pandemi COVID-19: Tinjauan literatur

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Abstract

Malnutrition is one of the public health problems that existed during the pandemic; both problems, under and overnutrition, existed. Furthermore, malnutrition can worsen the infection in all groups, including children. The risk of being infected was higher in the malnutrition group than in the well-nourished one. This article aimed to review the risk of malnutrition and possibly related factors in children during the pandemic. This article used the literature review method and was conducted by the initial 2022 from several countries. The object included in the analysis was children's health and nutrition related. The source of articles highlighted the occurrence of malnutrition in children. The source of articles was from PubMed and Cochrane Library, which resulted in 21 eligible papers. The result of the study found that the identified possible factors are self-isolation, physical activity, dietary patterns, nutrient shortage, and socioeconomic factors. There was a shift in dietary patterns among children during the COVID-19 pandemic due to several factors. Those are the scarcity of food sources and compensation for the lockdown, and those findings confirmed the possibility of under- and overnutrition among children. In low-middle income countries (LMICs), the risk of malnutrition problems in this pandemic has heightened the magnitude of the public health problem. The mitigation program should overcome the existing problem to minimize the adverse effect of malnutrition among children.
Keywords: COVID-19, LMICs, malnutrition, pandemic

Abstrak

Malnutrisi merupakan salah satu masalah kesehatan masyarakat yang ada pada masa pandemi, baik gizi kurang maupun lebih. Selain itu, malnutrisi dapat memperburuk risiko infeksi pada semua kelompok, termasuk anak-anak. Risiko infeksi lebih tinggi pada kelompok malnutrisi dibandingkan yang tidak. Artikel ini bertujuan untuk meninjau risiko malnutrisi dan kemungkinan faktor terkait pada anak-anak selama pandemi. Artikel ini menggunakan metode tinjauan literatur dan dilakukan awal tahun 2022 dari beberapa negara. Obyek yang dianalisis adalah kesehatan dan gizi anak. Rujukan yang digunakan menyoroti terjadinya gizi buruk pada anak. Sumber artikel berasal dari *PubMed* dan *Cochrane*, yang menghasilkan 21 tulisan yang memenuhi syarat. Hasil penelitian menemukan bahwa faktor yang mungkin teridentifikasi adalah isolasi diri, aktivitas fisik, pola makan, kekurangan gizi, dan faktor sosial ekonomi. Terjadi pergeseran pola makan pada anak di masa pandemi COVID-19 karena beberapa faktor. Beberapa penyebabnya adalah kelangkaan sumber makanan, kompensasi dari isolasi, dan temuan tersebut mengkonfirmasi kemungkinan kekurangan dan kelebihan gizi pada anak-anak. Di negara-negara berpendapatan rendah-menengah (LMICs), risiko masalah gizi buruk dalam pandemi ini meningkat dan memperbesar masalah kesehatan masyarakat.
Kata Kunci: COVID-19, malnutrisi, negara berkembang, pandemi

Introduction

In early 2020, an outbreak affected the world, depriving the economy and increasing global malnutrition. The severe acute respiratory coronavirus (SARS-CoV-2), caused by Coronavirus Disease 2019 (COVID-19), was officially announced on March 11, 2020 (WHO, 2020). COVID-19 has spread to more than 200 countries worldwide and has affected many groups, including children, for which the virus infection is mainly asymptomatic (Balasubramain, 2020). In Indonesia, based on National Survey on Nutritional Status (NSNS) 2021, the prevalence of stunting at the national level was 24,4% and considered a public health problem.

In children, the infection rate of COVID-19 accounted for 1-5%, while during SARS 2002-3 and Middle East Respiratory Syndrome (MERS), it was 6,9% and 2%, respectively (Balasubramain, 2020). Those who have been diagnosed with an infection might have mild-to-moderate symptoms. However, for those with comorbidities, the severity can escalate to generate multiple organ failure, acute respiratory distress syndrome (ARDS), and mortality (Ceriello et al., 2020; Cavalcante et al., 2021).

