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REVIEW ARTICLE

A CRISIS WITHIN A CRISIS: COVID-19 AND HIDDEN HUNGER

Gul Eda Kilinc[1], Alev Keser[1]

[1] Ankara University, Faculty of Health Sciences, Department of Nutrition and Dietetics, Ankara, Turkey

ORCID: G.E.K. 0000-0002-9068-3081, A.K. 0000-0003-2620-6747.

Corresponding author: Alev Keser, **E-mail:** akeser@ankara.edu.tr
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ABSTRACT

The coronavirus (Covid-19), which was recognized in December 2019 and quickly became a worldwide pandemic, has become a significant public health problem. When it comes the immune and infectious diseases, effects of nutrition on the inflammatory system cannot be ignored. Micronutrients, including vitamins and minerals, are critical to a well-functioning immune system and vital in supporting nutritional and health well-being. However, there are serious vitamin and mineral deficiencies worldwide known as "Hidden Hunger". It is thought that need for micronutrients in nutrition may increase especially during Covid-19 pandemic process. Therefore, it is essential take precautions regarding the formation of hidden hunger. While the underlying determinants and complexity of malnutrition have been better understood through years of research, these researches have been limited in scaling, developing and implementing nutrition and food system approaches closely related to sustainable agriculture targeting food diversity and livelihoods. In this review, the Covid-19 pandemic and its interactions with health, environment, food and their relationship to chronic micronutrient deficiencies, known as 'hidden hunger,' which affected more than two billion people worldwide, are evaluated.

Keywords: Covid-19, Food Security, Hidden Hunger

INTRODUCTION

The United Nations Millennium Declaration adopted In September 2000, united in a global partnership to address the goal of development and health and reduce extreme poverty. Among these Millennium Development Goals, one of the key goals pursued globally is a commitment to halve the proportion of people suffering from hunger between 1990 and 2015 (1). Hunger continues to be a dramatic problem in underdeveloped and developing countries and progress towards reaching this target is slow, with nearly 1 billion hungry people (2). On the other hand, hidden hunger, which is not taken into account, also emerges as an important problem. “Hidden hunger” is a term used to describe essential vitamins and minerals deficiencies known as micronutrients. In 1991, World Nutrition Award winner Dr. Nevin Scrimshaw warned that "hidden hunger progresses silently and chronically and often permanently harms hundreds of millions of people" and highlighted it as an often invisible but devastating chronic malnutrition problem in poor countries (3). The world has often come a long way in understanding the nature, scale, and scope of solutions to hidden hunger. However, the alarming increase in obesity and related comorbidities has often caused food insecurity to be overlooked and overshadowed in recent years. However, the outbreak of new coronavirus disease 2019 (Covid-19) has brought with it heartbreaking images of individuals lining up at local food banks, including in developed countries, with scenes reminiscent of the baselines of starvation periods. Additionally to the sudden impact on society and health, the Covid-19 pandemic has led to important short- and long-term disruptions to food systems. It has led to reduced availability of nutritious foods,

especially for vulnerable and poor populations and the global prevalence of all forms of malnutrition, including micronutrient malnutrition or “Hidden Hunger” (3, 4). This review aims to discuss the interactions of food, health, and environment during the Covid-19 pandemic and their relationship with chronic micronutrient deficiencies known as 'Hidden Hunger'.

