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CLINICAL SCIENCE OF NUTRITION

CONTENTS

Level of Knowledge and Teaching of Infant and Young Child Feeding Practices among Health Workers in Delta State, South-South Nigeria

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ABSTRACT

Objective: The aim of this study was to find out how well Delta State health workers are acquainted with infant and young child feeding practices.

Methods: This study involved randomly selecting 235 primary health care centers from 445 functioning primary health care centers in Delta State and enlisting the most skilled health workers (198 nurses and 37 community health extension workers, 1 from each facility) to carry out the study. The survey instrument consisted of a structured and validated questionnaire. Data were obtained on information about early initiation, exclusive breastfeeding, complementary feeding, and many more. Statistical analysis was performed using International Business Machines Corporation Statistics for Social Sciences version 22.0. (IBM SPSS Corp.; Armonk, NY, USA), which utilized descriptive statistics and 1-sample tests.

Results: There was variation in the respondent's knowledge of breastfeeding immediately after delivery. Poor attachment knowledge was observed among the health workers, accounting for 39.1% in total. Also, 48.1% of the health workers had no idea when a retroviral disease-positive mother needs to stop breastfeeding.

Conclusion: The study showed that the respondent's knowledge level and teaching of infant and young child feeding practices were average. The nutritional status of infants and young children can be enhanced through training and supportive supervision of their knowledge and counseling skills pertaining to infant and young child feeding practices.

Keywords: Colostrum, community health extension workers (CHEWs), infant and young child feeding (IYCF), nutrition, primary health care centers (PHCs)

INTRODUCTION

Adequate nutrition is critical to child health and development. Infant and young child feeding (IYCF) practices ensure adequate nutrition for a child within the first 2 years of life (0-24 months).[1-3] These include early initiation of breastfeeding (within the first 30 minutes of child's birth), exclusive breastfeeding and continued breastfeeding till 2 years and beyond, and adequate complementary feeding. The World Health Organization (WHO) and United Nations International Children's Emergency Fund developed the global strategy for IYCF in 2002 to revitalize world attention to the impact that feeding practices have on the nutritional status, growth, development, health, and survival of infants and young children.[4,5] In addition to providing food and fluid security for the first 6 months,

breastfeeding provides active immunity, protection and remains a significant source of energy, nutrients, and protection for as long as 2 years. Mothers and their infants are uniquely able to benefit from breastfeeding as it provides hygienic and nutritious food for the healthy growth and development of babies.[6,7] Breast milk also has anti-infective properties that help keep the infant healthy, and exclusive breastfeeding and child spacing have a relationship to one another.[8-11]

Twenty-two percent of the under-5 children were estimated to be underweight in West and Central Africa in 2012, which is higher than the global estimate of 15%.[12] In Nigeria, the rate of stunting is 32.0%, which is within the WHO's "serious levels." Despite this, the situation in the North West (52.1%) and North East (44.3%) states is

Odo et al. Infant and Young Child Feeding Practices

Clin Sci Nutr 2022; 4(2): 33-39

critical. A 2011 report has shown that 41% of these children are mostly from rural areas. Other factors have also been pinpointed.[13]

On average, rural children are twice as likely to be underweight as their urban counterparts (43% vs. 26%).[13] Health workers have been identified as vital links between the rural and urban communities through enhanced knowledge, counseling skill and supportive care to IYCF.[14-19]

This study is aimed at assessing the knowledge among health workers in IYCF. Also, the study will compare findings with related/relevant articles on the subject matter.

METHODS

Study Area and Design

The prospective research was a descriptive cross-sectional study carried out in Delta state of South-South Nigeria involving the use of a well-structured questionnaire (containing open and close-ended questions). The sample population was 235 primary health care centers (PHCs), which were randomly selected from 445 functioning PHCs in Delta State. The most experienced health workers (198 nurses and 37 community health extension workers (CHEWs), 11 from each center) were recruited for the study. Validation of the content of the questionnaire was done by some staff of the Delta State Primary Health Care Development Center, Asaba. The participants were pre-informed, and they gave their consent before they participated in the study.

Data obtained were on the following subject matters: knowledge and teaching of early initiation, exclusive breastfeeding, appropriate breastfeeding, complementary feeding, colostrum and its importance, mixed feeding, signs of good attachment, expressed breastfeed

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Main Points

- The knowledge of health care workers on infant and young child feeding practices was assessed using a structured questionnaire in health care centres across Delta State, Nigeria.

- Knowledge about attachment and when RVD mothers should stop breastfeeding was below average.

- The study showed that the training and experience of the health care workers across the facilities greatly varied, giving rise to a range of responses.

- The questionnaire assessment showed that the overall knowledge of the health care workers was average, indicating that there is need for further training and development across health facility in Delta State, South-South Nigeria.

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and storage time, breastfeeding in the context of human immunodeficiency virus (HIV)/acquired immunodeficiency syndrome, weight monitoring, etc.

Statistical Analysis

Statistical Package for the Social Sciences version 22.0. (IBM SPSS Corp.; Armonk, NY, USA) was used. Descriptive statistics (mean, frequency, and percentage) and a 1-sample test were used to determine the level of significance from the respondence. A statistically significant result connotes that the P-value is < .05 and vice versa.

RESULTS

A study was conducted on a sample of 235 health workers (198 nurses and 37 CHEWs) from Delta State to determine the level of knowledge of IYCF practices among them. The majority of health workers were women (97%), while 3% were men. The average age and experience of the health personnel were 42.7 years and 12 years, respectively.

The subjects' responses to the time they informed mothers to initiate breastfeeding after birth was within 20 minutes of birth (40%), while only 0.4% responded that it should be immediately after birth. There was no statistically significant difference in time to initiate breastfeeding after birth from the respondents ($P = .051$) (Table 1). The majority of the subjects (36.6%) said that early initiation of breastfeeding helps to stop postpartum bleeding. while 25.5% said that it helps to expel the placenta after delivery and 15.3% had no idea of the importance. There was a difference in the knowledge about early breastfeeding from the respondence ($P = .028$) (Table 1). A total of 49.8% said that colostrum helps in child protection, while 8.5% said that it helps in the release of meconium and 31.5% had no idea or gave wrong answers. No difference in the knowledge about colostrum from the respondents was observed ($P = .090$) (Table 1). The majority of the respondents (70.6%) said that a baby from 0 to 6 months of age needs nothing apart from breast milk, while 15.3% said infant formula and 6.4% said pap. There was no difference in the knowledge of what the baby should eat between 0 and 6 months from the health workers ($P = .195$) (Table 1). A total of 35.7% said that exclusive breastfeeding (EBF) helps in child protection, 16.2% said bonding, 3.0% said improvement in intelligent quotient (IQ), 20.4% had no idea, and 1.3% said that it helps in family planning. Difference was observed in respondence perceptions ($P = .025$) (Table 1).

The majority of subjects (52.8%) had no idea of any sign of good attachment, 6.8% correctly identified 1 sign, and 1.3% correctly identified 2 signs. There was no difference in knowledge about good attachment among the health workers ($P = .139$) (Table 2).

Table 1. Responses from the Health Workers on When to Initiate Breastfeeding, Its Importance, the Role of Colostrum, Knowledge of Other Supplements, and Exclusive Breastfeeding			
1. At what time do you tell the mothers to initiate breastfeeding after birth? (n=235)			
Response	Frequency	Percentage	*P*
No idea	12	5.1	.051
Immediately	1	0.4	
When the mother has strength	37	15.7	
Within 20 minutes	94	40	
Within 30 minutes	75	31.9	
Within 1 hour	16	6.8	
2. Mention the importance of early initiation of breastfeeding (n=235)			
No idea	36	15.3	.028
Stop postpartum bleeding	86	36.6	
Placenta expulsion	60	25.5	
All of the above	51	21.7	
No importance	2	0.9	
3. Mention the role of the colostrum (n=235)			
No idea/wrong answer	74	31.5	.09
Meconium release	20	8.5	
Protection	117	49.8	
Vitamin A rich/nutrition	18	7.7	
Improved IQ	6	2.5	
4. Apart from breast milk, what other foods does a baby need within 0 to 6 months age? (n=235)			
No idea	14	6	.195
Water	4	1.7	
Nothing	166	70.6	
Corn	15	6.4	
Infant formula	36	15.3	
5. Mention 1 importance of exclusive breastfeeding (n=235)			
No idea/wrong answer	48	20.4	.025
Complete food	44	18.7	
Protection	84	35.7	
Bonding	38	16.2	
Improved IQ	7	3	
Economic importance	7	3	
Involution of uterus	4	1.7	
Family planning	3	1.3	
IQ, intelligent quotient.			

Odo et al. Infant and Young Child Feeding Practices

Clin Sci Nutr 2022; 4(2): 33-39

Table 2. Responses from the Health Workers on Good Attachment, When to Stop Breastfeeding, RVD Mothers as Regard Breastfeeding, and Knowledge on Complementary Feeding			
6. Mention 2 signs of good attachment (n=235)			
Response	Frequency	Percentage (%)	*P*
No idea	124	52.8	.139
1 correct	16	6.8	
2 correct	3	1.3	
Wrong	92	39.1	
7. At what age do you teach a mother to stop breastfeeding her baby? (n=235)			
No idea	48	20.4	.093
6 months	11	4.7	
9 months	3	1.3	
12 months	26	11.1	
1 year 2 months	3	1.3	
1 year 6 months	15	6.4	
2 years	128	54.4	
As long as she wish	1	0.4	
8. EBF plus ARV drugs (for babies and RVD-positive mothers) is allowed (n=235)			
Yes	113	48.1	.081
No	33	14.1	
No idea	89	37.8	
9. At what age of the baby is an RVD-positive mother to stop breastfeeding her baby? (n=235)			
No idea	113	48.1	.073
At birth/no breastfeeding	13	5.5	
6 weeks	2	0.9	
2 months	5	2.1	
3 months	7	3	
4 months	5	2.1	
6 months	45	19.1	
9 months	3	1.3	
12 months	20	8.5	
1 year 6 months	5	2.1	
2 years	3	1.3	
10. At what age should mothers start complementary feeding for their babies? (n=235)			
No idea	72	30.6	.179
At birth	3	1.3	
From 4 month	8	3.4	
From 6 months	150	63.8	
Any time the mother thinks that breast milk is not enough	2	0.9	
ARV, antiretroviral; EBF, exclusive breastfeeding; RVD, retroviral disease.			

More than half of the respondents (54.4%) chose to teach mothers to stop breast feeding their babies after 2 years, while 11.1% said 12 months and 20.4% of the subjects did not give any specific response. No difference was observed about when to stop breastfeeding among the respondents (P = .093) (Table 2). Similarly, 48.1% responded that EBF plus antiretroviral (ARV) drugs (for babies and retroviral disease (RVD) mothers) are allowed, while 37.4% had no idea and 14.1% said that it is not allowed. No difference was observed about knowledge on ARV drugs and breastfeeding (P = .081) (Table 2). The majority of the respondents (48.1%) had no idea on the time that the RVD-positive mother should stop breastfeeding her baby, 19.1% said by 6 months, 5.5% said breastfeeding is not allowed from day 1, etc. No difference was observed as regards the knowledge of RVD-positive mothers on when they should stop breastfeeding (P = .073) (Table 2). In conclusion, the majority of the subjects said that complementary feeding starts from 6 months of the baby's age, 30.6% did not have the idea, and 3.4% said that it starts from 4 months. No difference was observed as regards the knowledge of when mothers should start complementary feeding (P = .179) (Table 2).

Almost all the respondents (98.7%) gave nutrition education to pregnant mothers/caregivers during antenatal/infant and young child welfare, and they all agreed that pregnant mothers must check their HIV status at their first visit. A total of 81.3% taught mothers how to express and store breast milk, while 18.7% could not teach them how to express and store breast milk. Most of the respondents (80%) indicated that they taught mothers to request their baby's weight each time they come to the infant and young child welfare clinic (Table 3).

DISCUSSION

A study to determine the level of knowledge and teaching of IYCF practices among health workers in Delta State has been carried out. There was mostly no statistically significant difference in response from the health workers (P > .05) from the questionnaire, and on general assessment, health workers' knowledge was average. A total of 84.3% were registered nurses and 15.7% of them were CHEWs; however, a study by Nsiah-Asamoah[20] in Ghana showed that community extension workers were more (30.2%) compared to registered nurses, which was 11.4%. A similar study by Utoo et al[21] identified the majority of her participants as CHEWs, accounting for 69.4%. The above comparison indicated that more CHEWs were trained and were in the field to teach mothers on IYCF. The above findings show that access to health care in many African countries is often limited and that most primary health facilities use CHEWs, who are most readily available.[22-25]

The study showed that 98.7% of the health workers taught nutrition education to pregnant mothers and to check their HIV status on their first visit. A study by Mahyavanshi

Table 3. Responses from the Health Workers on Nutrition Education, HIV Status, Expression of Breast Milk, and Request for Baby Weight

11. Do you give nutrition education to pregnant mothers/caregivers during antenatal/infant and young child welfare? (n = 235)	
Response	Frequency
Yes	232
No	3
12. Is it necessary for pregnant mothers to check for HIV status at their first visit?	
Yes	232
No	3
13. Do you teach the working mothers how to express and store breast milk? (n = 235)	
Yes	191
No	44
14. Do you tell the mothers to request for their babies' weight each time they come to the infant and young child welfare clinic? (n = 235)	
Yes	188
No	47
HIV, human immunodeficiency virus.	

Odo et al. Infant and Young Child Feeding Practices

Clin Sci Nutr 2022; 4(2): 33-39

et al[26] indicated a poor understanding of nutritional education (70.77%).

This showed that 40% of registered nurses and CHEWs were comfortable with the mothers initiating breastfeeding 20 minutes after delivery, while 0.4% of them responded that it should be done immediately. Only 5.1% of them had no idea. A total of 95% of the nurses and CHEWs taught mothers to initiate breastfeeding but at different timing. A study by Abebe et al[27] in Ethiopia, who assessed the knowledge of CHEWs, showed that 96% of them taught mothers about breastfeeding initiation, while Chaturvedi et al[28] in a study in India indicated 95%. A similar review by Kohli and Chadha[29] showed that 80% of health workers from 10 studies knew about early initiation of breastfeeding.

Most of the health workers agreed that complementary feeding should be initiated after 6 months (63.8%); this was also similar to what was obtained in a study by Nsiah-Asamoah[20] where health workers also indicated >6 months (86.5%).

Knowledge assessment of health workers on when mothers should stop breastfeeding (≥2 years) in a study by Nsiah-Asamoah[20] was 59.4%, and in a similar study by Abebe et al[27] it was was 50%, and this was similar to the knowledge by nurses and CHEWs in this study, which was 54.4%. Knowledge on when breastfeeding should stop was similar from both studies.

The importance of early initiation of breastfeeding by the health workers on the issue of stopping postpartum bleeding and placenta expulsion was 62.1%. The knowledge was seen to be above average; however, 15.3% of them had no idea. About 88.1% of the health workers (nurses and CHEWs) knew the name of the first breast milk which comes after birth, indicating that their knowledge in this aspect was good but 31.5% picked wrong answers or had no idea when they were asked of the role of colostrum. A study by Chaturvedi et al[28] in India indicated that 100% of the health workers had good knowledge about colostrum.

The knowledge about good attachment was poor in this study. About 52.8% had no idea about it, and 39.1% chose the wrong answer in the questionnaire. This was different in a study by Chaturvedi et al[28] where knowledge about attachment from health workers was 91%. About 81% of the health workers taught lactating mothers how to express and store breast milk.

This study showed that 20.1% of the respondent had no idea of how long breastfeeding should last but 54.4% of the participating health workers believed that breastfeeding should last up to 2 years (24 months), this was in line with a study by Utoo et al.[21] This study also identified a need to train health personnel to further enhance the knowledge of their patients.

The study identified some challenges, which included an incomplete questionnaire and some health workers declining to participate.

The health workers' knowledge was average in this study. Adequate training and supportive supervision will further enhance their skill in IYCF practice.

Recommendation

Comparison of this research work with local studies was limited. Further study is needed to be carried out in other states (and even tailored to privately owned hospitals where pregnant mothers go for antenatal) to ascertain the level and credibility of IYCF practices being disseminated by health workers (nurses and CHEWs) to pregnant/lactating mothers. This will help policymakers in designing strategies to ensure adequate nutrition for infants and young children.

REFERENCES

1. Demilew YM, Tafere TE, Abitew DB. Infant and young child feeding practice among mothers with 0-24 months old children in Slum areas of Bahir Dar City, Ethiopia. *Int Breastfeed J*. 2017; 12:26. [CrossRef]

2. Corkins MR, Daniels SR, de Ferranti SD, et al. Nutrition in children and adolescents. *Med Clin North Am*. 2016;100(6):1217-1235. [CrossRef]

3. Schwarzenberg SJ, Georgieff MK, Committee on Nutrition. Advocacy for improving nutrition in the first 1000 days to support childhood development and adult health. *Pediatrics*. 2018;141 (2) :e20173716. [CrossRef]

4. Prado EL, Dewey KG. Nutrition and brain development in early life. *Nutr Rev*. 2014;72(4):267-285. [CrossRef]

5. World Health Organization (WHO). *Indicators for Assessing Infant and Young Child Feeding Practices Part 3: Country Profiles*. France: WHO Publications. 2010.

6. World Health Organization (WHO). *Infant and Young Child Feeding. Model Chapter for Textbook for Medical Students and Allied Health Proffesions*. France: WHO publications; 2009.

7. Safari JG, Kimambo SC, Lwelamira JE. Feeding practice and nutritional status in Morongo Municipality, Tanzania. *Tanzan J Health Res*. 2013;15(3):3-7.

8. Ojo-Okunola A, Nicol M, Du Toit E. Human breast milk bacteriome in health and disease. *Nutrients*. 2018;10(11):1643. [CrossRef]

9. Fernández L, Langa S, Martín V, Jiménez E, Martín R, Rodríguez JM. The microbiota of human milk in healthy women. *Cell Mol Biol (Noisy-le-grand)*. 2013; 59(1):31-42.