There is a difference in the pattern of symptoms, infection, and infection rates, with mild-to-moderate symptoms primarily generated in children than in older groups (Girona-Alarcon et al., 2021). More than 80% of the common symptoms among children are mild, less than 15% are asymptomatic, and the rest are severe (Tsankov et al., 2021). Children are one of the vulnerable groups possibly infected by the virus. The reported cases related to COVID-19 in children were Kawasaki-like disease, Pediatric Inflammatory Multisystem Syndrome (PIMS), or Multisystem Inflammatory Syndrome associated with COVID-19 (MIS-C) (Tsankov et al., 2021).

These events are indicated by respiratory syndrome and fever, a hyperinflammatory shock-like severe illness caused by COVID-19 that is likely to be Kawasaki disease. The pandemic has increased the nutritional challenges in Low-Middle Income Countries (LMICs); under-five-year-old children are one of the affected groups (Aborode et al., 2021). In addition to the high number of cases during the pandemic, the recommendation was to have self-isolation, stay at home, and lockdown (Nicodemo et al., 2021). During this period, the daily routine disturbed food production and distribution, shifting the dietary pattern and physical activity, which heightened the risk of obesity and an unfavorable lifestyle (Cena et al., 2021). In addition, the nutritious intake during this pandemic raised another issue, since food scarcity was common at the household level due to economic loss and inability to afford it (Paslakis et al., 2021). Furthermore, during this pandemic, the economic situation worsened and increased vulnerability to nutritious meals and healthy access, which evolved into eating pathology (Paslakis et al., 2021).

On the contrary, the restriction on going outside elevated the risk of unhealthy diet consumption and low physical activity, resulting in the consumption of a high-fat diet and sweets. Both under-and overnutrition would affect the well-being and health of children by perturbing their immune system (Browne et al., 2021). Both insufficient excessive intake and a shift in meal patterns are issues that need to be addressed during this pandemic (Jia et al., 2021). Malnutrition in children exacerbates the deterioration of immune function through inflammation (Chatterjee et al., 2021). Children appear to contribute to the transmission of the virus, and malnutrition may worsen the infection in children. The government of Indonesia has seriously acted to reduce the prevalence of stunting to improve the quality of health of the next generations, therefore during the COVID-19 pandemic. Authorities are targeting a less than 14% reduction in the prevalence of stunting by 2024. Moreover, studies on the effects of the COVID-19 pandemic are not as frequent as in adults. COVID-19 is not as high as in the older population because comorbidities are rarely diagnosed.

This review aimed to identify the risk of malnutrition among children during the COVID-19 pandemic, which may contribute to the future. Identifying the malnutrition issue might ease the authority to design an appropriate intervention program to ensure that the selected variables overcome this problem.

Methods

The authors optimized the use of the NCBI search engine for leading research publications during

the pandemic. The search engines used were PubMed (http://www.ncbi.pubmed.com) and Cochrane.com.

We applied the Participant-Intervention-Comparison-Outcome (PICO) method to identify, categorize, and select the articles. This review also used a retrospective approach based on articles on child health and COVID-19 published from January 1, 2021, to March 31, 2021. By using the specified keywords "child AND COVID-19," "child AND stunting AND pandemic," "novel coronavirus AND malnourished," "child AND wasting AND pandemic, and "undernutrition AND pandemic. "The inclusion criteria for the study were as follows: within the range of publication and content relevant to the objective of the study.

We identified the source of the article from the search engine applied for this review in Figure 1.