Hidden Hunger

It is estimated that deficiencies in essential micronutrients such as iron, vitamin A, iodine and zinc as a result of malnutrition affect 2 billion people worldwide (5). Pregnant women and individuals in the period of rapid growth and development are the most vulnerable to micronutrient deficiencies and therefore, they are exposed to the greatest adverse effects (6). The term of hidden hunger refers to micronutrient deficiencies and accurately describes the invisible nature of hunger and overt and apparent symptoms of one or more nutrient deficiencies. Example, iron deficiency anemia is among the most common nutrient deficiencies in the world, affecting approximately 1.62 billion people. However, iron deficiency negatively affects children's cognitive and physical development, including infancy. The most common clinical manifestation of iodine deficiency disorder is goiter. Iodine deficiency causes complications such as miscarriage, stillbirth, congenital anomalies, neurological damage, cretinism, psychomotor disorders, hypothyroidism, newborn goiter, growth retardation (7). Beside these, zinc has an important role in ensuring growth and development, especially in children, and in functioning immune system. Although it is challenging to measure zinc levels accurately, 17% of the world's population is at risk for zinc deficiency when the dietary zinc level is examined (6). Iron deficiency anemia is also an important public health problem in Turkey. Every age group; especially pregnant and lactating women, 0-5 age group children, school age children and youth are important risk groups. In a study conducted in Turkey, in a study to determine hemoglobin levels in 6-17 month-old children and their mothers, it was found that hemoglobin level of 24.9% of mothers was below 12 g/dL. It was determined that 48.3% of these mothers were diagnosed with anemia before the study, 54.9% of them had iron deficiency anemia, and mothers who were reported to have anemia before were more likely to have anemia during pregnancy (71.8%). In addition, it was declared by the mothers that 4.6% of them were diagnosed with B_{12} deficiency and 2.3% of them were diagnosed with folic acid deficiency during pregnancy. Also, despite the iodine program being carried out in Turkey, it was determined that the median amount of iodine excreted in the urine in pregnant women was insufficient especially in the second and third trimesters of pregnancy (8).

With hidden hunger, especially there is an inflammation in the body. This inflammation in the body is caused by the inadequacy of micronutrients. At least 51 different nutrients, which have important physiological roles in maintaining a healthy life and 19 essential micronutrients are required for mental and physical development, functioning of the various metabolic processes and immune system (9). There is a complicated and strong relationship between nutrition and immunity. Experimental and epidemiological studies refer to the importance of diet in the triangle of infection, nutrition and immune system. Proper nutritional interventions are potentially effective in improving the intake of both macro and micronutrients, the immune system, and general public health. Hidden hunger can also occur due to excessive consumption of unhealthy foods, which may result in insufficient intake of micronutrients. In particular, micronutrients such as vitamins A, B_6, folate, B_{12}, C, D, E, zinc, iron, copper, selenium and magnesium play essential role in preventing diseases and maintaining immune system. Deficiencies in these nutrients can adversely affect the immune system and cause a decrease in the body's resistance to infections (10). In this context, studies conducted have focused on three micronutrients, especially iodine, vitamin A and iron, deficiency of which can have serious negative consequences (11, 12). In a study, it was determined that 90 million children under 5 years of age had vitamin A deficiency (according to serum retinol <0.70 µmol/L threshold), which caused a significant loss of immunity and an increased risk of death in children (6). In addition, zinc deficiency is frequently seen in those with HIV infection and is associated with immunological failure, inflammation and death. (13). In addition, it is stated that the prevalence of comorbidities such as cardiovascular disease, arterial hypertension or chronic kidney disease, which are risk factors among the causes of death associated with Covid-19, is higher in anemic patients (14).

Covid-19 and Mechanisms

When entry mechanisms of SARS-CoV-2 into the body are examined, there are basically two mechanisms. The first of these is that it easily binds to the angiotensin-2 converting enzyme (ACE_2) receptor found in lung type 2 alveolar cells, myocardium, kidney proximal tubule, esophagus, ileum epithelial cells and bladder urothelial cells in humans. This pathway seriously affects the immune system. The severe acute respiratory syndrome SARS-CoV-2 uses ACE_2 receptor and transmembrane protease serine 2 enzyme (TMPRSS2) to enter host cell (15). Another mechanism is that Covid-19 binds to the beta chain between iron and hemoglobin and prevents iron from binding to hemoglobin. As a result of the binding of hemoglobin with Covid-19, porphyrin metabolism is inhibited, oxygen transport to cells cannot be achieved and respiratory problems occur. In addition, the iron molecule, which cannot bond with hemoglobin, becomes free and shows an oxidative radical effect that creates an oxidative stress potential for the organism. Therefore, the increase in free iron in the body with these mechanisms in Covid-19 patients gives evidence of an increase in ferritin levels in blood findings (16). All these mechanisms reveal the importance of adequate amounts of micro minerals, which have duties in the body's immune system, in the diet.