10. Goldman AS. Evolution of immune functions of the mammary gland and protection of the infant. *Breastfeed Med*. 2012;7(3):132-142. [CrossRef]

11. Daher J, Cassard F, Gari S, Sauveplane-Stirling V, Nyawo M, Codjia P. Implementation of nutrition surveys using SMART methodology in sub-Saharan Africa. *Field Exch*. 2018;58:68.

12. *Levels and Trends in Child Malnutrition: UNICEF / WHO / World Bank Group Joint Child Malnutrition Estimates Key Findings of the 2018 Edition*. WHO/NMH/NHD/18.9. 2018.

13. *National Nutrition and Health Survey (NNHS): Report on the Nutrition and Health Situation of Nigeria* [National Bureau of Statistic Main report]. Abuja Nigeria; 2018.

14. Samuel FO, Olaolorun FM, Adeniyi JD. A training intervention on child feeding among primary healthcare workers in Ibadan Municipality. *Afr J Prim Health Care Fam Med*. 2016;8(1):e1-e6. [CrossRef]

15. Sunguya BF, Poudel KC, Mlunde LB, et al. Effectiveness of nutrition training of health workers toward improving caregivers' feeding practices for children aged six months to two years: a systematic review. *Nutr J*. 2013;12:66. [CrossRef]

16. Owoaje ET, Oyemade A, Kolude OO. Previous BFHI training and nurses' knowledge, attitudes and practices regarding exclusive breastfeeding. *Afr J Med Med Sci*. 2002;31(2): 137-140.

17. Wallace LM, Kosmala-Anderson J. Training needs survey of midwives, health visitors and voluntary-sector breastfeeding support staff in England. *Matern Child Nutr*. 2007;3(1): 25-39. [CrossRef]

18. Nsiah-Asamoah C, Pereko KKA, Intiful FD. Nutritional counselling interactions between health workers and caregivers of children under two years: observations at selected child welfare clinics in Ghana. *BMC Health Serv Res*. 2019;19(1):817. [CrossRef]

19. Langa L. Breast is always best, even for HIV-positive mothers. *Bull World Health Organ*. 2010;88(1):9-10. [CrossRef]

20. Nsiah-Asamoah C. Gaps in knowledge levels of health workers on recommended child feeding practices and growth monitoring and promotion actions. *Ped Health Res*. 2018; 3(2):8.

21. Utoo BT, Ochejele S, Obulu MA, Utoo PM. Breastfeeding knowledge and attitudes amongst health workers in a health care facility in South-South Nigeria: the need for middle level health manpower development. *Clin Mother Child Health*. 2012;9(1):1-5. [CrossRef]

22. Sanders DM, Todd C, Chopra M. Confronting Africa's health crisis: more of the same will not be enough. *BMJ*. 2005; 331(7519):755-758. [CrossRef]

23. Welcome MO. The Nigerian health care system: need for integrating adequate medical intelligence and surveillance systems. *J Pharm Bioallied Sci*. 2011;3(4):470-478. [CrossRef]

24. Hsiao A, Vogt V, Quentin W. Effect of corruption on perceived difficulties in healthcare access in sub-Saharan Africa. *PLoS One*. 2019;14(8):e0220583. [CrossRef]

25. Pakenham-Walsh N, Bukachi F. Information needs of health care workers in developing countries: a literature review with a focus on Africa. *Hum Resour Health*. 2009;7:30. [CrossRef]

26. Mahyavanshi DK, Patel MG, Girija K, Purani SK, Nagar SS. A cross sectional study of the knowledge, attitude and practice of ASHA workers regarding child health (under five years of age) in Surendranagar district. *Healthline*. 2011;2(2): 50-53.

27. Abebe Z, Haki GD, Baye K. Health extension workers' knowledge and knowledge-sharing effectiveness of optimal infant and young child feeding are associated. *Food Nutr Bull*. 2016;37(3):353-363. [CrossRef]

28. Chaturvedi A, Nakkeeran N, Doshi M, Patel R, Bhagwat S. Capacity of frontline ICDS functionaries to support caregivers on infant and young child feeding (IYCF) practices in Gujarat, India. *Asia Pac J Clin Nutr*. 2014;23(suppl 1):S29-S37. [CrossRef]

29. Kohli S, Chadha R. Knowledge and counselling skills of community health workers for promotion of optimal infant and young child feeding (IYCF) practices: a review. *IJHSR*. 2017; 7(10):240-251.

Every Time Prealbumin May Not be an Indicator for Prognosis in Critically Ill Patients

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ABSTRACT

Objective: Prealbumin renamed transthyretin is a protein that is made in the liver and released in the blood and has been used as a beneficial nutritional indicator for long years. It aimed to investigate whether serum prealbumin level is a marker of mortality in patients hospitalized in the intensive care unit.

Methods: This retrospective and single-center study was carried out at level 3 intensive care unit. Data were collected from hospital electronic records and patient file archives. Patient age, gender, acute physiologic and chronic health evaluation score, nutritional risk screening 2002, nutric score, neutrophil-lymphocyte ratio, need for mechanical ventilation and duration, intensive care unit length of stay, comorbid conditions, the situation of nutrition support, causes of enteral feeding intolerance, the situation of protein and energy intake (7 days), laboratory parameters (included prealbumin (0 and 7 days)) at the time of admission to intensive care unit, and mortality status were recorded. Patients were divided into 2 groups as survivors and non-survivors, and the differences between the 2 groups were analyzed for all parameters.

Results: Sixty-three (60%) were female of 105 patients who participated in this study. The mean age was 59 ± 23 years. The mortality rate was 48.6%. The length of stay in the intensive care unit was 30 ± 34 days. The median level of serum albumin (g/dL) on day 1 was 2.7 (2.3-3.2) and on day 7, it was 2.5 (2.1-2.8). The mean level of serum prealbumin (mg/dL) on day 1 was 13.8 ± 6.6 and on day 7, it was 12.5 ± 6.5. Prealbumin (on days 0 and 7) values were not different between survivors and non-survivors (for all $P < .05$). In the binary logistic regression analysis, age and albumin value (on day 7) were found to be independent risk factors for mortality (odds ratio: 1.038 (1.002-1.075), $P = .036$, odds ratio: 1.148 (1.021-1.290), $P = .021$), respectively.

Conclusions: Prealbumin levels did not differ for critically ill patients with and without mortality.

Keywords: Albumin, intensive care unit, prealbumin, prognosis

INTRODUCTION

Malnutrition is characteristic of intensive care unit (ICU) patients.[1] This condition leads to an increase in complications, cost, and length of hospitalization and is considered an independent risk factor for mortality.[2] Nutritional support is very important for critically ill patients; however, the response to them is difficult to monitor and diagnose malnutrition. Advanced age, comorbidities, and pre-existing malnutrition, which are common in many critically ill patients, can exacerbate the condition.[3] These numerous methods, which do not have a clear "gold standard," indicate the difficulty of diagnosing malnutrition in the ICU. Prealbumin is secreted mainly by the liver and choroid plexus. Its short half-life (2 days), small volume of distribution, and uncomplicated measurement make it a good candidate for monitoring rapid changes in metabolic status.[4-5] It is common practice to adjust the amount of calories and protein given to patients according to serum albumin and prealbumin levels during hospitalization. Albumin and prealbumin are negative acute phase reactants and their levels may reflect decreased synthesis due to inflammation rather than nutritional status.[6] Therefore, serum concentrations may be low in critically ill patients, and also there is no strong evidence that increased food intake and control of inflammation in patients lead to increase in serum albumin or prealbumin levels or that increased levels are associated with better outcomes.

Clin Sci Nutr 2022; 4(2): 40-45

Altun et al. Prealbumin May Not Predict Prognosis in ICU

In this study, it was aimed to investigate whether serum prealbumin level is an indicator of mortality in patients hospitalized in the ICU.

METHODS

This retrospective and single-center study was carried out at Training and Research Hospital, Division of Critical Care Unit. The study protocol was approved by the ethics committee of our institution (Date: April 7, 2021; Decision No: 842), and informed consent from patients was not procured because of the retrospective study. Patients were evaluated retrospectively from April 2021 and March 2022. The critically ill patients were excluded if they were not at least 18 years of age and were not expected to remain in the ICU hospitalization for at least 24 hours. One hundred five septic patients followed up in the ICU were included in this study. Demographic and laboratory data were collected from hospital electronic records and patient file archives. Patient age, gender, acute physiologic and chronic health evaluation score (APACHE II), nutritional risk screening (NRS 2002), nutric score, neutrophil-lymphocyte ratio (NLR), need for invasive mechanical ventilation (IMV) and non-invasive mechanical ventilation (NIMV), IMV duration, the rate of pressure ulcer, length of stay (LOS) in ICU, comorbid conditions, situation of enteral, parenteral, dextrous, and oral nutrition support, causes of enteral feeding intolerance, situation of target protein and energy and protein and energy intake (on day 7), white blood cell (WBC), c-reactive protein (CRP), arterial lactate, procalcitonin, albumin and prealbumin (on days 0 and 7) levels at the time of admission to the ICU, and mortality status were recorded.

Statistical Analysis

Continuous variables were tested using Shapiro–Wilk test for normality and data are expressed as median and interquartile range or mean ± standard deviation. Mann–Whitney U test was performed to compare distinctions for non-normally distributed variables. Student's t-test was performed to compare distinctions for normally distributed variables. Categorical variables were analyzed with

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Main Points

- Prealbumin is a liver-derived protein thought to be significant in the assessment of nutritional deficiency and nutrition support.

- Prealbumin is a negative acute phase reactant, which means that levels decrease during inflammation or infection.

- Although its relationship with mortality in different disease groups has been shown in many studies, it may not always be associated with mortality.

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a Chi-square test or Fisher's exact test and expressed as numbers (percentages). Binary logistic regression analysis was performed to determine the independent risk factors for mortality. Patients were divided into 2 groups: survivors and non-survivors and the differences between the 2 groups were analyzed for all parameters. The outcomes of the regression analyses were expressed as odds ratio (OR) and 95% CI. A P value less than .05 was presumed statistically significant. Statistical analyses were carried out using Statistical Package for the Social Sciences version 22.0. (IBM SPSS Corp.; Armonk, NY, USA).

RESULTS

Sixty-three (60%) were female of 105 patients who participated in this study. The mean age was 59 ± 23 years. The mortality rate was 48.6%. The length of stay in ICU was 30 ± 34 days. Acute physiologic and chronic health evaluation score II score was 17 ± 9. Nutritional risk screening 2002 was 4 ± 1. Nutric score was 3 ± 2. Neutrophil-lymphocyte ratio was 14 ± 23. The need for IMV was 63 (60%), and the need for NIMV was 19 (18.1%). Invasive mechanical ventilation duration was 18 ± 33 days. Mean lactate value was 2.5 ± 1.9. The median level of serum albumin on day 0 was 2.7 (2.3-3.2) g/L, and on day 7, it was 2.5 (2.1-2.8) g/L. The mean level of serum prealbumin on day 0 was 13.8 ± 6.6 g/dL, and on day 7, it was 12.5 ± 6.5 g/dL. Enteral nutrition support was 59 (56.2%), parenteral nutrition support was 6 (5.7%), oral nutrition support was 25 (23.8%), and intravenous dextrose support was 9 (8.6%). Among the major causes of enteral feeding intolerance, the most common cause was feeding intolerance (29 (27.6%)) and the next most common cause was diarrhea (16 (15.2%)). While median target protein (g/day) was 118 (107-127), median protein intake (g/day) on day 7 was 90 (67-105). While the mean target energy (kcal/day) was 1709 ± 385, the mean energy intake (kcal/day) on day 7 was 1507 ± 460. The frequency of pressure ulcer was 31 (29.5%). In this study, 30 (28%) patients had hypertension, 20 (19%) patients had diabetes mellitus, and 21 (20%) patients had chronic obstructive pulmonary disease. Non-survivors had higher hypertension and cerebrovascular disease as compared to survivors (for all, $P < .05$). Sex, need for NIMV, IMV duration day, WBC, lactate, CRP, procalcitonin, albumin (on day 0) and prealbumin (on days 0 and 7) values, parenteral, oral, and intravenous dextrose nutrition support, major causes of enteral feeding intolerance, LOS in ICU, mean target energy, median target protein, and median protein intake (day 7) were not different between survivors and non-survivors (for all $P > .05$). Non-survivors had higher APACHE II score (21 ± 9 vs. 14 ± 8, $P=.001$), age (69 ± 16 vs. 49 ± 25, $P=.001$), NRS score (4 ± 1 vs. 3 ± 1, $P=.008$), nutric score (4 ± 2 vs. 2 ± 2, $P=.001$), need for IMV (38 (74.5%) vs. 21 (38.9%), $P=.003$), enteral

Altun et al. Prealbumin May Not Predict Prognosis in ICU

Clin Sci Nutr 2022; 4(2): 40-45

Table 1. Demographic and Clinical Characteristics of the Patients				
	Total	Survivors	Non-survivors	
Variables	n=105	n=54	n=51	P
Age, (years)	59 ± 23	49 ± 25	69 ± 16	**.001**
Male, n (%)	63 (60)	34 (63)	29 (56.9)	.524
APACHE II score	17 ± 9	14 ± 8	21 ± 9	**.001**
NRS 2002	4 ± 1	3 ± 1	4 ± 1	**.008**
Nutric score	3 ± 2	2 ± 2	4 ± 2	**.001**
NLR	14 ± 23	15 ± 30	14 ± 10	.811
Need for IMV, n (%)	63 (60)	25 (46.3)	38 (74.5)	**.003**
Need for NIMV, n (%)	19 (18.1)	6 (11.1)	13 (25.5)	.06
IMV duration, days	18 ± 33	33 ± 44	26 ± 17	.322
WBC (10³/μL)	13 ± 5	13.2 ± 4.8	12.9 ± 6.2	.773
Lactate (mmol/L)	2.5 ± 1.9	2.5 ± 2.1	2.5 ± 1.6	.962
CRP (mg/dL)	82 ± 81	79 ± 76	84 ± 87	.763
Procalcitonin (μg/L)	7 ± 28	9 ± 36	5 ± 14	.427
Albumin (g/dL), 0 day	2.7 (2.3-3.2)	2.9 (2.5-3.2)	2.7 (2.2-3.1)	.09
Albumin (g/dL), 7 day	2.5 (2.1-2.8)	2.6 (2.4-2.9)	2.2 (1.9-2.6)	**.001**
Prealbumin (mg/dL), 0 day	13.8 ± 6.6	14.6 ± 6.2	13 ± 7.1	.202
Prealbumin (mg/dL), 7 day	12.5 ± 6.5	13.5 ± 5.8	11.5 ± 7.2	.122
Enteral nutrition support, n (%)	59 (56.2)	21 (38.9)	38 (74.5)	**.001**
Parenteral nutrition support, n (%)	6 (5.7)	3 (5.6)	3 (5.9)	.943
Oral nutrition support, n (%)	25 (23.8)	14 (25.9)	11 (21.6)	.600
Dextrose support, n (%)	9 (8.6)	5 (9.3)	4 (7.8)	.600
Major causes of enteral feeding intolerance (0-7 day), n (%)				
Diarrhea	16 (15.2)	10 (19.6)	6 (11.1)	.226
Gastrointestinal bleeding	8 (7.6)	3 (5.6)	5 (9.8)	.480
Feeding intolerance	29 (27.6)	12 (22.2)	17 (33.3)	.203
Nausea/vomiting	15 (14.3)	7 (13)	8 (15.7)	.690
Ileus	2 (1.9)	1 (1.9)	1 (2)	1.000
Target protein (g/day)	118 (107-127)	117 (106-127)	120 (109-127)	.417
Protein intake (g/day), 7 day	90 (67-105)	90 (64-108)	90 (70-105)	.982
Target energy (kcal/day)	1709 ± 385	1761 ± 446	1654 ± 304	.156
Energy intake (kcal/day), 7 day	1507 ± 460	1600 ± 445	1410 ± 461	**.034**
Pressure ulcer, n (%)	31 (29.5)	11 (20.4)	20 (39.2)	**.034**
Comorbidities, n (%)				
COPD	21 (20)	11 (20.4)	10 (19.6)	.922
CAD	14 (13.3)	5 (9.3)	9 (17.6)	.206
HTN	30 (28.6)	8 (14.8)	22 (43.1)	**.001**
CVD	9 (8.6)	1 (1.9)	8 (15.7)	**.014**
DM	20 (19)	7 (13)	13 (25.5)	.102
LOS in ICU, days	30 ± 34	33 ± 44	26 ± 17	.249

APACHE II, acute physiologic and chronic health evaluation; CAD, coronary artery disease; COPD, chronic obstructive pulmonary disease; CRP, c-reactive protein; CVD, cerebrovascular disease; DM, diabetes mellitus; HTN, hypertension; ICU, intensive care unit; IMV, invasive mechanical ventilation; LOS, length of stay; n, number; NIMV, non-invasive mechanical ventilation; NLR, neutrophil-lymphocyte ratio; NRS, nutritional risk screening; WBC, white blood cell; y, year.