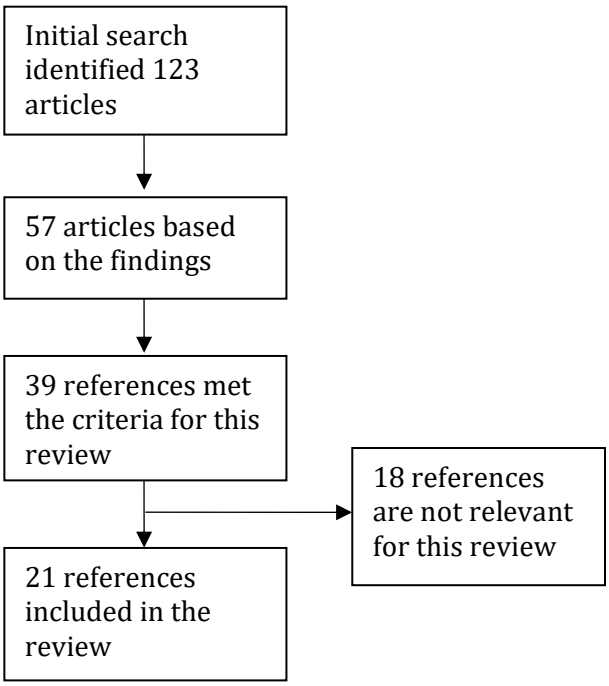

Figure 1. The sources of the articles included in the review

Using a search engine, 123 articles were collected during the initial search, of which only 57 articles were suitable. From the content of the paper, 39 articles met the criteria for review writing, but 18 articles were excluded. Finally, 21 articles were included in the review and met the criteria for the study's objectives. The inclusion criteria were met in the analysis.

Result and Discussion

Twenty-one papers were elaborated upon in this review, and we highlighted some ideas from each article in the Table 1.

We identified articles related to the objectives of the study from the references collected. These articles revealed that malnutrition, undernutrition, and overnutrition were found worldwide. In LMICs countries, the prevalence of undernutrition increased, while obesity appeared to be a problem in developed countries. The undernutrition problem is related to socioeconomic factors, food security, breastfeeding–weaning food for infants, and policy support to aid LMICs. Obesity was associated with mental health, a shift in diet, reduced physical activity, higher screen time due to school closure, and policies to support the movement of children. At the same time, COVID-19 infection in children is not as severe as that in the older group, but malnutrition might increase the risk of SARS-CoV-2.

The COVID-19 pandemic has affected all aspects of life including the public health system. All groups, including the children, were affected by this pandemic. Clinical studies have revealed that the severity, clinical outcome, and progression of disease infection in children are mild, asymptomatic, and not as severe as in the older group (Balasubramain, 2020; Gray et al., 2020).

The most common symptoms are cough and fever; however, children might contribute to the transmission of the disease (Balasubramain, 2020). In fact, for patients with a pre-existing medical condition who might develop complications such as multisystem inflammatory syndrome (MIS) and ARDS, prospective data on the development of the disease needs further research to investigate the prognosis of the disease (Siebach et al., 2021). Although the risk of infection in children is rare, malnutrition may increase the risk of the disease. Both forms of malnutrition, under- and over-nutrition, cause the same severe public health problems during the pandemic (Browne et al., 2021; Aborode et al., 2021). Under-and overnutrition, they indicated an imbalance in nutrient intake and storage. The shortage of macro- and micronutrients heightened the risk of infection because of the alteration in immune function due to the role of nutrients in the mechanism.

Table 1. Characteristics of the references in this review

Author	Study Design	The objective of the study	Result	Conclusion
(Browne et al., 2021)	Review	To address the impact of COVID-19 on obese children.	Obesity is a complex disease with various causes and multiple impacts.	Drive the policy to be issued on healthy food and nutrition campaigns related to advertising for children.
(Jia et al., 2021)	A nationwide retrospective survey	To assess changes in diet patterns among youths in China under the COVID-19 lockdown, named the COVID-19 Impact on Lifestyle Change Survey (COINLICS)	There was a significant shift in intake among gender. Females consume more rice, other staple food, fresh and preserved vegetables and fruit, and less meat, poultry, soybean, and dairy products than males. Males tend to consume these types of foods more frequently than females	Designing better public health practices and policymaking at the policy level is mandatory.
(Kang et al., 2021)	A retrospective cohort study	to investigate changes in anthropometric indices and metabolic parameters in children following six months of lockdown.	On average, the BMI z-scores increased in the COVID-19 period compared to the pre-COVID-19 period. The proportion of overweight or obesity increased during the COVID-19 period	Within six months of observation, obesity and vitamin D deficiencies were revealed. The period of school lockdown was significantly related to higher BMI, and having normal weight still has the chance of gaining weight.
(Aborode et al., 2021)	A review	To address the crisis of COVID-19 and hunger on the well-being of children in LMICs.	Maintain adequate nutrition content food through safe school meals for vulnerable children and avoid unhealthy food and beverages.	The support for organizations was working on providing social protections to safeguard access to nutritious diets and essential services among the poorest household, including young children and pregnant and breastfeeding mothers.
(Zemrani et al., 2021)	Preliminary data from the literature and from our survey	To elaborate on the potential impact of this pandemic on children's nutrition and lifestyle	This pandemic has public health implications that could affect crisis has public health implications that have life-long consequences for children	It required effective and targeted indicators, mainly for vulnerable children and households, to ensure the fulfillment of children's basic needs for optimal nutrition, health, and development
(Stavridou et al., 2021)	Literature review	to evaluate the trend of obesity in children, adolescents, and young adults during the COVID-19 pandemic	Changes in dietary behaviors increased unhealthy food intake and choices during the ongoing COVID-19 pandemic	COVID-19 changes eating behaviors and physical activity among children, adolescents, and young adults.
(Mertens and Penalvo, 2020)	Calculation from the secondary data, Global Burden of Disease 2019 at the country-level	to identify the countries where the prevalent malnutrition may be a driving factor for the fatal disease after SARS-CoV-2 infection.	Countries ranking high on at least triple burden of malnutrition indicators and also presenting an elevated CFR for COVID-19 are sub-Saharan African countries: Angola, Chad, Burkina Faso, Mali, Liberia, Sudan, Niger, and Tanzania, as well as Guyana and Yemen.	The response to reduce COVID-19 fatality in malnourished countries should include nutrition, food security, and social protection.
(Sajid et al., 2021)	Letter to editor	To describe the nutritional status of children in Pakistan	For countries that rely on external aid, travel restrictions or a decline in production would be a problem	To strengthen the existing nutrition program by promoting