The effect of the Covid-19 pandemic process on nutritional habits and lifestyle

During the Covid-19 pandemic, hidden hunger is observed especially among children and elderly individuals. Studies reporting indirect effects on lifestyle and nutrition, especially in children, are still scarce and these studies were mostly conducted in middle or high-income countries. In a study conducted in Italy, 41 obese children aged 6-18 years were examined during a 3-week home quarantine period during the Covid-19 pandemic. It was determined that the consumption of sugary drinks, potato chips and red meat increased significantly during this period and the time spent in sports activities decreased by 2.3 hours / week, while the time spent in front of the screen increased by 4.8 hours/d (17). Similarly, an international survey in Italy, Spain, Chile, Colombia and Brazil reported a significant increase in consumption of sweet and fried foods among 820 adolescents during Covid-19 restrictions. Another Italian study, conducted during the Covid-19 restrictions, included 3,533 people aged 12 to 86, and compared the 18-30 age group, the 12-17 year old group had more significant increase in unhealthy snack consumption and lower adherence to the Mediterranean diet. Overall, 71.5% of respondents reported food insecurity in autumn 2019, while 93.5% reported food insecurity in April 2020. In addition, 41.4% of the participants stated a decrease in vegetable and fruit intake due to Covid-19 (18). 37,252 adult individuals were included in one of the largest studies on this subject, conducted between March and May 2020. Study findings show that Covid-19 restrictions lead to unhealthy diet and lifestyle behaviors in a significant proportion of the population. In addition, it was determined that there was a decrease in the level of physical activity (53%), an increase in the duration of inactivity (63%), an increase in the consumption of snacks (21%), a decrease in the consumption of fresh foods (27%), and an increase in the consumption of sweets (22%) (19). During the Covid-19 pandemic and social isolation, individuals' emotional eating and uncontrolled eating behaviors increased. It has been reported that the body weight of 35% of the individuals participating in the study increased during this period (20).

However, contrary to these results, there are studies showing that the prevalence of eating disorders, especially anorexia nervosa, has changed during the pandemic. A cross-sectional study from Canada observed higher numbers of new diagnoses and hospitalizations for anorexia nervosa (AN) or atypical anorexia nervosa in children and adolescents during the first wave of the Covid-19 pandemic. (21). Since the onset of Covid-19 compared to the previous three years hospitalization rate of children with AN in Australia an increase of 104% was observed (22). In another study, three main themes were identified with six contributing sub-themes. The main themes were; support during restriction, loss of control, and reflection time on recovery. Theme content varied according to the current clinical management and stage of recovery. Availability of "safe" foods, compensatory exercise and increases in symptomology, and increased opportunities for "privacy" were identified. These findings provide a unique insight for a vulnerable group in Covid-19 confinement. The data showed that the impact on individuals with anorexia nervosa was largely negative, and participants expressed concern about the long-term effects of the pandemic on their

recovery. (23). In a study conducted with AN patients in Germany, approximately 70% of patients reported that shape, eating and weight concerns, drive for physical activity, loneliness, sadness, and inner restlessness increased during the pandemic (24). Considering all these studies, individuals with avoidant/restrictive food intake disorder (ARFID) who already have difficulty achieving adequate diet variety and volume may face reduced access to "safe" foods, potentially leading to further malnutrition. (25). More research is needed to better understand the prognosis of these patients and to prepare for their mental health needs in the event of future pandemics or prolonged social isolation.

Covid-19 and nutritional status

Pandemic restrictions have caused micronutrient deficiencies, especially in individuals who have had Covid-19. In a study conducted with 29 female and 21 male individuals with Covid-19 positive in Korea, the nutritional status of the participants was evaluated. It was determined that vitamin D deficiency was 75.9% and 76.2% in women and men, respectively, vitamin B6 deficiency was 7.9% and 4.8%, folate deficiency was 7.9% and 4.8%, selenium deficiency was 44.8% and 38.1%. When compared with 50 Covid-19 positive patients and 150 healthy control groups, it was determined that 43.3% of the control group and 74% of the patient had vitamin D deficiency, it was determined that 24% of the patient group and 7.3% of the control group had severe vitamin D deficiency. When the patients were evaluated within themselves, it was stated that the rate of at least one or more nutrient deficiencies in those with pneumonia was 87.5% (26). in a study conducted in Turkey, It was determined that patients who very severe deficiency was recorded in 16 (3.92%), severe deficiency in 105 (25.73%) and deficiency in 127 (31.12%) (27). In another study, 10 survivors and 10 people who lost their lives consequently of Covid-19 were evaluated. When the body mass index (BMI) levels were examined, it was determined that both groups were in the obese category, but those who deceased had a vitamin C level of 15.4 µmol/L, while the survivors had a vitamin C level of 29.1 µmol/L (28). In a study carried out in Germany, 22 patients were evaluate. It was determined that 50% of the patients had significant Se deficiency. Low levels of Zn were initially observed in 56% of patients (29). However, there is insufficient information about micronutrient deficiencies in healthy people during the pandemic, as most studies have focused on micronutrient deficiencies in Covid-19 patients. In general, studies are recommended as a precaution against micronutrient deficiencies of healthy people.