Clin Sci Nutr 2022; 4(2): 40-45

Altun et al. Prealbumin May Not Predict Prognosis in ICU

Table 2. Multivariable Binary Logistic Regression Modeling of Parameters for Mortality

Variables	OR	95% CI	P
Age	1.038	1.002-1.075	.036
Albumin, 7 day	1.148	1.021-1.290	.021
APACHE II score	1.055	0.950-1.173	.308
Need for IMV	1.834	0.550-6.097	.323
NRS 2002	1.010	0.626-1.623	.972
Nutric score	1.267	0.717-2.236	.415
Enteral nutrition support	2.325	0.677-8.000	.180
Energy intake, 7 day	1.000	0.999-1.002	.460
Pressure ulcer	1.041	0.331-3.277	.945
HTN	1.176	0.333-4.629	.746
CVD	2.624	0.217-31.250	.447
ARF	1.782	0.583-5.464	.310

APACHE II, acute physiologic and chronic health evaluation; ARF, acute renal failure; CVD, glomerular filtration rate; HTN, hypertension; IMV, invasive mechanical ventilation; NRS, nutritional Risk Screening; OR, odds ratio.

nutrition support (38 (74.5%) vs. 25 (46.3%), P=.001), and the frequency of pressure ulcer (20 (39.2%) vs. 11 (20.4%), P=.034) as compared to non-survivors. Survivors had higher albumin (on day 7) (2.6 (2.4-2.9) vs. 2.2 (1.9-2.6) P=.001) and mean energy intake (on day 7) (1600 ± 445 vs. 1410 ± 461, P=.034) as compared to non-survivors. Detailed demographic characteristics were described in Table 1. In the binary logistic regression analysis, age and albumin value (on day 7) were found to be independent risk factors for mortality (OR: 1.038 (1.002-1.075), P=.036, OR: 1.148 (1.021-1.290), P=.021), respectively (Detailed demographic characteristics were described in Table 2).

DISCUSSION

In this study, the files of a total of 105 patients hospitalized in the tertiary ICU were reviewed retrospectively, and it was planned to investigate the effects of parameters, primarily prealbumin, on mortality. When the prealbumin values of the patients at the time of hospitalization and on the seventh day were examined, it was observed that there was no relationship with mortality and that age and seventh day albumin level were independent risk factors for mortality. It has been shown in the studies that advanced age and hypoalbuminemia have a poor prognosis in patients hospitalized in the ICU.[7-11] In a study evaluating the 90-day mortality of septic patients, mean

albumin values of the patients who died were 2.2 g/dL, and it has been reported that the cut-off value for mortality is 2.5 g/dL.[12] Vincent et al[13] reported that hypoalbuminemia adversely affects the entire clinical spectrum, mortality, morbidity, and ICU LOS in critically patients. Hypoalbuminemia occurs with decreased albumin synthesis secondary to inflammatory mediator release after acute phase processes, leakage from vascular capillaries, and renal losses following renal damage. Because albumin plays significant roles in the human body, such as maintenance of osmotic pressure, acid-basic balance, and transport of substances, decreased serum concentrations of albumin may be associated with death.[14] There have been numerous studies investigating the relationship between prealbumin and prognosis. Cheng et al[15] reported that the rate of infection and mortality increased and the length of hospital stay was prolonged in trauma patients with low prealbumin levels in the ICU. Another study, by Avram et al[16] reported that serum prealbumin was an independent risk factor for mortality in patients with peritoneal dialysis. Yang et al[17] observed that serum prealbumin levels were independently associated with mortality in critically ill patients who were severely burned. Zuo et al[18] reported that decreased prealbumin level is an independent prognostic factor of in-hospital mortality, ICU admission, and mechanical ventilation for older adults aged ≥ 65 years with COVID-19.[18] Zu et al[19] documented that the preoperative lower prealbumin group (<140 mg/L) was a prognostic risk for patients with gastric cancer. When the articles examining the relationship between prealbumin and mortality were searched on PubMed, it was seen that there was 1 article that was similar to our results. In the study by Lim et al. prealbumin levels were investigated on days 0 and 7 by including patients who received parenteral nutrition for more than 7 days in the ICU. At the end of 7 days, the patients were divided into two groups as increasing and decreasing the prealbumin value. There was no statistical difference between the groups in terms of mortality as a prognostic marker (P=.673).[20] Since prealbumin has a shorter half-life (2 days) than albumin and a more fast ratio of hepatic synthesis, a predictable catabolic ratio, and a rapid rising with adequate protein intake, it can also be an indicator of prognostic index in tumors, malnutrition, trauma, surgery, cirrhosis, burns, and critically ill patients as demonstrated in the aforementioned studies. When our results were examined, it was determined that both 0 and 7 days' prealbumin levels of the patients were lower than the reference prealbumin values in the studies (prealbumin values below 15 and 18 mg/dL were evaluated as low in the studies).[21, 22] Although nutritional support was given, prealbumin values on the seventh day decreased in both groups. Table 1 shows that target energy and protein levels could not be reached at the

Altun et al. Prealbumin May Not Predict Prognosis in ICU

Clin Sci Nutr 2022; 4(2): 40-45

end of the seventh day. Although the prealbumin value did not show the nutritional status sensitively enough, the fact that the patients were not given sufficient nutritional support may have prevented the increase in the prealbumin value. Statistically, the inability to detect prealbumin as a risk factor for mortality can be explained by the absence of an increase in the prealbumin value on the seventh day.

Limitations

The study was conducted in a single center and further our study population was relatively heterogeneous (e.g., cardiothoracic, neurosurgical, trauma, and pulmonary patients). Second, bias was inevitable because of the limited number of patients involved. There are a large number of variables that affect prealbumin levels that have not been looked at in the study (e.g., malnutrition status, renal and live function, type and extent of surgery, corticosteroid use, and other causes of inflammation). This preliminary results of 105 patients presented that prealbumin may not be an indicator of prognosis in critically ill patients. We predict that as a result of increasing the number of patients, a different outcome may be obtained in terms of prognosis.

Prealbumin level may not always give an idea about the prognosis in patients hospitalized in the ICU. The results may be unexpected, especially if there are many poor situations that may affect the prognosis and prealbumin values. Seeing more than one intermittent prealbumin value rather than a single value is important in terms of interpreting the results. We are of the opinion that it would be more accurate to determine the prognosis according to the increase or decrease in the prealbumin value in the follow-up.

REFERENCES

1. Christman JW, McCain RW. A sensible approach to the nutritional support of mechanically ventilated critically ill patients. *Intensive Care Med.* 1993;19(3):129-136. [CrossRef]
2. Mogensen KM, Robinson MK, Casey JD, et al. Nutritional status and mortality in the critically ill. *Crit Care Med.* 2015;43(12):2605-2615. [CrossRef]
3. Horwood A. A literature review of recent advances in enteral feding and the increased understanding of the gut. *Intensive Crit Care Nurs.* 1992;8(3):185-188. [CrossRef]
4. Mears E. Outcomes of continuous process improvement of a nutritional care program incorporating serum prealbumin measurements. *Nutrition.* 1996;12(7-8):479-484. [CrossRef]
5. Sung J, Bochicchio GV, Joshi M, et al. Admission serum albumin is predictive of outcome in critically ill trauma patients. *Am Surg.* 2004;70(12):1099-1102.
6. Jensen GL. Inflammation as the key interface of the medical and nutrition universes: a provocative examination of the future of clinical nutrition and medicine. *JPEN J Parenter Enter Nutr.* 2006;30(5):453-463. [CrossRef]
7. Kalın BS, Özçaylak S, Solmaz İ, Kılıç J. Assessment of risk factors for mortality in patients in medical Intensive Care Unit of a tertiary hospital. *Indian J Crit Care Med.* 2022;26(1):49-52. [CrossRef]
8. Kendall H, Abreu E, Cheng AL. Serum albumin trend is a predictor of mortality in ICU patients With sepsis. *Biol Res Nurs.* 2019;21(3):237-244. [CrossRef]
9. Padkins M, Breen T, Anavekar N, Barsness G, Kashani K, Jentzer JC. Association Between albumin level and mortality Among cardiac Intensive Care Unit patients. *J Intensive Care Med.* 2021;36(12):1475-1482. [CrossRef]
10. Abuhasira R, Anstey M, Novack V, Bose S, Talmor D, Fuchs L. Intensive care unit capacity and mortality in older adults: a three nations retrospective observational cohort study. *Ann Intensive Care.* 2022;12(1):20. [CrossRef]
11. Roso-Llorach A, Serra-Picamal X, Cos FX, et al. Evolving mortality and clinical outcomes of hospitalized subjects during successive COVID-19 waves in Catalonia, Spain. *Glob Epidemiol.* 2022;4:100071. [CrossRef]
12. Ranzani OT, Zampieri FG, Forte DN, Azevedo LCP, Park M. C-reactive protein/albumin ratio predicts 90-day mortality of septic patients. *PLoS One.* 2013;8(3):e59321. [CrossRef]
13. Vincent J-L, Dubois M-J, Navickis RJ, Wilkes MM. Hypoalbuminemia inAcuteIllness: is there a RationaleforIntervention? *Annsurg.* 2003;237(3):319-334.
14. Santos NSJd, Draibe SA, Kamimura MA, Cuppari L. Albuminasérica como marcador nutricional de pacientes emhemodiálise. *Rev Nutr.* 2004;17(3):339-349. [CrossRef]
15. Cheng V, Inaba K, Haltmeier T, et al. Serum transthyretin is a predictor ofclinical outcomes in critically ill trauma patients. *Surgery.* 2015;158(2):438-444. [CrossRef]
16. Avram MM, Sreedhara R, Fein P, Oo KK, Chattopadhyay J, Mittman N. Survival on hemodialysis and peritoneal dialysisover 12 years with emphasis on nutritional parameters. *Am Jkidney Dis.* 2001;37(1):S77-S80. [CrossRef]

17. Yang HT, Yim H, Cho YS, et al. Prediction of clinical outcomes for massively-burned patientsvia serum transthyretin levels in the early postburn period. *Jtrauma Acute Care Surg*. 2012;72(4):999-1005. [CrossRef]

18. Zuo P, Tong S, Yan Q, et al. Decreased prealbumin level is associated with increased risk for mortality in elderly hospitalized patients with COVID-19. *Nutrition*. 2020;78:110930. [CrossRef]

19. Zu H, Wang H, Li C, Xue Y. Preoperative prealbumin levels on admission as an independent predictive factor in patients with gastric cancer. *Med (Baltim)*. 2020;99(11):e19196. [CrossRef]

20. Lim SH, Lee JS, Chae SH, Ahn BS, Chang DJ, Shin CS. Prealbumin is not sensitive indicator of nutrition and prognosis in critical ill patients. *Yonsei Med J*. 2005;46(1):21-26. [CrossRef]

21. Arbab K, Majid H, Jafri L, et al. Assessing nutritional status of critically ill patients using serum prealbumin levels. *J Ayub Med Coll Abbottabad*. 2019;31(2):178-181.

22. Yang Q, Liu W, Yu J, Jiang J, Xu T, Zhou Y. Effect of prealbumin level on mortality in heatstroke patients. *Exp Ther Med*. 2019;17(4):3053-3060. [CrossRef]

Evaluation of Sarcopenia in COVID-19 Survivors: A Common But Overlooked Problem

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ABSTRACT

Objective: In patients with COVID-19, the possibility of sarcopenia has climbed further by adding inflammation, malnutrition, and physical inactivity to pre-existing health conditions. This study aimed to examine the sarcopenia status and related factors of patients diagnosed with COVID-19 in the near term after discharge.

Methods: Patients hospitalized due to COVID-19 were included in this cross-sectional study on the 14th day after discharge. Examinations of the patients were performed in the post-COVID-19 follow-up outpatient clinic and then comprehensive assessments were made in the geriatric medicine outpatient clinic. Anthropometric measurements, handgrip strength, muscle mass assessment by ultrasonography, and bioelectrical impedance analysis were performed. Grip strength cut-offs were taken as 16 kg for females and 27 kg for males, and those lower than these values were accepted as having probable sarcopenia.

Results: In total, 49 patients participated and their mean age was 59.0 ± 12.4 years, while the ratio of female participants was 53.1% (n = 26). Of the patients, 49.0% (n = 24) had multimorbidity. There were 17 (34.7%) probable sarcopenic patients. In bioelectrical impedance analysis measurements, the fat ratio was higher ($P < .05$), and appendicular skeletal muscle index was lower in probable sarcopenic patients ($P < .001$). In ultrasonography measurements, gastrocnemius muscle thickness, gastrocnemius fascicle length, rectus femoris muscle thickness, and rectus femoris cross-sectional area were lower in probable sarcopenic patients ($P < .05$ for all), but there was no difference in trunk muscles ($P > .05$). Among anthropometric measurements, mid-arm and calf circumferences were lower in probable sarcopenic patients ($P < .05$ for all). In regression analysis, as a result of the model created, multimorbidity was associated with probable sarcopenia (odds ratio: 3.9, 95% CI: 1.06-14.30, $P = .04$).

Conclusion: The possibility of sarcopenia increases in patients with COVID-19, especially the group with multimorbidity should be evaluated in terms of sarcopenia to prevent adverse health outcomes related to sarcopenia. Handgrip strength, bioelectrical impedance analysis, ultrasonography, and anthropometric measurements can be used in the evaluation of sarcopenia.

Keywords: COVID-19, malnutrition, sarcopenia

INTRODUCTION

Sarcopenia is a syndrome with decreased muscle mass, strength, and function.[1] It increases the risk of adverse health outcomes such as dysphagia, falls, fractures, functional decline, frailty, hospital admissions, morbidity, and mortality.[2,3] There are many causes of sarcopenia, such as low protein and energy intake, malabsorption, cancer, neurological diseases, joint and muscle diseases, diabetes, chronic obstructive lung disease, sedentary lifestyle, immobilization, hospital admission, drugs, and cachexia.[4]

COVID-19 caused a pandemic that resulted in nearly 6.5 million deaths over the last 3 years. In addition to mild

to severe inflammatory response, quarantine processes, curfews, social isolation, and stress increased the risk of sarcopenia. Increased sarcopenia risk was also related to inflammation, malnutrition, physical inactivity, and pre-existing diseases.[5,6] COVID-19 patients with sarcopenia showed higher prevalences of frailty and mortality.[7] The mean time required for the development of sarcopenia varies according to the severity and duration of the disease. Sarcopenia can occur at any stage of the disease, acute or post-COVID-19 processes.[5,8]

Due to the isolation during the pandemic, it is difficult to evaluate sarcopenia. The European Working Group on Sarcopenia in Older People (EWGSOP) recommends the

measurement of muscle strength with handgrip, and low muscle strength is related to probable sarcopenia (PS).[2] Therefore, the aim of this study was to examine the PS and related factors of patients with COVID-19 after hospital discharge.

METHODS

Participants

This cross-sectional study included 49 patients hospitalized with COVID-19. Patients were evaluated on the 14th day of the hospital discharge in post-COVID follow-up outpatient clinic. Comprehensive assessments were performed in the geriatrics outpatient clinic of hospital. Age, sex, education and marital status, hospitalization clinical follow-up, chronic diseases, medications, activities of daily living, nutritional status, frailty status, anthropometric measurements, and laboratory examinations of the patients were recorded.

Inclusion criteria for the study were given as follows:

1. hospitalization with COVID-19 infection and
2. being able to cooperate with tests.

Exclusion criteria for the study were given as follows:

1. not being able to cooperate with the tests,
2. hemodialysis/peritoneal dialysis patients,
3. presence of severe edema in the lower extremities (grade 3 and 4 pretibial edema),
4. having severe dehydration (hypovolemic symptoms like decline in consciousness, tachycardia, low blood pressure, peripheral cyanosis, oligouria, etc.),
5. uncontrolled hypothyroidism or hyperthyroidism,
6. having a cardiac pacemaker or implant,
7. history of amputation in extremities,
8. inflammatory rheumatic diseases (independent from disease activity),
9. systemic atrophies that mainly affect the central nervous system such as Huntington's disease, hereditary ataxia, spinal muscular atrophy and related syndromes, postpolio syndrome,
10. demyelinating diseases of the central nervous system,
11. oral corticosteroids (≥ 5 mg/day for >3 months), and
12. history of ischemic/hemorrhagic stroke after COVID-19 infection.

Comprehensive Assessment

All patients were evaluated comprehensively. The independence status of the patients was evaluated using the Katz Index of Independence in activities of daily living (ADL)[9] and the Lawton–Brody instrumental ADL (IADL).[10] Katz ADL has 6 items: feeding, continence, transferring, dressing, toileting, and bathing. Lawton–Brody IADL includes the following items: ability to use a telephone, shopping, food preparation, housekeeping, laundry, transportation method, medication use, and handling finances. Katz ADL and Lawton–Brody were both validated for older adults. However, they were used in studies including young populations.[11,12] Nutritional status was assessed using the mini nutritional assessment-short form (MNA-SF).[13] In this test, which is evaluated out of 14 points, 7 points and below are considered malnutrition, between 8 and 11 points are considered malnutrition risk, and 12 points and above are considered normal. Muscle strength was measured by grip strength measurement. A calibrated hand-held dynamometer (T.K.K.5401; Takei Scientific Instruments, Tokyo, Japan) was used. Grip strength was measured 3 times with a dynamometer while the arms of the patients were parallel to the floor. The highest of these 3 values was included in the analysis. Grip strength cut-offs were taken as 16 kg for females and 27 kg for males.[2] Values lower than those cut-offs were considered significant for PS. Gait speed was measured using a digital watch with patients walking 4 m at their usual speed. Gait speed ≤ 0.8 m/s indicates low physical performance.[2] Multimorbidity has been accepted as the coexistence of 2 or more chronic diseases.[14] Frailty assessment was made using the Clinical Frailty Scale, scored from 1 to 9. While 1,2, and 3 points are not considered frail, after the update made in 2020, those who score 4 points and above are considered living with frailty.[15] It was validated for older people but was also used for young adults in studies.[16]

Anthropometric Measurements

Weight and height were measured without shoes while wearing light clothing. Waist circumference was measured from the umbilicus level with the help of a tape, while hip circumference was measured from the widest part of the buttocks. The mid-arm circumference was measured from the midpoint of the acromial and olecranon protrusions while the arm was twisted by 90° from the elbow. Calf circumference was measured from the widest part of the calf while the foot was pressing on a hard surface.

Main Points

- COVID-19 increases the risk of sarcopenia.

- There are several ways to evaluate muscle mass.

- Sarcopenia assessment remains in the background in COVID-19 patients.

- In multimorbid COVID-19 patients, health professionals should be alert for the development of sarcopenia.