Author	Study Design	The objective of the study	Result	Conclusion
			providing a nutritious meal. Furthermore, malnourished children tend to have immune system problems and increased susceptibility to viral diseases that can cause mortality.	safe breastfeeding and providing complementary foods to children- either by upscaling or non-governmental organizations. Every effort should be made to provide food security, a buffer stock of a minimum of two months, including therapeutic milk foods to prevent malnourished children.
(Gray et al., 2020)	Review	COVID-19 and chronic lung disease in children are studied in Cape Town, South Africa.	South African epidemiological data confirms a low severe disease burden among children <18 years, <10% for all COVID-19 admissions, including lower respiratory tract infections. For children who developed COVID-19, the disease course was not severe	Current findings reveal that children with a pre-existing respiratory disease are not a significant risk factor for severe COVID-19. Prospective data are still required to assess risk in children with a particular medical condition.
(Chen et al., 2021)	Survey	To compare and assess psychological distress, perceived weight stigma, and problematic internet-related behaviors among schoolchildren with and without being overweight in psychological distress.	Schoolchildren with overweight had a significantly higher possibility of mental health-related than those without during the COVID-19 pandemic.	Strategies to manage perceived weight stigma and problematic internet-related behaviors may determine mental health among overweight schoolchildren during the COVID-19 pandemic.
(Siebach et al., 2021)	Literature review	Investigating current evidence on clinical presentation, transmission, complications, and risk factors regarding SARS-CoV-2 in children highlights crucial knowledge gaps.	Children are more likely to get infected with the virus from an adult household member. Higher transmission rates are observed in older (10–19 years old) than younger children (<10 years old). While breast milk is not likely a vehicle for transmission from mother to neonates.	The majority of clinical cases of COVID-19 in children are mild, but there are rare cases that have developed complications like multisystem inflammatory syndrome, which often presents with severe cardiac symptoms requiring intensive care
(Heidkamp et al., 2021)	Brief	To highlight and identify the action the evidence-based nutrition, food systems, social protection, health, water, sanitation, and hygiene interventions on maternal and child nutrition in the future.	Interventions and policies targeting the first 1000 days of life require renewed commitment, implementation research, and increased funding source from domestic and global actors.	Due to the COVID-19 crisis, a call to action for the 2021 Nutrition for Growth Summit is to unite global and national nutrition stakeholders around common priorities to tackle an extensive, unfinished undernutrition agenda.
(Jansen et al., 2021)	Cross-sectional	to investigate the impact of pandemic-associated stress on food parenting practices, including interactions surrounding snacks, and child diet	Higher COVID-19-specific stress was associated with more nonnutritive use of food and snacks, more structure, positive interactions, and greater child intake frequency of sweet and savory snacks	Stress-related to the child snack intake with potential impacts on child obesity risk, suggesting several modifiable intervention points within the family context during the COVID-19 pandemic.