As a result of micronutrient deficiencies, especially immune system mechanisms are damaged. Therefore, it is crucial to evaluate the nutritional status of individuals in terms of evaluating the functionality of infection caused by the Covid-19 virus on immune system through various mechanisms. Malnutrition is associated with a compromised immune system making individuals more vulnerable to viral infection (30). It is also stated that individuals with Covid-19 tend to be malnourished at the time of hospitalization. Chronic diseases commonly found in patients with Covid-19 (mainly dementia, diabetes, cardiovascular diseases, renal insufficiency, chronic obstructive pulmonary disease etc.) as well as other risk factors such as low socio-economic status or frailty have adverse effects on the nutritional status of these patients. Further, prolonged inactivity during the stay in hospital, mainly in ICU for a long time, causes muscle mass loss, making it difficult for sick individuals to recover. In addition, the increase in the need for assistive devices to provide long-term respiratory functions also causes the development of sarcopenia and malnutrition (15, 31).

BMI changes and weight don't accurately reflect the determination of nutritional status in Covid-19 patients, due to increase in the loss of lean tissue in addition to the fluid support in the treatment. Therefore, determining lean body mass loss is more critical in evaluating BMI. In addition, it is imperative to detect muscle loss and sarcopenia since the less muscle mass decreases, the more severe malnutrition will be (32).

When the studies conducted together with the concepts of covid 19 and malnutrition are examined, it is seen that evaluations are made with different screening tests. One study included 413 patients, of whom 346 were seriously ill and 67 were critically ill. It has been determined that most of the patients, especially those at critical level, have significant changes in inflammatory markers and nutritional parameters. As for nutritional risk, the critically ill patients had a significantly higher proportion of higher Nutrition Risk Screening (NRS) scores that correlated with inflammatory and nutritional markers. Only 84 of 342 patients with NRS score ≥3 (25% of 342 patients) received nutritional support. Critically ill patients and

those with a higher NRS score had a higher risk of mortality and a longer hospital stay (33).

In a cross-sectional study of elderly patients who were found to be positive for Covid-19 in China, the nutritional status of 182 patients (117 women, 65 men) mean age 69 years was evaluated. Nutritional assessment of the participants was made using the MNA, which is frequently used for geriatric patients. MNA is used to assess morbidity, food intake, major or acute psychological illness, weight loss, BMI and cognitive status. As a result of the study, 53% of the patients are malnourished, 28% are at risk of malnutrition and 20% are undernourished. In addition, the mean MNA score was determined as 22.9, which means the risk of malnutrition. There was no difference between the three groups in terms of gender, age, mid-arm circumference, triceps skinfold thickness, cardiovascular, cerebrovascular and chronic lung diseases or hypertension. However, statistical differences were found among the three groups in terms of knee circumference, diabetes mellitus incidence, BMI, lymphocyte counts albümin and hemoglobin. The levels of these parameters were highest in the malnourished group and lowest in the malnourished group. In addition, multivariate regression analysis showed that low albumin levels, the presence of diabetes and decreased knee circumference, were independent risk factors for malnutrition in these subjects. In light of these results, a high rate of malnutrition was observed in the elderly patients with Covid-19 of Wuhan (China) (34). In another study, 41 Covid-19 patients were evaluated with the Mini Nutritional Assessment (MNA) screening tool. 61% of individuals had weight loss (26.2% had weight loss >10%), and 19.5% of these patients had hypocalcemia, 17.1% hypoproteinemia, 19.5% hypoalbuminemia, 34.1% anemia, It was stated that 12.2% had hypomagnesemia and 51.2% had vitamin D deficiency (35).

In different study evaluating the nutritional status of Covid-19 patients, mNUTRIC score was used in 136 patients and malnutrition was found in 61%. In addition, it was determined that patients with malnutrition had an 87% higher mortality rate and stayed longer in intensive care units than patients with better nutrition (36).