Ceylan et al. COVID-19 Survivors and Sarcopenia

Clin Sci Nutr 2022; 4(2): 46-53

Ultrasonographic Assessment

Ultrasound is a valid and reliable imaging method for evaluating muscle thickness.[17] Measurements were performed using an 8-10 MHz linear probe of 5 cm width (LOG·IQ 200 PRO, General Electric Medical Systems). Measurements were made from the right side of the body, applying minimal pressure with the US probe. Rectus femoris muscle thickness (MT), rectus femoris cross-sectional area (CSA), gastrocnemius MT, gastrocnemius (GC) pennate angle, GC fascicle length, rectus abdominis MT, internal oblique MT, external oblique MT, and transverse abdominis MT were measured according to the recommendations.[18,19] Images of trunk muscles were taken at the end of expiration to reduce the effect of respiration.[20] The greatest distance between superficial and deep fascia on transverse images was captured for muscle thicknesses. For the pennate angle, the angle between the muscle fibers and the deep fascia was measured in the longitudinal image. The length between the fascicle insertion points to the superficial and deep aponeuroses was measured for fascicle length. Rectus femoris cross-sectional area was defined as the area of the cross-section of a muscle perpendicular to its longitudinal axis. Ultrasound measurements were performed by specialist physicians working in the geriatric polyclinic, which also has a certificate.

Assessment by Bioelectrical Impedance Analysis

The bioelectrical impedance analyses of the patients included in the study were performed using the Body Stat Quadscan 4000 bioimpedance analyzer (BodyStat Ltd, Douglas, Isle of Man, British Isles). There are several factors that affect BIA measurements.[21,22] These factors are noted in the "inclusion and exclusion criteria" section, and patients with one of these were excluded from the study. Measurements were performed after overnight fasting using the multifrequency tetrapolar technique while the patients were lying supine. The appendicular skeletal muscle mass index (ASMI) was calculated. The following equation, suggested by Kyle et al[23], was used to determine the appendicular skeletal muscle mass (ASM): $4.211 + 0.267 \times$ height^2/resistance $+ 0.95 \times$ weight $+ 1.999 \times$ sex (males $= 1$, females $= 0$) $+ -0.012 \times$ age $+ 0.058 \times$ reactance. The ASMI was calculated and corrected for height^2. An ASMI below 7.0 kg/m^2 for males and 5.5 kg/m^2 for females was accepted as low muscle mass.[2]

Ethical Approval

The study was approved by the Hacettepe University Faculty of Medicine Non-interventional Clinical Research Ethics Board (Date: May 21, 2021, Decision No: 2021/11-31). It was performed in compliance with the Declaration of Helsinki.

Statistical Analysis

Statistical analysis was wielded using Statistical Package for the Social Sciences version 24.0 (IBM Corp, Armonk, NY, USA). While descriptive statistics were presented, mean, standard deviation, median, and interquartile range were used according to the normal distribution status for numerical values. In contrast, numbers and percentages were used for categorical variables. In comparing numerical values, Student's t-test or Mann–Whitney U test was used according to normal distribution. Chi-square or Fisher exact tests were performed to compare categorical variables. For correlations, the Spearman rho test was employed. Logistic regression analysis was performed to determine the parameters that independently affect PS. A P-value <.05 was accepted as statistically significant.

RESULTS

This study included 49 patients and their mean age was 59.0 ± 12.4 years, while the ratio of female participants was 53.1% (n = 26). Forty-nine percent (n = 24) of the patients had multimorbidity. Twenty-three (46.9%) patients had used 5 or more drugs daily. The median hospital stay was 11.0 days (interquartile range (IQR): 7.0), while 46.9% (n = 23) of the patients stayed in the intensive care unit. The ratio of patients given steroid treatment because of COVID-19 was 61.2% (n = 30). The median CFS score was 3.0 (IQR: 1.0). There were 9 (18.4%) patients with slow gait speed. The main demographic and clinical characteristics of patients are given in Table 1. There were 17 (34.7%) PS patients. According to age and sex, there was no difference. Probable sarcopenia was more common in patients with multimorbidity and frailty (Table 1).

The median MNA-SF score was 9.0 (IQR: 2.0). There was a risk of malnutrition according to MNA-SF in 83.7% of the patients. Six (12.2%) patients were malnourished. Although the probability of PS was high in malnourished patients, this was not statistically significant (P = .16) (Table 1). Four (8.2%) patients were discharged with oral nutrition supplement therapy.

In anthropometric measurements, mid-arm and calf circumferences were lower in the PS group (P = .001, P = .03, respectively). There was no difference between the groups in other anthropometric measurements (Table 2). None of the anthropometric measurements correlated with grip strength (Table 3).

In BIA measurements, the fat ratio was higher and ASMI was lower in PS patients. In ultrasonographic measurements, GC MT, GC fascicle length, RF MT, and RF CSA were lower in PS patients, but there was no difference in trunk muscles. Among anthropometric measurements,

Clin Sci Nutr 2022; 4(2): 46-53

Ceylan et al. COVID-19 Survivors and Sarcopenia

Table 1. Demographic and Clinical Characteristics of Patients				
Characteristics	Total (n=49) (n, %)	Probable Sarcopenia (n=17, 34.7%) (n, %)	Non-Sarcopenia (n=32, 65.3%) (n, %)	P
Age (years) (mean ± SD)	59.0 ± 12.4	62.4 ± 8.7	57.2 ± 13.8	.17
Sex (female)	26 (53.1)	12 (70.6)	14 (43.8)	.07
Education (≤5 years)	20 (40.8)	9 (52.9)	11 (34.4)	.21
Marital status (married)	39 (79.6)	15 (88.2)	24 (75.0)	.46
Smoking	12 (24.5)	2 (11.8)	10 (31.3)	.17
Multimorbidity	24 (49.0)	12 (70.6)	12 (37.5)	.03
Drug number (median, IQR)	4.0 (5.0)	6.0 (7.0)	3.0 (6.0)	.09
Polypharmacy (≥5 drugs)	23 (46.9)	11 (64.7)	12 (37.5)	.07
Steroid	30 (61.2)	9 (52.9)	21 (65.6)	.39
Length of hospital stay (median, IQR)	11.0 (7.0)	12.0 (11.5)	10.0 (5.8)	.24
Intensive care unit admission	23 (46.9)	10 (58.8)	13 (40.6)	.22
Katz ADL (median, IQR)	6.0 (0.0)	6.0 (0.0)	6.0 (0.0)	.45
Lawton–Brody IADL (median, IQR)	8.0 (0.0)	8.0 (1.0)	8.0 (0.0)	.003
MNA-SF (median, IQR)	9.0 (2.0)	9.0 (2.0)	9.0 (2.0)	.82
MNA-SF (≤7 points)	6 (12.2)	4 (23.5)	2 (6.3)	.16
CFS (median, IQR)	3.0 (1.0)	4.0 (1.5)	3.0 (2.0)	.01
CFS (≥4 points)	22 (44.9)	11 (64.7)	11 (34.4)	.04
Gait speed (<0.8 m/s)	9 (18.4)	7 (41.2)	2 (6.3)	.003
Hemoglobin (g/dL) (mean ± SD)	13.1 ± 1.8	12.5 ± 1.9	13.4±1.6	.13
Leukocyte (×10³/μL) (mean ± SD)	6.6 ± 1.8	6.3 ± 1.7	6.8 ± 1.8	.41
Albumin (g/dL) (mean ± SD)	4.0 ± 0.4	3.8 ± 0.4	4.0 ± 0.4	.53
C-reactive protein (mg/dL) (median, IQR)	0.64 (0.82)	0.81 (0.92)	1.04 (0.62)	.68

ADL, activities of daily living; CFS, Clinical Frailty Scale; IADL, instrumental activities of daily living; IQR, interquartile range; MNA-SF, mininutritional assessment-short form; n, number; SD, Standard deviation.

mid-arm and calf circumferences were lower in PS patients (Table 2). Sarcopenia diagnosis was confirmed by BIA in only 6 (12.2%) patients.

Fat ratio, age, CFS score, and gait speed were negatively correlated with grip strength, while ASMI, GC MT, RF MT, RF CSA, RA MT, and EO MT were positively correlated. The strongest negative correlation was in the fat ratio ($r=-0.67$). The strongest positive correlations were in the measurements made from the RF muscle (RF MT $r=0.52$, RF CSA $r=0.53$) (Table 3).

In regression analysis, as a result of the model created, multimorbidity was associated with PS (OR: 3.9, 95% CI: 1.06-14.30, $P=.04$) (Table 4).

DISCUSSION

In the present study, PS in COVID-19 patients was evaluated after hospital discharge. It is important because it was performed in the first weeks of the recovery period after suffering from COVID-19. In this study, which included patients from all age groups, the PS rate was 34.7%. Multimorbidity was independently related to PS.

Although sarcopenia occurs at the end of multiple chronic pathophysiological changes, acute medical disorders can accelerate the development of sarcopenia. The risk of sarcopenia increases in hospitalized patients.[24] COVID-19 accelerates the development of sarcopenia as it causes acute inflammation and is related to hospitalization. In a multicenter study conducted with 407 patients, 73% of the patients hospitalized for COVID-19 were at high risk for sarcopenia.[25] Decreased muscle strength and physical performance had occurred in hospitalized patients due to COVID-19 pneumonia.[26] In our study, decreased grip strength was found in 34.7% of the patients. Appropriate interventions such as nutritional support and exercise can prevent adverse health outcomes in patients with decreased grip strength in COVID-19 patients. However, few COVID-19 patients receive nutritional therapy during recovery.[25] In our study, only 4 (8.2%) patients were discharged with oral nutrition supplement therapy.

Increased unmet needs, healthcare use, sick days, and a decline in perceived health status and quality of life are all linked to multimorbidity.[27] Sarcopenia is more prevalent in those with multimorbidity, and patients with multimorbidity are at increased risk of sarcopenia.[28] Multimorbidity is also a significant problem affecting the course of COVID-19 patients, and COVID-19 patients with comorbidities have a higher mortality risk.[29] There are only few studies about the relationship between sarcopenia and multimorbidity in COVID-19 patients, and more evidence

Ceylan et al. COVID-19 Survivors and Sarcopenia

Clin Sci Nutr 2022; 4(2): 46-53

Characteristics	Total (n=49) (n,%)	Probable Sarcopenia (n=17) (n,%)	Non-Sarcopenia (n=32) (n,%)	P
Table 2. Muscle Mass Assessments by Different Methods				
BIA assessment				
Fat (%) (mean, SD)	34.9 ± 12.2	40.3 ± 7.1	32.3 ± 13.2	.01
ASMI (kg/m²) (median, IQR)				
Females	6.3 (5.0-8.7)	5.8 (4.8-7.7)	6.7 (5.9-9.0)	<.001
Males	8.5 (7.9-11.0)	7.6 (7.1-10.2)	8.9 (8.2-10.9)	<.001
Ultrasonographic assessment				
GC muscle thickness, mm (mean, SD)	15.6 ± 3.1	14.4 ± 3.3	16.2 ± 2.8	.04
GC fascicle length, mm (mean, SD)	28.3 ± 5.2	26.2 ± 4.8	29.4 ± 5.1	.03
GC pennate angle, (°) (median, IQR)	28.0 (6.5)	28.0 (6.5)	28.5 (7.0)	.14
RF muscle thickness, mm (mean, SD)	15.8 ± 3.6	13.8 ± 3.2	16.9 ± 3.4	.003
RF cross-sectional area, mm² (mean, SD)	7.29 ± 2.7	6.0 ± 2.1	8.0 ± 2.8	.02
RA muscle thickness, mm (median, IQR)	8.0 (3.4)	7.2 (2.1)	8.5 (3.0)	.10
EO muscle thickness, mm (mean, SD)	3.9 ± 1.0	3.6 ± 0.9	4.0 ± 1.1	.21
IO muscle thickness, mm (median, IQR)	5.8 (1.8)	5.5±1.3	6.5±2.0	.07
TA muscle thickness, mm (median, IQR)	3.8 (1.7)	3.7±1.0	4.0±1.1	.36
Anthropometric assessment				
Mid-arm circumference, cm (mean, SD)	29.0 ± 3.9	26.2 ± 3.5	30.3 ± 3.4	.001
Calf circumference, cm (median, IQR)	36.0 (8.0)	33.5±4.3	36.8±4.6	.03
Waist circumference, cm (mean, SD)	96.8 ± 12.2	92.5 ± 12.4	98.0 ± 11.7	.37
Hip circumference, cm (mean, SD)	104.6 ± 10.9	101.7 ± 10.0	105.8 ± 10.3	.27
Waist/hip ratio (median, IQR)	0.92 (0.14)	0.93 (0.21)	0.92 (0.13)	.70
Body mass index (kg/m²) (mean, SD)	29.5 ± 5.6	27.8 ± 4.4	30.4 ± 6.0	.33

ADL, activities of daily living; CFS, Clinical Frailty Scale; IADL, instrumental activities of daily living; IQR, interquartile range; MNA-SF, mininutritional assessment-short form; n, number; SD, Standard deviation.

is needed with further studies. Our data showed that multimorbidity increased the risk of PS independent of other variables. It is crucial that patients with multimorbidity who have had COVID-19 should also be evaluated regarding sarcopenia.

Bioelectrical impedance analysis is one of the reference methods used to evaluate sarcopenia. As ASMI obtained after BIA measurement indicates skeletal muscle mass, it is part of the algorithm for diagnosing sarcopenia.[2] In addition, the increased fat rate is one of the indirect indicators of the decrease in muscle mass.[22] In our study, the fat ratio and the ASMI measured by BIA were correlated

to the grip strength. It will be appropriate to evaluate sarcopenia in patients with COVID-19 with BIA, which is easy to perform.

An increasingly used technique to measure muscle mass in recent years is muscle ultrasonography. Evidence regarding the validity and reliability of ultrasound in demonstrating muscle mass is accumulating, despite the fact that it has not yet been included in the European Working Group on Sarcopenia in Older People (EGSWOP) guidelines. Although there are various publications about which muscle should be taken as a reference in muscle mass measurements performed with ultrasound, and what the

Table 3. Correlation Between Grip Strength and Other Characteristics		
	Grip Strength	
Characteristics	**Correlation Coefficient**	***P***
BIA assessment		
Fat (%)	−0.67	<.001
ASMI	0.58	<.001
Ultrasonographic assessment		
GC muscle thickness	0.42	.003
GC fascicle length	0.25	.09
GC pennate angle	0.19	.19
RF muscle thickness	0.52	<.001
RF cross-sectional area	0.53	<.001
RA muscle thickness	0.46	.001
EO muscle thickness	0.35	.01
IO muscle thickness	0.27	.06
TA muscle thickness	0.11	.44
Anthropometric assessment		
Mid-arm circumference	0.15	.30
Calf circumference	0.06	.67
Waist circumference	−0.07	.64
Hip circumference	−0.22	.13
Waist/hip ratio	0.01	.98
Body mass index	−0.16	.28
Other parameters		
Age	−0.35	.01
Drug number	−0.26	.07
CFS	−0.56	<.001
Gait speed	−0.66	<.001

ASMI, appendicular skeletal muscle index; CFS, Clinical Frailty Scale; EO, external abdominal oblique; GC, gastrocnemius; IO, internal abdominal oblique; RA, rectus abdominis; RF, rectus femoris; TA, transverse abdominis.

Table 4. Regression Analysis of Factors Affecting Probable Sarcopenia			
Characteristics	**OR**	**95% CI**	***P***
Sex	3.0	0.80-11.09	.10
Multimorbidity	3.9	1.06-14.30	.04

Model: age, sex, ICU stay, length of hospitalization, multimorbidity, polypharmacy, Clinical Frailty Scale.
ICU, intensive care unit; OR, odds ratio.

similar to other studies in the literature.[32] Unlike the literature, no difference was found in the measurements of abdominal muscles. This may be because young patients were included in the study. On the other hand, there was a correlation between the abdominal muscles and hand-grip strength in sarcoidosis patients with a mean age of 53.2 years.[16]

In the present study, RF MT and RF CSA measurements were correlated with grip strength. In the study conducted with COVID-19 patients hospitalized in the intensive care unit due to acute respiratory distress syndrome, the RF MT decreased in the follow-up.[33] In another study conducted on intensive care patients, RF MT and RF CSA were decreased.[34] There was also a decline in quadriceps muscle strength in patients with mild to moderate COVID-19.[35] Based on these data, *RF muscle mass measurements* can also be used to evaluate sarcopenia in COVID-19 patients.

Calf circumference is one of the anthropometric measurements used to diagnose sarcopenia and can be used to show muscle mass.[36,37] Another anthropometric measurement that can evaluate sarcopenia is the mid-arm circumference.[38] It successfully demonstrates sarcopenia in various disease groups.[39,40] Our results showed that calf and mid-arm circumferences in COVID-19 patients differed between PS and non-sarcopenic patients. These 2 anthropometric measurements should be kept in mind for evaluating sarcopenia in health centers where there are no devices that can evaluate muscle mass and strength.

Our study has several limitations. First, it is a single-center, cross-sectional study. The number of patients is relatively low, and this might change the statistical significance of some analysis between sarcopenia and other variables such as age, gender, polypharmacy, and so on. Second, the sarcopenia status of the patients before they had COVID-19 is unknown. Third, the cut-off values used to evaluate PS are the values determined to be used in older adults, but our study has patients of different age groups. These cut-off values may have caused the underdetection of PS in patients younger than 65 years.

cut-off values should be for the diagnosis of sarcopenia, a consensus has not been reached yet.[30,31] In the present study, GC MT and GC fascicle length, RF MT, and RF-CSA were found to be significantly lower in the PS group. There was no difference in the thickness of the abdominal muscles. Measurements from the lower extremity were

Ceylan et al. COVID-19 Survivors and Sarcopenia

Clin Sci Nutr 2022; 4(2): 46-53

As a result, the possibility of sarcopenia increases in patients with COVID-19, especially the group with multimorbidity should be evaluated in terms of sarcopenia to prevent adverse health outcomes related to sarcopenia.