Author	Study Design	The objective of the study	Result	Conclusion
(Alves et al., 2021)	Prospective study	To assess emotional responses, sedentary, and physical activity (PA) related to anxiety among children with healthy weight and overweight/obesity during the pandemic	For children with overweight/obesity, higher positive affect and PA were related to reduced anxiety levels. In contrast, higher positive affect was related to reduced anxiety in children with a healthy weight. Longer leisure screen time was associated with higher negative affect irrespective of the child's BMI status.	These relationships highlight the potential mental health benefits of maintaining positive affect, engaging in PA, and limiting leisure screen time for children during the pandemic. These associations may be particularly relevant for children with overweight/obesity.
(Akhtar et al., 2021)	Review	To recognize the intervention-related nutrition that might prevent or aid in recovering from the COVID-19 pandemic.	Deficiencies of micronutrients are common among vulnerable populations in general and COVID-19 patients in particular and could plausibly increase mortality risk.	The micronutrient supplementation and micronutrient fortification programs are warranted in the current global pandemic, especially in low- and middle-income countries.
(Ten Velde et al., 2021)	Cohort study	To investigate the effect of COVID-19 measures on screen time and physical activity (PA) in Dutch children pre-, during- and post-school closures.	On weekdays during school closure, self-reported screen time increased by 34±105min/d. In different cohort data collection, the leisure time increased by 45±67 min/d, and only 20% reached PA levels of 60 min/d compared to before the pandemic.	During the lockdown of the COVID-19 pandemic, children were less physically active, and screen time was higher during and after the school closures. This low physical activity is alarming as an active lifestyle in children is crucial in preventing chronic diseases such as obesity
(Androutsos et al., 2021)	An online survey	To identify changes in children's and adolescents' lifestyle habits during the first COVID-19 lockdown and define potential associations between changes in participants' lifestyle behaviors and weight gain in Greece.	The present study shows that during the lockdown, children's/adolescents' sleep duration and screen time increased while their physical activity decreased. Fast-food consumption decreased, while fruits and fresh fruit juices, vegetables, pasta, total snacks, dairy products, sweets, and breakfast increased. Weight gain increased almost in 40% of children/adolescents.	The study revealed changes in children's and adolescents' lifestyle behaviors and weight gain during the first COVID-19 lockdown in Greece. Effective strategies are required to prevent excessive weight gain in future lockdowns.
Lopez-Gil, et al.,	Online survey	to assess changes in physical activity (PA), screen time (ST), and sleep duration of preschoolers, children, and adolescents and the prevalence of meeting the 24-h movement guidelines during the lockdown caused by COVID-19 in a sample from Spain and Brazil	The subjects who met the PA and ST recommendations significantly decreased during the lockdown in both areas, while sleep duration significantly increased.	The prevalence of preschoolers, children, and adolescents in both areas meeting the 24-h movement guidelines during lockdown was as low as in other countries.
(Riazi et al., 2021)	Survey	to explore how parents experienced their children's movement behaviors during the COVID-19 pandemic.	The children's movement behaviors are related to individual, interpersonal, built, and natural environment factors. The findings highlighted the loss	It will be important to encourage outdoor time, practice, and support policies that facilitate independent mobility

Author	Study Design	The objective of the study	Result	Conclusion
			of structured activities, restricted opportunities for outdoor play, destinations for children's physical activity, and exacerbated by shrinking independent childhood mobility.	and develop centralized resources that help families maintain healthy movement behaviors.
(Jennsen, 2021)	Cross-sectional study.	To assess the shifting rates of obesity for patients attending visits and explore disparities based on age, insurance, race and ethnicity, and income.	A similar trend was observed comparing those in the lowest and highest neighborhood income quartiles, with the obesity disparity increasing from 12% to 14%	Pediatricians can advocate for improved school lunches, address agriculture policies that distort market forces, reduce obesity (e.g., agricultural subsidies), and promote physical activity through community-based changes in the built environment.
(Jurak et al., 2021)	National data on children's physical activity	To maintain physical activity (PA) at home with aggressive campaigns. Self-isolation that national authorities have mandated has reduced child physical fitness during the COVID-19 pandemic.	This pandemic in child fitness requires integrated community participation and a robust public health policy response. It is intended that policymakers and the public will advocate for progressive and bold actions to combat this national health emergency.	This surveillance tool tracks government action to combat the increasing child physical inactivity and obesity trends brought on as a direct result of COVID-19 isolation regulations.