In a study using the GLIM screening tool, one of the new nutritional screening tools that has been used frequently recently, 114 Covid-19 patients were included and the percentages of individuals with moderate and extreme malnutrition were determined as 23.7% and 18.4%, respectively. In addition, GLIM was found to be correlated with lower albumin levels and increased length of stay in ICU, regardless of age and CRP levels (37).

In another study, evaluation was made with the CONUT screening tool and 348 Covid-19 patients were included. According to the study results, individuals with mild-moderate to severe malnutrition were defined as 46.3% and 39.9%, respectively. It was specified that the patients in the moderate-to-severe malnourished group had worse inflammation and nutritional parameters, and muscular dystrophy and acute cardiac damage developed in these patients, and most of them resulted in death (38). In a study conducted in Turkey during the Covid-19 pandemic, 62 elderly individuals were evaluated and the GLIM screening tool was used to assess malnutrition. As a result, 12.9% (n=8) of the participants were malnourished; It was determined that 29% (n=18) had probable sarcopenia and 3.2% (n=2) had severe sarcopenia, and there was no significant difference between the scale results according to gender (39).

Screening and evaluation for malnutrition in adults with suspected or confirmed Covid-19 infection is recommended by authorities and studies (40, 41). ESPEN recommends diagnosis, prevention, and the treatment of malnutrition and micronutrient deficiencies to be routinely included in the management of Covid-19 patients in the presence of obesity and to take special monitoring and precautions in this population for the health risks arising from isolation (41). Early detection of patients in need of nutritional intervention through nutritional risk screening and assessment is of great importance, especially in the comprehensive treatment of new coronary pneumonia. (42). Despite the possible contribution of malnutrition to the incidence and severity of Covid-19, it is not clear which nutritional screening tools may best diagnose malnutrition in these patients in the early stages. It was determined that NRS 2002 showed superior sensitivity compared to other traditional screening methods. Simple measures based on routine laboratory research, such as the CONUT score, can be shown as a timely, inexpensive and valuable alternative to identify Covid-19 patients at high nutritional risk. The MNA may be the only measure used to detect residual malnutrition and patients at high risk of malnutrition (43).

CONCLUSION

It is known that a healthy diet has positive effects on the immune system, while inadequate and unbalanced nutrition deteriorates the immune system functions and increases the susceptibility to infections. For this reason, in the treatment and/or prophylaxis of Covid-19, it is essential to ensure that people have adequate and balanced nutrition, to meet their vitamin and mineral needs, and to maintain the normal functions of the immune system. Studies or authorities often make recommendations for the diagnosis of micronutrient deficiencies for individuals with covid 19 or those with comorbidities. However, it is important to examine the micronutrient deficiencies of healthy individuals in terms of monitoring and precautions. Additionally, datas have shown that with the emergence and recognition of long Covid-19, nutritional status increases the adverse sequelae associated with a severe Covid-19 infection. While the number of patients experiencing the long Covid-19 is increasing, the role of community health professionals and dietitians in providing improvements in the nutrition of patients is very important. With the pandemic, the importance of the concept of health and nutrition has emerged once again. Also, the current and potential effects of climate change and economic crisis on healthy nutrition cannot be ignored. These factors may lead to additional new effects on the effects of the pandemic. In this case, it may cause the effects of the pandemic to become more severe over time. The pandemic has deepened existing social and health inequalities. Groups that are disadvantaged in terms of malnutrition (such as the poor, the unemployed) have grown. Especially pregnant women, children and adolescents and the elderly constitute social risk groups in terms of malnutrition. Pandemic has expanded social groups that are risk groups in terms of malnutrition. The concept of hidden hunger, which developed due to malnutrition during the Covid-19 pandemic, has become common public health problem in all countries. Impact of hidden hunger on diet and lifestyle is just the tip of the iceberg with potential intergenerational consequences. The concept of hidden hunger accompanies protein-energy malnutrition, obesity and many related chronic diseases. Therefore, a healthy diet and lifestyle should be an essential component of the response plan in preventing hidden hunger in such an epidemic, especially for risk groups of the population. In this context, world and government policies to be planned in areas such as nutritional enrichment and supplements for the vulnerable groups of the society, providing well-trained personnel for the sustainable production and distribution of fortified foods, ending trade barriers such as export bans and quotas of important grain exporting countries, and eliminating social and economic inequalities will be a vital step in preventing insecurity and insecurity and thus hidden hunger.

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