REFERENCES

1. Santilli V, Bernetti A, Mangone M, Paoloni M. Clinical definition of sarcopenia. *Clin Cases Miner Bone Metab*. 2014;11(3):177-180. [CrossRef]
2. Cruz-Jentoft AJ, Bahat G, Bauer J, et al. Sarcopenia: revised European consensus on definition and diagnosis. *Age Ageing*. 2019;48(4):601. [CrossRef]
3. Xia L, Zhao R, Wan Q, et al. Sarcopenia and adverse health-related outcomes: an umbrella review of meta-analyses of observational studies. *Cancer Med*. 2020;9(21):7964-7978. [CrossRef]
4. Cruz-Jentoft AJ, Sayer AA. Sarcopenia. *Lancet*. 2019;393(10191):2636-2646. [CrossRef]
5. Piotrowicz K, Gąsowski J, Michel JP, Veronese N. Post-COVID-19 acute sarcopenia: physiopathology and management. *Aging Clin Exp Res*. 2021;33(10):2887-2898. [CrossRef]
6. Welch C, Greig C, Masud T, Wilson D, Jackson TA. COVID-19 and acute sarcopenia. *Aging Dis*. 2020;11(6):1345-1351. [CrossRef]
7. Wang PY, Li Y, Wang Q. Sarcopenia: an underlying treatment target during the COVID-19 pandemic. *Nutrition*. 2021;84:111104. [CrossRef]
8. Anker MS, Landmesser U, von Haehling S, Butler J, Coats AJS, Anker SD. Weight loss, malnutrition, and cachexia in COVID-19: facts and numbers. *J Cachexia Sarcopenia Muscle*. 2021;12(1):9-13. [CrossRef]
9. Arik G, Varan HD, Yavuz BB, et al. Validation of Katz index of independence in activities of daily living in Turkish older adults. *Arch Gerontol Geriatr*. 2015;61(3):344-350. [CrossRef]
10. Lawton MP, Brody EM. Assessment of older people: self-maintaining and instrumental activities of daily living. *Gerontologist*. 1969;9(3):179-186. [CrossRef]
11. Samuel R, Thomas E, Jacob KS. Instrumental Activities of Daily Living dysfunction among people with schizophrenia. *Indian J Psychol Med*. 2018;40(2):134-138. [CrossRef]
12. Bulbuloglu S, Kapikiran G. The effect of immunosuppressive therapy after liver transplantation on activities of daily living and fear of death during the COVID-19 pandemic. *Transpl Immunol*. 2021;69:101470. [CrossRef]
13. Rubenstein LZ, Harker JO, Salvà A, Guigoz Y, Vellas B. Screening for undernutrition in geriatric practice: developing the short-form mini-nutritional assessment (MNA-SF). *J Gerontol A Biol Sci Med Sci*. 2001;56(6):M366-M372. [CrossRef]
14. Johnston MC, Crilly M, Black C, Prescott GJ, Mercer SW. Defining and measuring multimorbidity: a systematic review of systematic reviews. *Eur J Public Health*. 2019;29(1):182-189. [CrossRef]
15. Rockwood K, Theou O. Using the clinical frailty scale in allocating scarce health care resources. *Can Geriatr J*. 2020;23(3):210-215. [CrossRef]
16. Eşme M, Karcıoğlu O, Öncel A, et al. Ultrasound assessment of sarcopenia in patients With sarcoidosis. *J Ultrasound Med*. 2022;41(4):951-959. [CrossRef]
17. Nijholt W, Scafoglieri A, Jager-Wittenaar H, Hobbelen JSM, van der Schans CP. The reliability and validity of ultrasound to quantify muscles in older adults: a systematic review. *J Cachexia Sarcopenia Muscle*. 2017;8(5):702-712. [CrossRef]
18. Perkisas S, Baudry S, Bauer J, et al. Application of ultrasound for muscle assessment in sarcopenia: towards standardized measurements. *Eur Geriatr Med*. 2018;9(6):739-757. [CrossRef]
19. Wilson A, Hides JA, Blizzard L, et al. Measuring ultrasound images of abdominal and lumbar multifidus muscles in older adults: A reliability study. *Man Ther*. 2016;23:114-119. [CrossRef]
20. Shahtahmassebi B, Hebert JJ, Hecimovich MD, Fairchild TJ. Associations between trunk muscle morphology, strength and function in older adults. *Sci Rep*. 2017;7(1):10907. [CrossRef]
21. Wu TJ, Huang JJ, Lin CY. Effects of fluid retention on the measurement of body composition using bioelectric impedance. *J Formos Med Assoc Taiwan Yi Zhi*. 1994;93(11-12):939-943.
22. Kyle UG, Bosaeus I, De Lorenzo AD, et al. Bioelectrical impedance analysis-part II: utilization in clinical practice. *Clin Nutr*. 2004;23(6):1430-1453. [CrossRef]
23. Kyle UG, Genton L, Hans D, Pichard C. Validation of a bioelectrical impedance analysis equation to predict appendicular skeletal muscle mass (ASMM). *Clin Nutr*. 2003;22(6):537-543. [CrossRef]
24. Welch C, Hassan-Smith ZK, Greig CA, Lord JM, Jackson TA. Acute sarcopenia secondary to hospitalisation - an emerging condition affecting older adults. *Aging Dis*. 2018;9(1):151-164.
25. Wierdsma NJ, Kruizenga HM, Konings LA, et al. Poor nutritional status, risk of sarcopenia and nutrition related complaints are prevalent in COVID-19 patients during and after

Clin Sci Nutr 2022; 4(2): 46-53

Ceylan et al. COVID-19 Survivors and Sarcopenia

hospital admission. *Clin Nutr ESPEN.* 2021;43:369-376. [CrossRef]

26. Paneroni M, Simonelli C, Saleri M, et al. Muscle strength and physical performance in patients without previous disabilities recovering From COVID-19 pneumonia. *Am J Phys Med Rehabil.* 2021;100(2):105-109. [CrossRef]

27. Kim J, Keshavjee S, Atun R. Trends, patterns and health consequences of multimorbidity among South Korea adults: analysis of nationally representative survey data 2007-2016. *J Glob Health.* 2020;10(2):020426. [CrossRef]

28. Veronese N, Smith L, Cereda E, et al. Multimorbidity increases the risk for sarcopenia onset: longitudinal analyses from the English Longitudinal Study of Ageing. *Exp Gerontol.* 2021;156:111624. [CrossRef]

29. Bustos-Vázquez E, Padilla-González E, Reyes-Gómez D, et al. Survival of COVID-19 with multimorbidity patients. *Healthcare (Basel, Switzerland).* 2021;9(11). [CrossRef]

30. Perkisas S, Bastijns S, Baudry S, et al. Application of ultrasound for muscle assessment in sarcopenia: 2020 SARCUS update. *Eur Geriatr Med.* 2021;12(1):45-59. [CrossRef]

31. Ozturk Y, Koca M, Burkuk S, et al. The role of muscle ultrasound to predict sarcopenia. *Nutrition.* 2022;101:111692. [CrossRef]

32. Minetto MA, Caresio C, Menapace T, et al. Ultrasound-based detection of low muscle mass for diagnosis of sarcopenia in older adults. *PM R J Inj Funct Rehabil.* 2016;8(5):453-462. [CrossRef]

33. Umbrello M, Guglielmetti L, Formenti P, et al. Qualitative and quantitative muscle ultrasound changes in patients with COVID-19-related ARDS. *Nutrition.* 2021;91-92:111449. [CrossRef]

34. de Andrade-Junior MC, de Salles ICD, de Brito CMM, Pastore-Junior L, Righetti RF, Yamaguti WP. Skeletal muscle wasting and function impairment in intensive care patients with severe COVID-19. *Front Physiol.* 2021;12:640973. [CrossRef]

35. Tanriverdi A, Savci S, Kahraman BO, Ozpelit E. Extrapulmonary features of post-COVID-19 patients: muscle function, physical activity, mood, and sleep quality. *Ir J Med Sci.* 2021:1-7.

36. Bahat G, Tufan A, Tufan F, K, et al. Cut-off points to identify sarcopenia according to European Working Group on Sarcopenia in Older People (EWGSOP) definition. *Clin Nutr (Edinburgh, Scotland).* 2016;35(6):1557-1563.

37. Hwang AC, Liu LK, Lee WJ, Peng LN, Chen LK. Calf circumference as a screening instrument for appendicular muscle mass measurement. *J Am Med Dir Assoc.* 2018;19(2):182-184. [CrossRef]

38. Landi F, Russo A, Liperoti R, et al. Midarm muscle circumference, physical performance and mortality: results from the aging and longevity study in the Sirente geographic area (ilSIRENTE study). *Clin Nutr.* 2010;29(4):441-447. [CrossRef]

39. Santos LAA, Lima TB, Ietsugu MDV, Nunes HRC, Qi X, Romeiro FG. Anthropometric measures associated with sarcopenia in outpatients with liver cirrhosis. *Nutr Diet.* 2019;76(5):613-619. [CrossRef]

40. Bataille S, Serveaux M, Carreno E, Pedinielli N, Darmon P, Robert A. The diagnosis of sarcopenia is mainly driven by muscle mass in hemodialysis patients. *Clin Nutr.* 2017;36(6):1654-1660. [CrossRef]

Evaluation of Using Dietary Supplements, Functional Foods and Herbal Products with Nutritional Habits of Individuals Diagnosed with COVID-19 Before, During, and After Disease

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ABSTRACT

Objective: This study aimed to evaluate the nutritional habits of individuals diagnosed with COVID-19 before, during, and after disease.

Methods: A total of 401 adult individuals, 125 males and 276 females, aged 19-65 years living in Turkey and diagnosed with COVID-19, were included in the study. The general and health information, anthropometric measurements, symptoms experienced during the disease, meal consumption, vitamin/mineral supplement use of functional foods and herbal products, and food consumption frequencies of the individuals were questioned by questionnaire form before, during, and after the COVID-19 disease.

Results: The mean age of the individuals diagnosed with COVID-19 was 29.7 ± 10.9 years. More than half of the individuals (57.1%) stated that they survived the disease at moderate or higher severity. More than half of the obese individuals (56.2%) survived the disease severely. More than half of the individuals (59.1%) stated that their appetite decreased during the disease. During the COVID-19 disease, more than 50% of individuals stated that there was no change in the consumption of milk, yogurt, eggs, meat/chicken, fish, legumes, oilseeds, green leafy vegetables, fast food, packaged food and there was an increase in consumption of fruit. It was determined that the use of at least one vitamin and mineral supplement during the disease (55.6%) increased compared to the pre-disease (38.4%). The most preferred vitamin and mineral supplements during the disease are vitamin C (41.1%) and multivitamin (18.2%). It was determined that all of the individuals (100%) used at least one functional food and herbal product during the disease. The functional foods and herbal products that increase in use during the disease are turmeric (28.2%), ginger (16.5%) and thyme (11.0%), respectively.

Conclusion: In the light of the study data, it was concluded that individuals used more vitamin and mineral supplements during disease preferred the use of more functional foods and herbal products, and increased their fruit consumption.

Keywords: COVID-19, functional foods, herbal product, nutritional habits, vitamin–mineral supplement

INTRODUCTION

Coronavirus disease-2019 (COVID-19) was first reported in Wuhan, China, in December 2019 and has caused many deaths and economic losses worldwide since then.[1] When coronavirus disease-related deaths have been investigated, it has been stated that death rates vary significantly by country, race, and socioeconomic level. Age, weak immune status, and the presence of a concomitant chronic disease have been shown to increase vulnerability to the disease.[2] Weakened immunity is an important risk factor for the development of infection by viruses that cause respiratory tract diseases. Providing adequate and balanced nutrition and improving nutritional status are very important to prevent infections. It has been stated

that especially in this period, unhealthy, inadequate, and unbalanced nutrition and vitamin and mineral deficiencies due to nutritional problems will increase the burden of COVID-19 disease.[3,4] In addition, some symptoms that develop in association with the disease may adversely affect the food intake and thus the nutritional status of individuals. Respiratory problems that prevent eating, such as coughing and shortness of breath; loss of taste and smell, which negatively affects appetite and desire to eat; increased body temperature, which suppresses nutritional needs and appetite and increases the inflammatory response; and fatigue and weakness, which negatively affect normal life activities such as food shopping and cooking, are among the most common symptoms of the disease.[4]

During the pandemic period, national and international organizations have talked about the importance of adequate and balanced nutrition in preventing disease and supporting the immune system. These organizations have emphasized taking adequate amounts from all food groups, increasing the consumption of fresh vegetables and fruits, ensuring daily fluid intake, maintaining a healthy body weight, sleeping adequately, and adopting a healthy lifestyle. Nutritional habits, food preferences, and food consumption amounts may change in individuals diagnosed with the disease, depending on the symptoms of the disease.[5,6] It is stated that the preference of use of vitamin, mineral, functional food, and herbal product support has increased in order to reduce the duration of illness and symptoms, especially in patients who continue to be treated at home.[7] However, there are no studies with a high level of evidence on the use of vitamin, mineral, functional food, and herbal product support during this pandemic period, and therefore, there is no recommended nutritional supplement. It is only recommended that nutrient deficiencies, if any, be eliminated and daily needs of individuals diagnosed with COVID-19 be met.[8,9]

When the literature is examined, it is seen that there are many studies evaluating the nutritional habits of healthy individuals during and after the pandemic but there is no study evaluating the nutritional habits of individuals diagnosed with COVID-19 before, during, and after the disease. We think that the results of this study, which aims to evaluate the eating habits of individuals diagnosed with COVID-19 before, during, and after illness, will contribute to the literature by filling this gap.

METHODS

This cross-sectional and descriptive study was conducted with 401 adult individuals at the ages of 19-65 years living in Turkey, who were diagnosed with COVID-19 and treated at home, between September and November 2021. Within the scope of the study, a web-based questionnaire was applied. Individuals diagnosed with COVID-19 and treated at home, who marked the statement

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Main Points

- During the pandemic period, there have been significant changes in the eating habits of individuals.

- During the pandemic period, the trend toward the use of vitamin–mineral support, functional food, and herbal products has increased in order to protect against COVID-19.

- During the pandemic period, individuals who survived COVID-19 displayed healthier eating habits during the disease.

"I voluntarily consent to participate in this study" at the beginning of the form and who completely filled out the questionnaire, constituted the sample of the study. Before starting the study, Ethics Committee Approval with decision number 703 dated September 29, 2021, was obtained from the Clinical Research Ethics Committee of the Faculty of Medicine at Akdeniz University. All procedures in the study were carried out in accordance with the Declaration of Helsinki.

With the help of the questionnaire, the socio-demographic characteristics of the individuals, their general and health information, anthropometric measurements, symptoms experienced during the disease, meal consumption before, during, and after the pandemic, vitamin/mineral support, functional food and herbal product use, and food consumption frequency were questioned.

Anthropometric Measurements
The anthropometric measurements (body weight and height) of the individuals were questioned based on their statement. Body mass index (BMI) was calculated by dividing the body weight by the square of the height. Those with a BMI below 18.50 kg/m^2 were classified as underweight, those with BMI between 18.50 and 24.99 kg/m^2 as normal, and those with BMI 25.0 kg/m^2 and above as overweight/obese.[10]

Nutrition Habits
Participants' appetite status, main and snack consumptions, food consumption frequencies, vitamin–mineral support, functional food and herbal product use were questioned.

Statistical Analysis
Statistical Package for the Social Sciences version 22.0. (IBM SPSS Corp.; Armonk, NY, USA) program was used in the statistical evaluation of the data obtained from the study. Data were expressed using mean and standard deviation for quantitative variables and using frequency and percentage for qualitative variables. The chi square analysis was employed to compare qualitative data and to detect differences between the groups. Changes in meal consumption status were determined using the McNemar Test, which is a dependent paired sample test. The results were evaluated at the 95% CI, and statistically at $P < .05$ significance level.

RESULTS

The general characteristics of the individuals included in the study, their health information, and the evaluation of the disease severity are shown in Table 1. Of the participating individuals diagnosed with COVID-19, 31.2% were

Table 1. Evaluation of the General Characteristics, Health Information, and Disease Severity of Individuals	
Variables	X ± SD
Age (years)	29.7 ± 10.9
	N (%)
Gender	
Female	276 (68.8)
Male	125 (31.2)
Diagnosed chronic disease	
Yes	73 (18.2)
No	328 (81.8)
Diabetes mellitus	6 (1.5)
Hypertension	16 (4.0)
Cancer	5 (1.2)
Kidney	5 (1.2)
Asthma or COPD	23 (5.7)
Allergy	25 (6.2)
Severity of the disease	
Very mild	57 (14.2)
Mild	115 (28.7)
Moderate	152 (37.9)
Severe	73 (18.2)
Very severe	4 (1.0)

SD, standard deviation.
In the chronic diseases section, individuals stated more than one disease.

male (n = 125), 68.8% were female (n = 276), and their mean age was 29.7 ± 10.9 years. Of the individuals, 18.2% had a diagnosed chronic disease. Allergy (6.2%) and asthma/Chronic obstructive pulmonary disease (COPD) (5.7%) had the highest rates among comorbidities. More than half of the patients (57.1%) stated that they survived the disease moderately, severely, and very severely.

The evaluation of the disease severity according to the BMI classification of the individuals, their appetite status, and the symptoms they experienced during the disease is shown in Table 2. More than half of the overweight/obese individuals (56.2%) stated that they experienced the disease severely. During the illness, weakness and fatigue (77.3%), headache (65.8%), loss of taste and smell (63.3%), joint and muscle pain (58.1%), and back pain

(54.6%) were found to be the most common symptoms (data were not shown in the table). When the frequency of symptoms was evaluated according to BMI classification, a significant difference was found between the groups in terms of headache and muscle pain ($P < .05$). When the appetite status of the individuals was evaluated, more than half (59.1%) stated that their appetite decreased during the disease (data were not shown in the table). When the appetite status was evaluated according to BMI classification, although the decrease (51.1%) and increase (53.6%) in the appetite status of individuals with normal weight were found to be higher, no significant difference was found between the groups ($P > .05$).