Obesity is a manifestation of various causes and multiple effects that are independent factors for COVID-19 severity (Browne et al., 2021). Among children, school closure, lockdown, and travel restrictions result in lower physical activity (Ten Velde et al., 2021) and movement (Stavridou et al., 2021). During self-isolation, the duration of physical activity was significantly reduced compared to that before the pandemic (Velde et al., 2021). Insufficient physical activity for daily recommendations results in higher BMI and micronutrient deficiency, and those with normal weight can still gain weight (Kang et al., 2021). Self-isolation tends to increase mental health problems and anxiety in children. This emotional response is related to maintaining engagement in physical activity and reducing gadget screen time (Alves et al., 2021). Children with obesity are unable to manage stress and compensate for it by consuming dense energy snacks (Jansen et al., 2021), longer sleep duration, and longer screen time (Alves et al., 2021; Androutsos et al., 2021).

In addition, the possibility of mental health problems was higher in overweight children than in those without overweight status (Chen et al., 2021). An online survey in Brazil and Spain revealed that adolescents, children, and preschoolers' physical activity significantly decreased during the lockdown (Lopez-Gil et al., 2021). Restrictions on visiting public facilities lessen outdoor play and mobility (Riazi et al., 2021). Public areas, facilities, and school time intensify children's eagerness for outdoor movements and play (Jurak et al., 2021). Furthermore, during self-isolation, the dietary pattern of youth has shifted, especially in the frequency of consumption of some foods, as shown in the COVID-19 Impact on Lifestyle Change Survey (COINLICS) (Jia et al., 2021).

The choice of an unhealthy diet was popular among children during the pandemic as a possible contributing factor to overweight and obesity (Stavridou et al., 2021). A study in Greece indicated that weight gain in the youth was found in almost 40% of the population. Changes in lifestyle and behavior resulted in increased body weight during the COVID-19 lockdown (Androutsos et al., 2021). In LMICs, undernutrition has become more serious since it existed before the pandemic. In LMICs, countries with a high burden of malnutrition might escalate the case fatality rate (CFR), as in sub-Saharan countries (Mertens & Penalvo, 2020). Similar conditions were observed for other LMICs that depend on external assistance for food security (Sajid et al., 2021). Malnutrition in children increases their susceptibility to viral diseases and impairs their immune system (Zar et al., 2020). It is mandatory to aid these countries in reducing

the burden and providing children with nutritious meals. Supplementing micronutrients and fortification are intervention programs that warrant adequate micronutrient deficiency in vulnerable populations, including children (Akhtar et al., 2021).

Promoting exclusive breastfeeding should be reinforced because there is doubt that breastmilk is the transmission of viral disease from the mother to the neonate; meanwhile, the benefit of breastfeeding is clinically significant for growth and development (Siebach et al., 2021).

The authority, leader, and organization should work to drive policies to minimize the impact of malnutrition due to the COVID-19 pandemic. Issuing the policy as a mitigation program to maintain the physical activity of the children, support a healthy and balanced lifestyle, reinforce exclusive breastfeeding for the infants for the first 1000 days of life, improve public health practices, and assist countries with a high burden of nutrition by prioritizing extensive and sustainable monitoring to diminish the problem (Heidkamp et al., 2021; Zemrani et al., 2021).

Conclusion

The Covid-19 pandemic may expand the burden of malnutrition worldwide. Countries with overnutrition problems face an increase in overweight and obesity among youth.

Authorities should campaign for a healthy and balanced lifestyle, consume nutritious meals, and reduce stress to improve mental health. Countries with existing malnutrition problems should be able to define an intervention program to minimize the impact of the pandemic on the quality of life of long-life generations.

Policymakers work hand in hand with other stakeholders to design effective and efficient intervention programs to meet the requirement for youth to have a better quality of life in the future.

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