The evaluation of the consumption of main meals and snacks before, during, and after the disease is shown in Table 3. It was found that the main meal consumption of individuals during the illness was lower than that before and after the illness, but a statistically significant difference was found only for the dinner ($P < .05$).

The evaluation of individuals' consumption of various food groups during the illness is given in Table 4. It was determined that there was no change in the consumption of milk, yogurt, eggs, meat/chicken, fish, legumes, oilseeds, green leafy vegetables, fast food, and packaged food, and there was an increase in fruit consumption in more than 50% of the individuals during the disease.

The evaluation of individuals' use of vitamin and mineral supplements before, during, and after the disease is shown in Table 5. It was determined that the use of at least 1 vitamin and mineral supplement increased during the disease (55.6%) compared to the pre-disease period (38.4%), and although it tended to decrease after the disease, it was more (51.6%) compared to the pre-disease period ($P < .05$). The most preferred vitamin and mineral supplement during the disease was detected to be vitamin C (41.1%) and multivitamin (18.2%).

The evaluation of the individuals' use of functional food and herbal products before, during, and after the disease is shown in Table 6. It was revealed that all individuals (100%) used at least 1 functional food and herbal product during the disease. Although they preferred functional foods before the illness, the functional foods and herbal products that increased in use during illness were curcuma (28.2%), ginger (16.5%), and thyme (11.0%), respectively.

DISCUSSION

Adequate and balanced nutrition has an important place in the prevention and management of viral respiratory tract infections and in the fight against COVID-19 due to

Table 2. The Evaluation of the Severity of Recovery, Appetite Status, and the Symptoms Experienced During the Disease of the Individuals According to the Body Mass Index Classification

Severity of recovery	Underweight	Normal Weight	Overweight/ Obese	χ^2; P
	N (%)	N (%)	N (%)	
Very mild (n=57)	2 (7.0)	33 (57.9)	20 (35.1)	17.207; **.028***
Mild (n=115)	10 (8.7)	66 (57.4)	39 (33.9)	
Moderate (n=152)	13 (8.6)	85(55.9)	54 (35,5)	
Severe (n=73)	3 (4.1)[a, b]	29 (39.7)[b]	41(56.2)[a]	
Very severe (n=4)	-	-	4 (100)	
Symptoms during disease				
Cough (n=179)	17 (9.5)	92 (51.4)	70 (39.1)	1.944; .378
Shortness of breath (n=81)	5 (6.2)	37 (45.7)	39 (48.1)	3.260; .196
Nasal congestion (n=161)	15 (9.3)	88 (54.7)	58 (36.0)	32.110; .348
Loss of taste and smell (n=254)	17 (6.7)	134 (52.8)	103 (40.6)	0.825; .662
Headache (n=264)	27 (10.2)[a]	135 (51.1)[b]	102 (38.6)[b]	8.474; **.014***
Joint pain (n=233)	18 (7.7)	117 (50.2)	98 (42.1)	1.924; .382
Back pain (n=219)	18 (8.2)	108 (49.3)	93 (42.5)	2.814; .245
Muscle pain (n=191)	17 (8.9)[a,b]	89 (46.6)[b]	85 (44.5)[a]	6.310; **.043***
Weakness and fatigue (n=310)	25 (8.1)	161 (51.9)	124 (40.0)	1.104; .576
Appetite status				
Increased (n=28)	-	15 (53.6)	13 (46.4)	4.194; .380
Decreased (n=237)	18 (7.6)	121 (51.1)	98 (41.4)	
Not changed (n=135)	12 (8.9)	76 (56.3)	47 (34.8)	

Chi square test, *P < .05; [a,b]For groups of different letters P < .05, for groups of same letters P > .05.
Individuals stated more than one symptom in the symptoms experienced during the disease.

Table 3. The Evaluation of the Consumption of Main Meals and Snacks of Individuals Before, During, and After the Disease

	Breakfast	Lunch	Dinner
	N (%)	N (%)	N (%)
Before disease	338 (84.3)	245 (61.1)	379 (94.5)[a]
During disease	323 (80.5)	227 (56.6)	362 (90.3)[b]
After disease	328 (81.8)	241 (60.1)	380 (90.8)[c]
	Mid-morning	**Afternoon**	**Night**
	N (%)	N (%)	N (%)
Before disease	63 (15.7)	241 (60.1)	179 (44.6)[a]
During disease	77 (19.2)	222 (55.4)	146 (36.4)[b]
After disease	55 (13.7)	231 (57.6)	184 (45.9)[c]

McNemar test; a, b for groups of different letters P < .05, for groups of same letters P > .05.

the effects of individuals' nutritional habits and nutritional status on the immune response.[11] Especially during the pandemic period, individuals make changes in their dietary

Table 4. The Evaluation of Individuals' Consumption of Various Food and Food Groups During the Disease

Various Food and Food Groups	Increased	Decreased	Not changed
	N (%)	N (%)	N (%)
Milk	68 (17.0)	84 (20.9)	249 (62.1)
Yogurt	130 (32.4)	71(17.7)	200 (49.9)
Egg	91 (22.7)	91 (22.7)	219 (54.6)
Meat/chicken	100 (24.9)	89(22.2)	212 (52.9)
Fish	57 (14.2)	81 (20.2)	263(65.6)
Legumes (chickpeas, lentils, beans, kidney beans)	48 (12.0)	92 (22.9)	261(65.1)
Nuts and oilseed (hazelnuts, peanuts, almonds, walnuts)	99 (24.7)	87 (21.7)	215 (53.6)
Green leafy vegetables	120 (29.9)	76 (19.0)	205 (51.1)
Fruits	217 (54.1)	51(12.7)	133 (33.2)
Fast food (lahmacun, hamburger, pide, etc.)	27 (6.7)	157(39.2)	217(54.1)
Packaged foods (biscuits, cake, chocolate, etc.)	36 (9.0)	157 (39.2)	208 (51.9)

Table 5. The Evaluation of Individuals' Use of Vitamin and Mineral Supplements Before, During, and After the Disease

Use of Vitamin and Mineral Supplements	Before Disease	During Disease	After Disease
	N (%)	N (%)	N (%)
At least 1 vitamin and mineral supplement	150 (38.4)[a]	263 (55.6)[b]	207 (51.6)[b]
Multivitamin	31 (7.7)	73 (18.2)	43 (10.7)
Vitamin C	57 (14.2)	165 (41.1)	119 (29.7)
Vitamin D	43 (10.7)	22 (5.5)	36 (9.0)
Vitamin B_{12}	14 (3.5)	1 (0.2)	7 (1.7)
Iron	1 (0.2)	-	1 (0.2)
Zinc	1(0.2)	-	-
Calcium	1(0.2)	1 (0.2)	-
Omega 3	2 (0.5)	1 (0.2)	1 (0.2)

Chi square test, [a,b]For groups of different letters $P < .05$, for groups of same letters $P > .05$.

habits in order to protect themselves from the effects of the disease and to overcome the disease mildly.[12,13]

In order to ensure adequate and balanced nutrition during the pandemic period, national and international

Table 6. The Evaluation of the Individuals' Use of Functional Food and Herbal Products Before, During, and After the Disease

Use of Functional Food and Herbal Products	Before Disease	During Disease	After Disease
	N (%)	N (%)	N (%)
At least 1 functional food and herbal product	321 (80.0)[a]	401 (100)[b]	385 (96.0)[b]
Curcumin	59 (14.7)	113 (28.2)	67 (16.7)
Ginger	37 (9.2)	66 (16.5)	95 (23.7)
Thyme	41 (10.2)	44 (11.0)	40 (9.9)
Thyme oil	18 (4.5)	16 (4.0)	12 (2.9)
Black elderberry	3 (0.7)	1 (0.2)	6 (1.5)
Lemon	53 (13.2)	49 (12.2)	45 (11.2)
Honey	171 (42.6)	98 (24.4)	110 (27.4)

Chi square test, [a,b]For groups of different letters $P < .05$, for groups of same letters $P > .05$.
Individuals indicated more than one option.

organizations have specified that it is important to include fruit, vegetables, whole grain products, high protein foods (legumes, meat, eggs, fish, chicken, oilseeds, etc.), and dairy products (milk, yogurt, ayran, cheese, etc.) in daily nutrition. In addition, they have recommended limiting daily caffeine consumption and avoiding consumption of sugary and carbonated beverages and packaged foods with high trans-fat content.[14] When studies examining the nutritional habits of individuals in the pandemic are examined, it is seen that there is an increase especially in fruit consumption.[15-17] The results of the present study are consistent with the literature, and it was determined in the study that there was an increase in fruit consumption of individuals during the disease. Although there are studies in the literature indicating that the consumption of foods cooked with the frying method, sugary/carbonated beverages, packaged foods such as sweets, chocolate, cake, and biscuits, and some unhealthy foods such as fast food has increased in this period,[18,19] our study revealed no change in the consumption of fast food and packaged food in more than 50% of individuals during the disease. In studies evaluating the frequency of consumption of main meals and snacks during the pandemic period, it was reported that individuals increased the frequency of snack consumption,[20-22] and particularly, breakfast from the main meals was skipped.[23] In the present study, it was found that the consumption of main (breakfast, lunch, and dinner) and snack (night and afternoon) meals, except for late-morning meal, was lower during the illness than that before and after the illness. The main reason for this is that the loss of taste and smell, which is among the symptoms that occur in patients due to the disease, suppresses the appetite and reduces the desire to eat.[4] According to the results of the study, it was found that more than half of the patients (63.3%) experienced loss of taste and smell.

There are studies conducted on the potential interactions between nutrition and the immune system during the pandemic period.[24] The role of vitamins, minerals, and some functional nutrients and herbal products has been mentioned more in order to protect from the effects of the disease, to reduce the negative effects of the disease on health, and to overcome the symptoms in the mildest way possible during the disease.[25] In studies in which the effect of micronutrient supplementation such as vitamin D, B_{12}, vitamin C, zinc, and magnesium has found to increase immune function in individuals diagnosed with COVID-19, it should be noted that although the supplement has been found to have a positive effect on some symptoms of the disease, the level of evidence is low.[26-31] In this study, it was determined that the use of at least 1 vitamin and mineral supplement during the disease (55.6%) increased compared to the pre-disease period (38.4%), and although it tended to decrease after

the disease, it was still higher (51.6%) compared to the pre-disease period. It was found that the most preferred vitamin and mineral supplements during the disease were vitamin C (41.1%) and multivitamin (18.2%), respectively.

Clinical studies are being conducted to evaluate the long-term effects of bioactive components in functional foods and herbal products, as well as vitamin and mineral supplements, during the pandemic.[32,33] In the studies carried out, it has been stated that individuals consider functional foods and some herbal products to be effective in protecting against the effects of diseases related to COVID-19.[33,34] In the present study, it was detected that all of the individuals (100%) used at least 1 functional food and herbal product during the disease. Although they preferred functional foods before the illness, the functional foods and herbal products that increased in use during illness were curcuma (28.2%), ginger (16.5%), and thyme (11.0%).

The pandemic period has caused two-way changes in the eating habits of individuals, as positive and negative. In this study, it was determined that there were some changes in the eating habits of COVID-19 patients during the disease process, compared to before and after the disease. In particular, it was concluded that individuals used more vitamin and mineral supplements during illness, preferred the use of more functional foods and herbal products, and increased their fruit consumption.

REFERENCES

1. Nicola M, Alsafi Z, Sohrabi C, et al. The socio-economic implications of the coronavirus pandemic (COVID-19): a review. *Int J Surg*. 2020;78:185-193. [CrossRef]

2. Im JH, Je YS, Baek J, Chung MH, Kwon HY, Lee JS. Nutritional status of patients with COVID-19. *Int J Infect Dis*. 2020;100:390-393. [CrossRef]

3. Calder PC, Carr AC, Gombart AF, Eggersdorfer M. Optimal nutritional status for a well-functioning immune system is an important factor to protect against viral infections. *Nutrients*. 2020;12(4):1181. [CrossRef]

4. Holdoway A. Nutritional management of patients during and after COVID-19 illness. *Br J Community Nurs*. 2020;25(Sup8):S6-S10. [CrossRef]

5. Macİt MS. Covid-19 Salgını Sonrası Yetişkin Bireylerin Beslenme Alışkanlıklarındaki Değişikliklerin Değerlendirilmesi. *Mersin Univ Sağlık Bilimleri Derg*. 2020;13(3):277-288. [CrossRef]

6. Erdoğan R. Pandemi Döneminde Beden Eğitimi ve Spor Yüksekokulu Öğrencilerinin Beslenme Alışkanlıkları ve Fiziksel Aktivite Düzeylerinin Belirlenmesi. *Opus Int J Soc Res*. 2021;17(Özel Sayısı):3276-3295. [CrossRef]

7. El Sayed SM, Aboonq MS, El Rashedy AG, et al. Promising preventive and therapeutic effects of TaibUVID nutritional supplements for COVID-19 pandemic: towards better public prophylaxis and treatment (A retrospective study). *Am J Blood Res*. 2020;10(5):266-282.

8. Sönmez NN, Beyhan Y. COVID-19: Beslenme Stratejileri, Kılavuzlar ve Öneriler. *Haliç Univ Sağlık Bilimleri Derg*. 2021;4(3):159-171. [CrossRef]

9. Daziroğlu Meç YM, Akbulut G. COVID-19 Pandemisine Diyetetik Bakış: Besin, Besin Destekleri ve Tıbbi Beslenme Tedavisi. *ERÜ Sağlık Bilimleri Fak Derg*. 2021;8(1):13-22.

10. Gibson RS, Gibson RS. *Principles of Nutritional Assessment*. USA: Oxford University Press; 2005.

11. Özsoy S, Saka M. COVID-19 Tanılı Yoğun Bakım Hastalarında Omega-3 Çoklu Doymamış Yağ Asitleri Desteğinin Etkileri. *J Nutr Diet*. 2021;49(2):65-72. [CrossRef]

12. Di Renzo L, Gualtieri P, Pivari F, et al. Eating habits and lifestyle changes during COVID-19 lockdown: an Italian survey. *J Transl Med*. 2020;18(1):229. [CrossRef]

13. Sidor A, Rzymski P. Dietary choices and habits during COVID-19 lockdown: experience from Poland. *Nutrients*. 2020;12(6). [CrossRef]

14. Angelidi AM, Kokkinos A, Katechaki E, Ros E, Mantzoros CS. Mediterranean diet as a nutritional approach for COVID-19. *Metabolism*. 2021;114:154407. [CrossRef]

15. Pietrobelli A, Pecoraro L, Ferruzzi A, et al. Effects of COVID-19 lockdown on lifestyle behaviors in children with obesity living in Verona, Italy: a longitudinal study. *Obesity (Silver Spring)*. 2020;28(8):1382-1385. [CrossRef]

16. Ruiz-Roso MB, de Carvalho Padilha P, Mantilla-Escalante DC, et al. Covid-19 confinement and changes of adolescent's dietary trends in Italy, Spain, Chile, Colombia and Brazil. *Nutrients*. 2020;12(6). [CrossRef]

17. Rodríguez-Pérez C, Molina-Montes E, Verardo V, et al. Changes in dietary behaviours during the COVID-19 outbreak confinement in the Spanish COVIDiet study. *Nutrients*. 2020;12(6):1-19. [CrossRef]

18. Deschasaux-Tanguy M, Druesne-Pecollo N, Esseddik Y, et al. Diet and physical activity during the COVID-19 lockdown period. Results from the French NutriNet-Sante cohort study. *medRxiv*;2020.

19. Pellegrini M, Ponzo V, Rosato R, et al. Changes in weight and nutritional habits in adults with obesity during the "lockdown" period caused by the COVID-19 virus emergency. *Nutrients*. 2020;12(7):1-11. **[CrossRef]**

20. Scarmozzino F, Visioli F. Covid-19 and the subsequent lockdown modified dietary habits of almost half the population in an Italian sample. *Foods*. 2020;9(5):675. **[CrossRef]**

21. Sidor A, Rzymski P. Dietary choices and habits during COVID-19 lockdown: experience from Poland. *Nutrients*. 2020;12(6):1657. **[CrossRef]**

22. Mehta V. The Impact of COVID-19 on the dietary habits of middle-class population in Mulund, Mumbai, India. *AIJR Prepr*. 2020;1(10).

23. Husain W, Ashkanani F. Does COVID-19 change dietary habits and lifestyle behaviours in Kuwait: a community-based cross-sectional study. *Environ Health Prev Med*. 2020;25(1):61. **[CrossRef]**

24. Childs CE, Calder PC, Miles EA. Diet and immune function. *Nutrients*. 2019;11(8):1933. **[CrossRef]**

25. Santos HO, Tinsley GM, da Silva GAR, Bueno AA. Pharmaconutrition in the clinical management of COVID-19: a lack of evidence-based research but clues to personalized prescription. *J Pers Med*. 2020;10(4):145. **[CrossRef]**

26. Oristrell J, Oliva JC, Casado E, et al. Vitamin D supplementation and COVID-19 risk: a population-based, cohort study. *J Endocrinol Invest*. 2022;45(1):167-179. **[CrossRef]**

27. Kumari P, Dembra S, Dembra P, et al. The role of vitamin C as adjuvant therapy in COVID-19. *Cureus*. 2020;12(11): e11779. **[CrossRef]**

28. Kieliszek M, Lipinski B. Selenium supplementation in the prevention of coronavirus infections (COVID-19). *Med Hypotheses*. 2020;143:109878. **[CrossRef]**

29. Chinni V, El-Khoury J, Perera M, et al. Zinc supplementation as an adjunct therapy for COVID-19: challenges and opportunities. *Br J Clin Pharmacol*. 2021;87(10):3737-3746. **[CrossRef]**

30. Tang CF, Ding H, Jiao RQ, Wu XX, Kong LD. Possibility of magnesium supplementation for supportive treatment in patients with COVID-19. *Eur J Pharmacol*. 2020;886:173546. **[CrossRef]**

31. Tan CW, Ho LP, Kalimuddin S, et al. Cohort study to evaluate the effect of vitamin D, magnesium, and vitamin B12 in combination on progression to severe outcomes in older patients with coronavirus (COVID-19). *Nutrition*. 2020;79-80:111017. **[CrossRef]**

32. Hibino S, Hayashida K. Modifiable Host Factors for the Prevention and Treatment of COVID-19: Diet and Lifestyle/Diet and Lifestyle Factors in the Prevention of COVID-19. *Nutrients*. 2022;14(9). **[CrossRef]**

33. Kamarli Altun H, Karacil Ermumcu MS, Seremet Kurklu N. Evaluation of dietary supplement, functional food and herbal medicine use by dietitians during the COVID-19 pandemic. *Public Health Nutr*. 2021;24(5):861-869. **[CrossRef]**

34. Omer AK, Khorshidi S, Mortazavi N, Rahman HS. A review on the antiviral activity of functional foods against COVID-19 and viral respiratory tract infections. *Int J Gen Med*. 2022;15:4817-4835. **[CrossRef]**

Frequently Asked Questions and Current Answers to the KEPAN Nursing Study Group by Nutrition Nurses Working in Turkey

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ABSTRACT

Nutrition therapy is a critical intervention in the continuation of vital functions for patients whose nutritional needs cannot be met via normal nutrition. In recent years, thanks to the developments in medicine and technology, enteral and parenteral nutrition has been widely used. Nutrition therapy requires good care and teamwork at the beginning, treatment process and termination stages. The aim of this review is to provide information in line with the current literature on the issues of nutritional care practices, about which nurses working in nutrition units in Turkey are often curious. In addition, this review aims to raise awareness about the duties and responsibilities of nurses in nutritional therapy, who are members of the nutritional support team.

Keywords: Enteral nutrition, nursing, nutritional care, parenteral nutrition

INTRODUCTION

Nutrition is a mandatory action to take the nutrients needed by the body in sufficient quantities and at appropriate times in order to protect and improve health and the quality of life.[1] Mortality and morbidity rates are higher in patients who do not have adequate and balanced nutrition.[1] Nutritional therapy is applied for patients in cases in which nutrition cannot be achieved naturally or energy and calorie intake is insufficient due to various factors such as cancer, trauma, chronic diseases, and surgical interventions.[1,2] Factors such as increased average life expectancy in the world and in our country, increased incidence of chronic diseases, increased life expectancy with chronic diseases, and surgical interventions have led to an increase in the number of patients in need of nutritional therapy.[2-6] Nursing care has an important place in the safe application of enteral nutrition (EN) or parenteral nutrition (PN) treatments and in the follow-up of patients.[7] Responsibilities and duties of nurses related to nutritional therapy differ among countries and even among institutions.[6-8] While the duties and responsibilities of nutrition nurses in Europe have been defined, the duties and responsibilities of certified nutrition nurses related to the nursing care in nutritional therapy have not been defined

in our country.[7,9,10] This may cause nutrition nurses to experience dilemmas in clinical practice and patient care. Currently, according to the Regulation on the Amendment of the Nursing Regulation published in the official gazette in our country in 2011, intensive care nurses are responsible for determining the nutritional needs of the patients (enteral and parenteral nutrition), planning and implementing the nursing care according to their needs, and ensuring the continuity of the sterilization of the devices used in nutrition.[11]

Nurses have important responsibilities in the follow-up of patients receiving nutritional therapy and in observing and recording treatment-related complications. With an effective nursing care, nutritional therapy can be applied correctly and effectively, and the development of complications in the patient can be prevented.[7,12] In this direction, a Nursing Study Group was formed under the Turkish Society of Clinical Enteral and Parenteral Nutrition (KEPAN) in 2015, and studies were initiated to standardize the practices of nurses working in nutrition units in Turkey in line with the literature. The administrative staff of the study group consists of experienced nutrition nurses working in the clinical nutrition unit and doing clinical research in the field and academic nurses. Within the scope of

Uzunoğlu et al. Frequently Asked Questions about Nutritional Treatment

Clin Sci Nutr 2022; 4(2): 61-65

the scientific activities of the study group, training programs are organized for nutrition nurses. In addition to these trainings, a mobile messaging application group (Nutrition Nurses WhatsApp group) was established by the members of the KEPAN Nursing Study Group, where nutrition nurses can ask questions to be answered by the members of the study group across Turkey. This platform has been actively used since 2015 and is currently in contact with approximately 300 nurses. Moreover, nutrition nurses working in various cities of Turkey can reach the KEPAN Nursing Study Group via e-mail. In this review, 11 questions most frequently asked by nutrition nurses in the Nutrition Nurses WhatsApp group and via e-mail were answered in line with the studies and guidelines in the literature. In this respect, it is thought that this article can be a resource that nutrition nurses can refer to in cases they encounter frequently in practice.

Frequently Asked Questions on Enteral Nutrition

Nutrition nurses directed some situations that they encountered and hesitated during their routine work in the clinic to the Nutrition Nurses WhatsApp group and the KEPAN Nursing Study Group via e-mail. Based on the current literature, these questions were answered by the study group, and the questions and answers were recorded. According to incoming data, nutritional nurses frequently ask 7 questions about EN. Five of these questions are about the administration of enteral nutrition therapy and the other 2 are about the complications of EN therapy.

How Should the Water Need of the Enterally Fed Patient Be Met?
The amount of fluid needed by the patient is calculated by the physician considering the patient's weight, the number of calories given, the current disease, and clinical condition. However, the liquid ratio of the given product and also the amount of the water to be used for diluting the drugs and washing the tube should be considered.[1,4,5]

What Are the Findings That the Nurse Should Observe Regarding Fluid–Electrolyte Imbalance in an Enterally Fed Patient?
In enterally fed patients, symptoms such as edema or dehydration signs, muscle twitches or spasms, dryness of the mucous membrane, and changes in consciousness may occur due to fluid–electrolyte imbalance.[6-10] Nurses should observe patients in terms of such findings, monitor vital signs, amount of fluid intake and loss, diarrhea, vomiting, fistula or ostomy outputs, daily weight changes, and laboratory findings and inform the nutrition team.[6,7,12,13]

When Can the Feeding of Patient Be Started After the Percutaneous Endoscopic Gastrostomy tube is placed?
There is no consensus regarding the time to start feeding after percutaneous endoscopic gastrostomy is opened. The traditional approach in clinics tends to start enteral feeding 24 hours after percutaneous endoscopic gastrostomy is opened. In a meta-analysis study, it was stated that starting enteral nutrition in the early and late periods did not differ in terms of the development of complications.[13] Due to the results showing that early initiation of nutrition is safe for patients, the nutrition is well tolerated, and the length of hospital stay is shortened, it is recommended to start feeding in ≤4 hours according to the American Society of Parenteral and Enteral Nutrition (ASPEN) guideline and after 2-4 hours according to the European Society for Clinical Nutrition and Metabolism guideline.[14-16]

What Should Be Considered When Administering Drugs From Percutaneous Endoscopic Gastrostomy?
Drug-related properties such as the suitability of the drug that will be given through the gastrostomy tube for being administered with the nutritional product, the stability of the drug, possible drug interactions, the diameter of the feeding tube, and the position of the tube should also be evaluated.[12] The following American Society of Parenteral and Enteral Nutrition recommendations should be considered when administering medication from the gastrostomy tube.[15]

- Medication should not be added directly into the enteral nutrition product.
- Opinion of the clinical pharmacist should be sought regarding the form, side effects, and interaction of the drug requested by the physician with the enteral product given to the patient.

Main Points

- The KEPAN Nursing Study Group aims to provide evidence-based and standardized nursing care for patients receiving nutritional therapy. For this reason, a WhatsApp group has been established with nurses working in Turkey to provide information exchange among nurses, and the group's executive board makes literature-based explanations on issues about which nurses have difficulty in clinical care.

- In this communication process, it has been revealed that some topics are widely wondered by nutrition nurses and that there is no resource that can be presented as a guideline in this field.

- It is expected that this review will be a resource frequently used by nutrition nurses and will pave the way for nursing studies in this field.

- Each drug should be administered separately through the feeding tube.
- If possible, liquid dosage forms of drugs should be used.
- Immediate-release solid dosage forms approved for enteral administration according to the pharmacist's instructions may be used. Drug preparation techniques may include:

  - crush the simple compressed tablets into a fine powder and mix them with purified water;
  - open the hard gelatin capsules and mix the powder containing the immediate-release drug with pure water.

- Drugs should not be mixed together.
- Only clean enteral syringes (≥20 mL) should be used to administer drugs via the enteral route.
- Appropriate tube irrigation should be performed in drug administration:

  - stop feeding and flush the tube with at least 15 mL of distilled water before administering medication;
  - administer the drug using a clean enteral syringe;
  - re-wash the tube with at least 15 mL of distilled water, taking into account the patient's volume status;
  - administer the next medicine;
  - rinse the tube one last time with at least 15 mL of distilled water.

- Oral syringes labeled "for oral use only" should be used for drug administration through the feeding tube.
- Enteral nutrition therapy can be delayed for 30 minutes or more, when appropriate, to prevent changes in the bioavailability of the drug.
- In cases of doubt about drug administration, it is a correct approach not to administer the drug until certain information is obtained.

How Often Should Gastric Residual Volume Monitoring Be Performed in Intensive Care Patients?

There is no clear consensus on the threshold value, monitoring frequency and protocol of GRV in current studies and guidelines. Moreover, studies at the level of evidence directly linking GRV and aspiration pneumonia are not sufficient. Although it is considered that GRV monitoring is not required routinely in the care of critically ill patients, ASPEN recommends that patients be evaluated for gastrointestinal intolerance every 4 hours and that the GRV threshold value be considered as >500 mL, taking into account other intolerance findings such as nausea, vomiting, and abdominal distension.[15] Similarly, the European Society of Intensive Care Medicine recommends adding prokinetic agents to the treatment plan in cases where GRV is >500 mL, reducing the nutrition rate by half by

evaluating other intolerance findings and rechecking it every 6 hours.[17]

Can the Patient Be in the Prone Position During the Enteral Nutrition Process?

It is recommended that the patient's head be elevated 30-45° during enteral nutrition.[15] However, if the patient's condition requires feeding in the prone position, EN can also be provided in this way.[18] In a systematic review by Machado et al.[19] in which they investigated the effect of prone position on GRV and other clinical outcomes in adult and pediatric patients hospitalized in tertiary intensive care unit, 2 of the 4 studies did not show any difference in GRV in prone and supine positions [Van der Voort and Zandstra[20] Lucchini et al[21]]. In 1 study, GRV was reported to be higher in the prone position[22] and in another study, GRV was higher in the supine position.[23] Feeding in the prone position alone is not a contraindication or limitation for EN.[24] Oral hygiene of the patient should be ensured, an evaluation should be made every 4 hours in terms of intolerance, and prokinetic agents should be considered if clinically necessary.[17] Post pyloric tube feeding should be preferred in patients with a high risk of aspiration or with high GRVs.[15]

Frequently Asked Questions About Parenteral Nutrition

Nutrition nurses consulted the KEPAN Nursing Study Group via the Nutrition Nurses WhatsApp group and e-mail about some of the situations that they encountered and hesitated about PN during their routine work in the clinic. Based on the current literature, these questions were answered, and the questions and answers were recorded. Four frequently asked questions about PN from nutrition nurses and their answers are given below.

Can the Port Be Used for Parenteral Nutrition?

Parenteral nutrition therapy can be provided by peripheral or central venous access, depending on the osmolarity of the nutritional solution and the duration of PN. In cases where the osmolarity of the PN solution is above 900 mOsm/L and PN is required for a long time (more than 10-14 days), PN therapy can be applied through implanted ports through the central venous access routes.[9,10,17,25]

What Should Be Done in Case of Extravasation During Parenteral Nutrition?

In order to prevent the development of extravasation, the catheter insertion site should be evaluated at least once a day for symptoms such as pain, tenderness along the

Uzunoğlu et al. Frequently Asked Questions about Nutritional Treatment

Clin Sci Nutr 2022; 4(2): 61-65

vein, redness and warmth before PN treatment, and more frequently in the first hours of the day when nutritional therapy is started. It is recommended that the peripheral venous route be observed at 30-minute intervals and the central venous route at 1-hour intervals for the development of complications, especially during the use of 2-in-1 PN solutions.[26]

In the safe application of parenteral nutrition therapy, maintaining the patency of the venous access in catheter care and observing the catheter insertion site for catheter-related complications are important nursing interventions. When extravasation findings are detected, the infusion of the nutritional product is stopped immediately.[26-28] The site should be followed up for redness, pain, etc. Dermatology consultation may be requested.[26-28] Methods such as local cold application and lotion or cream application may be preferred.[17]

What Should Be Considered in the Filling and Transportation of Parenteral Nutrition Products?

According to the "Guideline for Safe Practices for Parenteral Nutrition" prepared by the Republic of Turkey Ministry of Health, PN solutions should be prepared under the responsibility of the pharmacist. In the clinical setting, PN bags can be stored on the shelf of the refrigerator for 6 days at 4°C and for 24 hours at room temperature, as long as their asepsis is intact. Manufacturer's recommendations should be taken into account for ready-to-use commercial products. ıntra-venous is attached to the PN bag or if a drug that will destabilize within 24 hours (trace element, phosphorus, etc.) is added to the bag, the bag should be used within 24 hours. Parenteral nutrition solutions should be placed in closed and locked trolleys and sent to clinics and delivered by signature.[29]

CONCLUSION

The Turkish Society of Clinical Enteral and Parenteral Nutrition Nursing Study Group aims to continue its studies for the realization of nutritional care practices in line with the information having high level of evidence in the light of the literature. In this review, the questions frequently asked to the study group by the nutrition nurses in our country were determined and the answers to these questions were compiled. In this direction, it is thought that this review will guide the nurses working in the nutrition units for the safe application of nutritional therapy.

REFERENCES

1. Sobotka L. *Basics in Clinical Nutrition*. Galen: Press; 2019:69-74.
2. Cederholm T, Barazzoni R, Austin P, et al. ESPEN guidelines on definitions and terminology of clinical nutrition. *Clin Nutr*. 2017;36(1):49-64. **[CrossRef]**
3. ASPEN Board of Directors, the Clinical Guidelines Task Force. Guidelines for the use of parenteral and enteral nutrition in adult and pediatric patients. *JPEN J Parenter Enter Nutr*. 2002;26(suppl):144.
4. Taylor BE, McClave SA, Martindale R.G., et al. Guidelines for the provision and assessment of nutrition support therapy in the adult critically ill patient: Society of Critical Care Medicine (SCCM) and American Society for Parenteral and Enteral Nutrition (A.S.P.E.N.). *Crit Care Med*. 2016;44(2): 390-438. **[CrossRef]**
5. Stroud M, Duncan H, Nightingale J, British Society of Gastroenterology. Guidelines for enteral feeding in adult hospital patients. *Gut*. 2003;52(suppl 7):vii1-vii12. **[CrossRef]**
6. Lochs H, Allison SP, Meier R, et al. Introductory to the ESPEN Guidelines on enteral Nutrition: terminology, definitions and general topics. *Clin Nutr*. 2006;25(2):180-186. **[CrossRef]**
7. Akçay K, Suluhan D, Kesik G, Uzunoğlu K, Kartal E, Şahna A. Nursing practices in enteral nutrition. *Cli Sci Nutr*. 2020;2(1):1-14. **[CrossRef]**
8. Al Kalaldeh M, Watson R, Hayter M. Jordanian nurses' knowledge and responsibility for enteral nutrition in the critically ill. *Nurs Crit Care*. 2015;20(5):229-241. **[CrossRef]**
9. Schaefer A, Benbenishty J, Gutysz-Wojnicka A, et al. Nurses responsibilities on providing enteral nutrition to the critically ill patient—an European Federation of Critical Care Nursing Associations position paper. *World Crit Care Nurs*. 2019;12(3):86-89.
10. National Collaborating Centre for Acute Care (UK). *Nutrition Support for Adults: Oral Nutrition Support, Enteral Tube Feeding and Parenteral Nutrition*. London: National Collaborating Centre for Acute Care (UK); 2006. Available at: https://www.ncbi.nlm.nih.gov/books/NBK49253
11. T.C. Resmi Gazete, 19 Nisan 2011, No: 27910.
12. Demirkan S, Ekincioğlu A, Kelleci Çakır B. Enteral ve parenteral Nütrisyonda İlaç Uygulamalarında Dikkat Edilecek Hususlar. *Turk Klin J Intensive Care-Spec Top*. 2017;3(2): 115-122.

13. Özen AT, Enç N. Kritik Hastalıklarda Sıvı Elektrolit Dengesi Değişikliklerinde Hemşirenin Rolü. *Kardiyovasküler Hemşirelik Derg.* 2013;4(5):9-13.

14. Szary NM, Arif M, Matteson ML, Choudhary A, Puli SR, Bechtold ML. Enteral feeding within three hours after percutaneous endoscopic gastrostomy placement: a meta-analysis. *J Clin Gastroenterol.* 2011;45(4):e34-e38. [CrossRef]

15. Boullata JI, Carrera AL, Harvey L, Escuro AA, Hudson L, Mays A. ASPEN safe practices for enteral nutrition therapy task force. *J Parenter Enter Nutr*, 2017;41(1):15-103.

16. Bischoff SC, Austin P, Boeykens K, et al. ESPEN guideline on home enteral nutrition. *Clin Nutr.* 2020;39(1):5-22. [CrossRef]

17. Singer P, Blaser AR, Berger MM, et al. ESPEN guideline on clinical nutrition in the intensive care unit. *Clin Nutr.* 2019;38(1):48-79. [CrossRef]

18. Ellis C, Brown M, Rosario K.A.D., et al. A review of the tolerance and adequacy of enteral nutrition administered in the prone position in critically ill patients receiving mechanical ventilation. *Curr Dev Nutr.* 2021;5(Suppl_2):216. [CrossRef]

19. Machado LS, Rizzi P, Silva FM. Administration of enteral nutrition in the prone position, gastric residual volume and other clinical outcomes in critically ill patients: a systematic review. *Rev Bras Ter Intensiva.* 2020;32(1):133-142.

20. Van der Voort PH, Zandstra DF. Enteral feeding in the critically ill: comparison between the supine and prone positions: a prospective crossover study in mechanically ventilated patients. *Crit Care.* 2001;5(4):216-220. [CrossRef]

21. Lucchini A, Bonetti I, Borrelli G, Calabrese N, Volpe S, Gariboldi R, et al. Enteral nutrition during prone positioning in mechanically ventilated patients. *Assist Inferm Ric.* 2017;36(2):76-83. [CrossRef]

22. Reignier J, Mercier E, Le Gouge A, et al. Effect of not monitoring residual gastric volume on risk of ventilator-associated pneumonia in adults receiving mechanical ventilation and early enteral feeding: a randomized controlled trial. *JAMA.* 2013;309(3):249-256. [CrossRef]

23. Chen SS, Tzeng YL, Gau BS, Kuo PC, Chen JY. Effects of prone and supine positioning on gastric residuals in preterm infants: a time series with crossover study. *Int J Nurs Stud.* 2013;50(11):1459-1467. [CrossRef]

24. Barazzoni R, Bischoff SC, Breda J, et al. ESPEN expert statements and practical guidance for nutritional management of individuals with SARS-CoV-2 infection. *Clin Nutr.* 2020;39(6):1631-1638. [CrossRef]

25. Worthington P, Balint J, Bechtold M, et al. When is parenteral nutrition appropriate? *J Parenter Enter Nutr.* 2017;41(3):324-377.

26. Tait J. Nursing Management. In: *Total Parenteral Nutrition. A Practical Guide for Nurses.* Hamilton H. editor. Edinburgh: Churchill Livingstone; 2000.

27. Clynes M, O'Connor C. The gastrointestinal system. In: Coynes I., Neill F., *Clinical Skills in Children's Nursing.* Oxford: Oxford University Press; 2010.

28. Ulusal Damar Erişimi yönetimi Rehberi 2019. *Hastane İnfeksiyonları Derg.* 2019;23:1-54.

29. T.C. Sağlık Bakanlığı Tedavi Hizmetleri Genel Müdürlüğü. *Total Parenteral Nütrisyon için Güvenli Uygulamalar Rehberi*; 2010.

Percutaneous Endoscopic Gastrostomy Infection: 10% Povidone Iodine Miracle

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ABSTRACT

Gastrostomy is the procedure of inserting a tube through the abdominal wall into the stomach in order to provide nutrition in cases where gastrointestinal system functions are normal but oral intake is not sufficient and enteral nutrition is predicted to take more than 4-6 weeks. Gastrostomy was first introduced in 1980. Although minor complications such as peristomal infection and infiltration, pneumoperitoneum, gastrointestinal bleeding and ulceration may be seen due to gastrostomy; Major complications such as necrotizing fasciitis, colocutaneous fistula and aspiration may also occur. In the literature, 1–4% minor and 8–30% important results related to gastrostomy are reported. Peristomal, which is one of the gastrostomy minor examinations, can already be treated with close and good care. In our case report, infections that may occur at the gastrostomy insertion site were reported, possible causes were discussed, a case with a diagnosed with peristomal infection and treated with povidone iodine solution (baticone/betadine) was presented, and the literature on the subject was compiled.

Keywords: Gastrostomy, infection, patientcare, povidone-iodine

INTRODUCTION

The process of placing a feeding tube from the point where the stomach is opened into the stomach in the patients, who have a functional gastrointestinal tract but cannot be fed adequately, is called gastrostomy.[1] Gastrostomy is widely used because it is easy to insert, inexpensive, and complications can be prevented.[2] Infections after gastrostomy procedure can be seen as peristomal, abdominal wall abscess, and necrotizing fasciitis.[3] Peristomal infections may occur due to foreign body reactions in the gastrostomy region, and its incidence is reported to be 15% in the literature. Peristomal infections can be successfully treated with appropriate wound care and antibiotic therapy.[4] Factors such as lack of antibiotic prophylaxis, host factors (malnutrition, obesity, diabetes, malignancy), drug treatments (immunosuppressive drug, chronic corticosteroid therapy), excessive traction between the inner plate and the stomach wall, and inadequate dressing predispose to infection.[5] While the first of these measures is antibiotic prophylaxis administered 30 minutes before the procedure, the second is oral care with chlorhexidine.[6,7]

It has been determined in the studies performed that the prevalence of peristomal infection decreased from 29% to 7% with a single dose of broad-spectrum antibiotic administration 30 minutes before the gastrostomy procedure.[2] In a study by Koca and Tarım (2019), in which the effect of pre-procedural oral care on peristomal infection in patients who underwent gastrostomy was evaluated, it was reported that 23.5% of the patients who did not receive oral care before gastrostomy application developed peristomal infection. In the same study, peristomal infection was found in 10.8% of the patients who underwent oral care before gastrostomy.[8] The third preventive measure is based on early detection of signs and symptoms of infection (erythema, purulent and/or foul-smelling exudate, fever, and pain). Routine skin care and antimicrobial pomades should be used to treat peristomal infections. If there is hair in the tube placement area, cutting it using an electric shaver is also recommended as part of infection precautions.[6]

Povidone-iodine has fast bactericidal, sporicidal, tuberculocidal, virucidal, and fungicidal effects on the applied

surface. The antimicrobial effect of iodine is rapid even at low concentrations, but the exact mode of action is unknown.[9]

The most commonly used agents in skin antisepsis are alcohol-based chlorhexidine gluconate and povidone-iodine solutions, which are effective against a wide variety of bacteria, fungi, and viruses. There are no evidence-based recommendations for the agent to be used in skin antisepsis in the published guidelines for the prevention of surgical site infections.[10]

In this case report, a case diagnosed with peristomal infection and treated with 10% povidone-iodine solution is presented together with the literature in order to emphasize the importance of patient care in the prevention of peristomal infection.

CASE PRESENTATION

A 86-year-old male, married patient with dementia was operated with the diagnosis of coccyx fracture as a result of falling. While he was bedridden for 6 months, he continued his treatment in the intensive care unit for 25 days with aspiration pneumonia. The patient, who was fed with a gastrostomy tube for 3 months after the intensive care treatment, applied to the emergency department due to redness and discharge at the gastrostomy site, and was interned in the palliative care unit for support purposes (Figure 1). The patient's admission laboratory values were C reactive protein: 3.7 mg/L, white blood cell: 8.26 µL, and albumin: 29.3 g/dL. Ceftriaxone was administered intravenously (IV) once daily. Enteral nutrition has been continued since the patient's admission.

Until the seventh day of hospitalization in the palliative care unit, a pomade containing sodium fusidate was dressed and covered with sterile gauze. As the patient's gastrostomy port infection did not improve despite the dressing made with sodium fusidate-containing ointment and intravenous ceftriaxone treatment, a consultation with the nutrition nurse was requested by the physician in charge of the palliative care unit on the seventh day of

Main Points

- The use of non-woven gauze in the care of gastrostomy is important for the prevention of possible infections.

- The most important issue in the prevention of gastrostomy infections is the frequent education of patients and their relatives with visual and auditory materials.

- In the treatment of gastrostomy infections, local applications such as povidone-iodine and systemic antibiotics provide satisfactory results.

Figure 1. In percutaneous endoscopic gastrostomy tube, discharge at the entry site and developed redness around it.

his hospitalization. The patient was advised by the nutrition nurse to wipe the dressing with 10% povidone-iodine twice a day and leave the gastrostomy site open. On the 10th day of dressing with 10% povidone-iodine, it was observed that the redness in the gastrostomy area was completely gone and there was no discharge (Figure 2). The patient was discharged on the 14th day.

DISCUSSION

The first dressing of the gastrostomy tube should be done 24 hours after the procedure. Hands should be washed and non-sterile gloves should be worn.[11] Gastrostomy care should be done by cleaning with aseptic (0.9% sodium chloride, sterile water, or boiled chilled water) sterile gauze for the first 5–7 days and the area should be kept dry. The gastrostomy site should be monitored daily for signs of inflammation such as bleeding, pain, redness, induration, and leakage.[7,12-14] Sterile gauze (without

Figure 2. The appearance of the gastrostomy tube and its surroundings after the application.

Kahveci et al. Percutaneous Endoscopic Gastrostomy Infection: 10% Povidone Iodine Miracle

Clin Sci Nutr 2022; 4(2): 66-69

shedding fibers) should be placed under the outer plate as a Y dressing. Care should be taken that the dressing is not tight when sterile gauze is placed under the outer pad. After the gastrostomy site has healed (about 1 week later), the stoma site should be cleaned twice a week using sterile gauze, boiled cooled drinking water (or sterile water) and soap, rinsed, and then left open after the skin is gently dried completely.

In addition, dressing with glycerin hydrogel or glycogel is recommended for gastrostomy care. After 1 week, the tube should be returned to its starting position with some free distance (0.5–1 cm) between the skin and the outer support.[14] While it is recommended in the literature to rotate the plate at the gastrostomy site 360° after the first 24 hours to prevent the embedded buffer syndrome.[6] In the home enteral nutrition report published by ESPEN in 2020, it is recommended that the plate of the tube should not be rotated 360° for the first week, but rotated every day after the gastrostomy tract has healed (about a week later) and move it inward at least once a week (minimum 2 cm, maximum 10 cm) and bring it to the same position.[14] Traction is not necessary for the first 24 hours of the gastrostomy to better adapt the stomach to the abdominal wall. It is recommended that the patient take a shower (attaching a waterproof tape) after a few weeks.[7,14]

In the study conducted by Avcı and Otku[15] (2017) in which they evaluated the antibacterial activities of some antiseptics and disinfectants, povidone-iodine (10%) was reported to be the most effective antiseptic, which inhibits the growth of all bacteria on *Acinetobacter baumannii*, *Pseudomonas aeruginosa*, methicillin-resistant *Staphylococcus aureus* (MRSA), and vancomycin-resistant Enterococcus bacteria. In the study by Yiğit et al (2020) in which they investigated the place of sodium hypochlorite in the treatment of orthopedic infections, it was reported that all bacteria in *Staphylococcus aureus* and *Staphylococcus epidermidis* strains died after 2 minutes of exposure with povidone-iodine (0.35%).[16] Again, in the same study, it was found that all bacterial strains died when exposed to povidone-iodine (0.35%) for 5 minutes.[16] Kayan and Altan[17] reported that 10% povidone-iodine solution was effective only against *Escherichia coli*, *Staphylococcus epidermidis*, and *Pseudomonas aeruginosa* strains in their study investigating the antimicrobial activities of some disinfectants and antiseptics frequently used in hospitals. It was found that 10% povidone-iodine solution showed antimicrobial effect against all strains except *Staphylococcus epidermidis* strain at 5 minutes.

Şimşek[18] (compared the susceptibility of MRSA and methicillin-sensitive *Staphylococcus aureus* (MSSA) isolates to various antiseptic and disinfectant agents and reported that the most effective antiseptic against MSSA and MRSA strains was povidone-iodine (10%).[18]

When peristomal infection is suspected or diagnosed, the antimicrobial agent is applied topically to the entry site of the tube. However, if the infection does not resolve despite this treatment, systemic broad-spectrum antibiotics should be used. At the same time, the gastrostomy area can be treated with antimicrobial ointment or a dressing containing a sustained release antimicrobial agent (e.g., foams, hydrocolloids, or alginates).[14] In case of peristomal leakage of gastric contents from the stoma site, care with zinc oxide-based skin protectants is recommended.[14] Our case was diagnosed with gastrostomy port infection, and despite the sodium fusidate ointment and ceftriaxone (IV) treatment, the infection findings continued, and the area was wiped with 10% povidone-iodine twice a day and kept dry, within the scope of expert opinion. On the 10th day of the application, the signs of infection in the gastrostomy area completely disappeared (Figure 2).

After the patient is discharged, it is important for more competent and high-quality care to provide support to caregivers through written or visual materials to prevent complications or to provide early treatment when complications develop.[14] Caregivers should be advised to begin home gastrostomy care after 1 week and clean every other day with boiled chilled drinking water (or sterile water) and then thoroughly dry the area. In a study conducted by Green et al[19] (2019) evaluating the problems experienced by caregivers of patients with feeding tubes regarding tube care, it was reported that more than half of the participants stated that they had to cope with problems with little or no support and that they did not know whom to contact for help in tube management.

In conclusion, we consider that 10% povidone–iodine solution is effective in the treatment of peristomal infection, as in our case. We believe that providing gastrostomy care when a peristomal infection develops by using 10% povidone–iodine solution by nutrition nurses and all nurses who care for gastrostomy will reduce the signs of infection. In this context, it is recommended to consolidate the research data by making more case series. In addition, gastrostomy care should be taught to caregivers practically by following evidence-based practices by nutrition nurses and health professionals. Dressing training should be planned by evaluating the education, age, vision, and hearing abilities of the caregiver. The patient's gastrostomy dressing should be done by the nutrition nurse after explaining it to the caregiver. The caregiver should be encouraged to do the second dressing of the patient and should be observed by the nutrition nurse.

The caregiver should be supported for all procedures performed during gastrostomy dressing. Written instructions on gastrostomy care should be prepared in accordance with the cognitive and educational level of caregivers. Photos and dressing videos should be included in the training materials as needed.

Informed Consent: Written informed consent was obtained from all participants who participated in this study.

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REFERENCES

1. Coşkun O, Arı D. Results of percutaneous endoscopic gastrostomy: evaluation of 58 cases. *Endoscopy Gastrointestinal.* 2019;27:93-96.
2. Sobotka L, eds. Klinik Nütrisyon Temelleri. Çev Gündoğdu RH, ed. Ankara: Bayt Yayın; 2017:314-316.
3. Anderson L. Enteral feeding tubes: an overview of nursingcare. *Br J Nurs.* 2019;28(12):748-754. [CrossRef]
4. Sobotka L, eds. Klinik Nütrisyon Temelleri. Çev Gündoğdu RH, ed. Ankara: Bayt Yayın; 2021:295.
5. Blumenstein I, Shastri YM, Stein J. Gastroenterictube feeding: techniques, problem sandsolutions. *World J Gastroenterol.* 2014;20(26):8505-8524. [CrossRef]
6. Roveron G, Antonini M, Barbierato M, et al. Clinical practice guidelines for the nursing management of percutaneous endoscopic gastrostomy and jejunostomy (PEG/PEJ) in adultpatients; annexecutive summary. *J Wound Ostomy Continence Nurs.* 2018;45(4):326-334.
7. Villalba CM, Rodríguez JAV, Sánchez FG. Percutaneous endoscopic gastrostomy. *Medclin (Barc).* 2019;152(6):229-236.
8. Koca B, Tarım İA. Perkütan Endoskopik Gastrostomi Tüpü Uygulanan Hastalarda Işlem Öncesi Ağız Bakımı Yapılmasının Peristomalinfeksiyon Üzerine Etkisi. *İzmir Tepecik Eğitim Hastanesi Derg.* 2019;29(2):188-192.
9. McDonnell G, Russell AD. Antiseptics and disinfectants: activity, action, andresistance. *Clinic Micro Rev.* 1999;12(1): 147-179.
10. Okgün Alcan A, Karacabay K, Savcı A. Ameliyathane Deri Hazırlığı Uygulamalarının Incelenmesi. *Harran Univ Tıp Fak Derg.* 2020;17(1):13-18.
11. Kahveci G. *Perkütan Endoskopik Gastrostomi Tüpü ile Beslenen Hastalara Bakım Veren Bireylerin Enteral Beslenme Uygulamalarına Ilişkin Bilgi Düzeyleri ve Uygulamalarının Değerlendirilmesi* (Yüksek Lisans Tezi). İstanbul: Okan Üniversitesi Sağlık Bilimleri Enstitüsü; 2020.
12. Malhi H, Thompson R. PEG tubes: dealing with complications. *Nursing Times.* 2014; 110(45):18-21.
13. Rahnemai-Azar AA, Rahnemaiazar AA, Naghshizadian R, Kurtz A, Farkas DT. Percutaneous endoscopic gastrostomy: indications, technique, complications and management. *World J Gastroenterol.* 2014;20(24):7739-7751. [CrossRef]
14. Bischoff SC, Austin P, Boeykens K, et al. ESPEN guideline on home enteral nutrition. *Clin Nutr.* 2020;39(1):5-22. [CrossRef]
15. Avcı D, Otkun M. Evalution of antibacterial activities of some antiseptics and disinfectants. *Turkbull Hygieneand Experimental Biology.* 2017;74(3):211-220.
16. Yiğit Ş, Akar MS, Özbek E. Ortopedik Enfeksiyonların Tedavisinde Sodyum Hipoklorit'in Yeri Var Mıdır? *Dicle Tıp Derg.* 2020;47(2):469-475. [CrossRef]
17. Kayan S, Altanlar N. Hastanelerde Sıklıkla Kullanılan Bazı Dezenfektan ve Antiseptiklerin Antimikrobiyal Aktivitelerinin Araştırılması. *Ank Ecz Fak Derg.* 2021;45(2):297-308.
18. Şimşek M. MRSA (metisiline Dirençli Staphylococcus Aureus) ve MSSA (Metisiline Duyarlı Staphylococcus Aureus) Izolatlarının Çeşitli Antiseptik ve Dezenfektan Maddelere Karşı Duyarlılıklarının Karşılaştırılması. *Uluslararası Bilimsel Araştırmalar Kongresi.* 2018:99-100.
19. Green SM, Townsend K, Jarrett N, Westoby C, Fader M. People with enteral tubes and their careers' views of living with a tube and managing associated problems: a qualitative interview study. *J Clin Nurs.* 2019;28(19-20):3710-3720.